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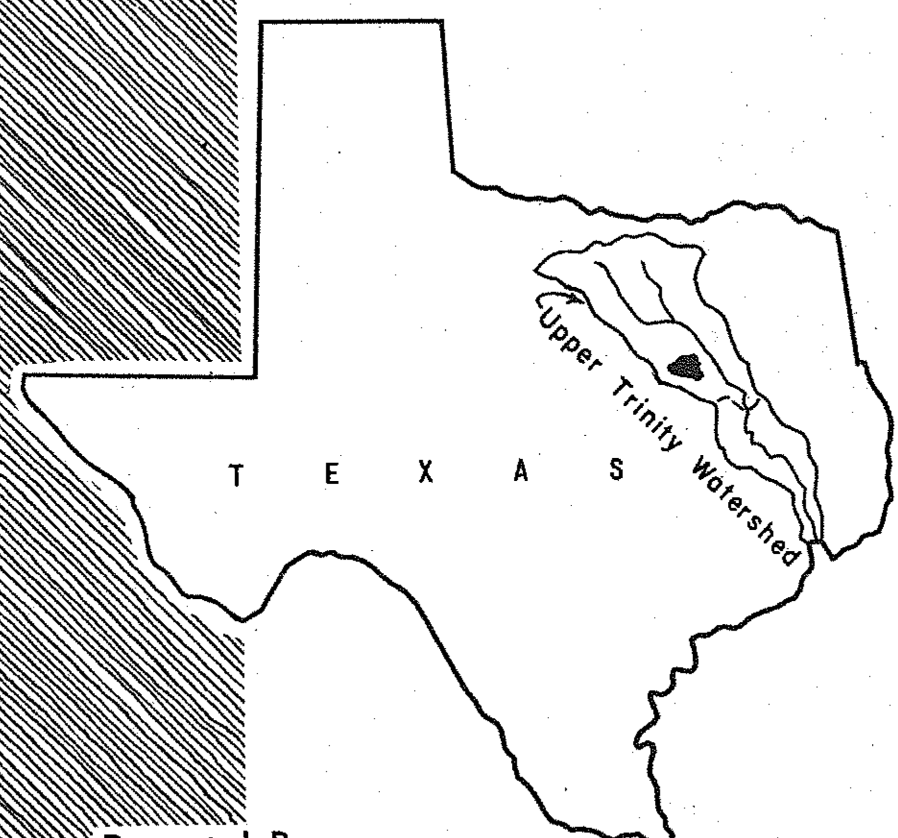
WORK PLAN

VILLAGE AND WALKER CREEK WATERSHED

OF THE TRINITY RIVER WATERSHED
ELLIS AND NAVARRO COUNTIES, TEXAS



Prepared By
SOIL CONSERVATION SERVICE
U. S. DEPARTMENT OF AGRICULTURE
Temple, Texas
June 1960

USDA-SCS-FORT WORTH, TEX. 1960
4-14821 2-60

WATERSHED WORK PLAN AGREEMENT

between the

Ellis-Prairie Soil Conservation District
Local Organization

Navarro-Hill Soil Conservation District
Local Organization

(Hereinafter referred to as the Districts)

Ellis County Commissioners Court
Local Organization

(Hereinafter referred to as the County)

In the State of Texas

and the

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

Whereas, the Districts have heretofore entered into a Flood Control Supplemental Memorandum of Understanding with the Soil Conservation Service for assistance in constructing Works of Improvement for the prevention of floods in the Village and Walker Creek Watershed, State of Texas, under the authority of the Flood Control Act of 1944 (58 Stat. 887).

Whereas, the responsibility for carrying out all or portion of the work of the Department on the Watershed has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Districts and the Service a mutually satisfactory plan for Works of Improvement for the Village and Walker Creek Watershed, State of Texas, hereinafter referred to as the Watershed Work Plan;

Whereas, the County will benefit from the carrying out of the plan for Works of Improvement through the reduction of damages to property, including County Roads and bridges in the County that are located within the flood plain of the watershed;

4-15149 12-60

It is mutually agreed that in installing and operating and maintaining the Works of Improvement described in the Watershed Work Plan:

1. The Districts and/or the County 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.

2. The Districts 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 Service will provide all construction costs and installation services applicable to Works of Improvement for flood prevention.

4. The Districts 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.

5. The Districts will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the Watershed Work Plan.

6. The Districts will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

7. The Districts and the County 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 an Operation and Maintenance Agreement which is to be entered into.

8. 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.

9. 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.

Ellis-Prairie Soil Conservation District
Local Organization

By W J Hamm

Title Chairman

Date December 8, 1960

The signing of this agreement was authorized by a resolution of the governing body of the **Ellis-Prairie Soil Conservation District**
Local Organization

adopted at a meeting held on December 8, 1960

Marvin Borders
(Secretary, Local Organization)

Date December 8, 1960

Navarro-Hill Soil Conservation District
Local Organization

By [illegible signature]

Title Vice Chairman

Date 12-16-60

The signing of this agreement was authorized by a resolution of the governing body of the **Navarro-Hill Soil Conservation District**
Local Organization

adopted at a meeting held on December 16, 1960

M B Padgett
(Secretary, Local Organization)

Date 12-16-60

4-15149 12-60

Ellis County Commissioners Court
Local Organization

By Milton Hartsfield
Milton Hartsfield

Title County Judge

Date December 9, 1960

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

adopted at a meeting held on December 9, 1960

Chas W. Huffer
(Secretary, Local Organization)

Date December 9, 1960

Soil Conservation Service
United States Department of Agriculture

By ______________________
State Conservationist

Date ______________________

WORK PLAN

VILLAGE AND WALKER CREEK WATERSHED
Of the Trinity River Watershed
Ellis and Navarro Counties, Texas

Plan Prepared and Works of Improvement to be Installed Under the Authority of the Flood Control Act of 1936 as Amended and Supplemented.

Participating Agencies

Ellis-Prairie Soil Conservation District
Navarro-Hill Soil Conservation District
Ellis County Commissioners Court

Prepared By:

Soil Conservation Service
U. S. Department of Agriculture
June 1960

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WORK PLAN

VILLAGE AND WALKER CREEK WATERSHED
Of the Trinity River Watershed
Ellis and Navarro Counties, Texas
June 1960

SUMMARY OF PLAN

General Data

Drainage Area:

77,000 Acres - 120.3 Square Miles

Location of Watershed:

Ellis County	75,000 Acres
Navarro County	2,000 Acres
Ellis-Prairie Soil Conservation District	75,000 Acres
Navarro-Hill Soil Conservation District	2,000 Acres

Land Use:

Cropland	30,310 Acres
Pasture	44,343 Acres
Miscellaneous (towns, roads, railroads, etc.)	2,347 Acres

Flood Plain Area:

Excluding 560 acres in stream channels, and including 255 acres in small laterals draining directly into the Trinity River	5,718 Acres

Flood Frequency:

A total of 117 floods occurred during the 30-year period of study (1928-1957), 29 of which inundated more than half the flood plain area.

Land Treatment:

Practice	Unit	Applied to Date	To Be Applied During Project Period
Conservation Cropping Systems	Acre	7,570	22,740
Contour Farming	Acre	5,450	21,550
Cover Cropping	Acre	16,692	14,068
Crop Residue Use	Acre	10,742	19,568

Land Treatment: Continued

Practice	Unit	Applied to Date	To Be Applied During Project Period
Rotation Hay and Pasture	Acre	2,206	4,768
Grassland Renovation	Acre	3,500	5,500
Pasture Improvement	Acre	4,683	15,500
Pasture Planting	Acre	3,598	5,565
Brush Control	Acre	1,178	5,889
Diversion Construction	Mile	14	14
Erosion Control Structures	No.	0	25
Grassed Waterways	Acre	264	528
Pond Construction	No.	183	225
Terracing	Mile	224	738

Structural Measures:

	Unit	
Floodwater Retarding Structures	No.	18
Stream Channel Improvement	Mile	12.69

Cost Installation Period:

Item	Federal (dollars)	Non-Federal (dollars)	Total (dollars)
Land Treatment	80,600	657,520	738,120
Structural Measures	909,618	159,170	1,068,788
Work Plan Preparation	11,500	-	11,500
Total	1,001,718	816,690	1,818,408

Average Annual Damages and Benefits:

Item	Damage			Benefit
	Without Project (dollars)	With Land Treatment (dollars)	With Project (dollars)	Structural Measures (dollars)
Floodwater	73,640	71,266	8,483	62,783
Sediment	5,884	3,880	250	3,630
Erosion	4,205	3,936	260	3,676
Indirect	8,373	7,909	899	7,010
Total	92,102	86,991	9,892	77,099

Benefit-Cost Ratio - Structural Measures:

Average Annual Benefits	$77,099
Average Annual Cost	$45,360
Benefit-Cost Ratio	1.7:1

Operation and Maintenance:

Land Treatment Measures - Landowners and Operators Under Agreement With:

Ellis-Prairie Soil Conservation District
Navarro-Hill Soil Conservation District

Structural Measures:

Ellis-Prairie Soil Conservation District
Ellis County Commissioners Court

Annual Cost - $5,730

DESCRIPTION OF WATERSHED

Physical Data

The Village and Walker Creek watershed is comprised of small drainages along the west side of the Trinity River extending approximately 13 miles from near Bristol in Ellis County, Texas, to the Ellis and Navarro County line. Smith and Village Creeks are the major streams and drain directly into the Trinity River. Walker Creek is a tributary of Village Creek. The watershed has an area of 77,000 acres (120.3 square miles), 97 percent of which is in farms and ranches.

The topography is generally rolling plains. Upland slopes range from 1 to 8 percent, with some slopes as steep as 20 percent in the upper reaches. The alluvial valleys of Smith and Village Creeks range from 3,000 feet in width, near their confluences with the Trinity River, to 200 feet in width near their headwaters. Elevations in the watershed range from 300 to 490 feet above mean sea level.

All the watershed lies in the Blackland Prairies Land Resource Area. The soils are deep, medium to fine textured, and very slowly to moderately permeable. The principal soil series are Houston, Hunt, Sumter, Irving, Wilson, Crockett, Kaufman, and Trinity. Erosion ranges from slight to severe, being determined largely by the amount of cultivated land and effective conservation treatment.

The Taylor and Navarro groups, both of the Cretaceous system, occur in the watershed. The greater part of the watershed is underlain by calcareous sandstones, clays and marls of the Taylor group. The Navarro group occurs only in a small area of the lower portion of the watershed and consists of sandy marls.

The land use for the watershed is as follows:

Land Use	Acres	Percent
Cropland	30,310	39.4
Pasture	44,343	57.6
Miscellaneous 1/	2,347	3.0
Total	77,000	100.0

1/ Includes roads, railroads, towns, etc.

Approximately 7 percent of the cropland in the watershed is in small grains and legumes, with the remainder in row crops. As a result, most of the soils are in poor condition.

Over 50 percent of the pastures have a good grass cover which is very effective in controlling erosion. Some formerly cultivated areas have not been established to grass and are in poor condition. Cover conditions of pasture expressed as percent is as follows:

Land Use	Acres	Good (percent)	Fair (percent)	Poor (percent)
Pasture (Open)	38,285	58.5	18.9	22.6
Pasture (Wooded)	6,058	91.1	8.9	-

The flood plain considered in this plan is that area other than Trinity River bottom that will be inundated by the runoff from a storm which can be expected to occur on an average of once in 30 years. Such a storm would produce runoff of 5.48 inches under present conditions and would inundate 5,718 acres, excluding 560 acres of stream channels.

The flood plain land use is:

Land Use	Acres	Percent
Cropland	3,330	58.2
Pasture	2,299	40.2
Miscellaneous 1/	89	1.6
Total	5,718	100.0

1/ Includes towns, roads, railroads, etc.

Approximately 16,100 acres of Trinity River bottom land are included in the watershed area, of which 10,400 acres are protected by levees.

The mean annual rainfall is 36 inches based on 35-year Weather Bureau records at Ennis, Rice and Rosser. Precipitation is well distributed, with the wettest months being April and May. Individual storms causing serious floodwater and sediment damage may occur in any season, but are most frequent in the Spring. The minimum recorded annual rainfall was 18.82 inches; the maximum was 56.52 inches.

Mean temperatures range from 84 degrees in the summer to 46 degrees in the winter, with a mean annual temperature of 66 degrees Fahrenheit. The extreme recorded temperatures are 9 degrees below zero and 115 degrees above zero. The normal frost-free period is 232 days.

Water for domestic and livestock uses in the rural areas is supplied largely by shallow wells and small farm ponds. The city of Ennis gets water from a reservoir located outside the watershed and from local wells.

Economic Data

The watershed economy is basically agricultural, with cotton, corn and grain sorghum being the predominant crops. There are also small acreages of Johnsongrass, oats and alfalfa which contribute to the economy.

The flood plain has approximately 3,330 acres of cropland and 2,299 acres of pasture. The upland consists of approximately 26,980 acres of cropland and

42,044 acres of pasture. The average annual net value of bottom land production is approximately $40.00 per acre which is three times that of the upland.

Livestock enterprises also contribute substantially to the income of the area. Recent increases in livestock farming have been mainly in the production of beef cattle.

The farms average approximately 190 acres in size, with a value of $25,000, or slightly over $130.00 per acre, for land and buildings, according to the census report for 1954. There are approximately 115 landowners in the area who will benefit from the project. Tenant farming and owner-operated farming are fairly equally divided in the watershed.

There are approximately 142 miles of roads, of which about 60 miles are hard surfaced. The western edge of the area is traversed by an interstate highway. Rail service is adequate for all sections of the area; however, the bulk of the freight is moved by truck.

Ennis, with an estimated population of 8,700 in 1957, is located at the southwestern edge of the watershed. Its population has increased approximately 30 percent during the last 10 years. There are several small villages throughout the area.

Industries located at Ennis, Waxahachie, and Dallas provide employment to numerous residents of the watershed.

WATERSHED PROBLEMS

Floodwater Damage

Frequent flooding has caused considerable damage, Figure 1. During the 30-year period studied, 1928 through 1957, there were 29 major floods, the runoff from which inundated more than half the flood plain, and 88 smaller floods. Approximately 57 percent of the major floods and 46 percent of the smaller floods occurred during the spring months and caused heavy damages to growing crops.

The largest storm included in the evaluation series occurred in May 1957, producing a runoff of 5.48 inches which inundated the entire flood plain. Floodwater damages from this flood were estimated to be $49,791 of which $33,246 was to crops and pastures. A storm of this magnitude is expected to occur on an average of once in 30 years.

It is estimated that the average annual direct monetary floodwater damage without the project is $73,640. Of this amount, $68,899 is crop and pasture damage; $3,626, other agricultural damages; and $1,115, damage to roads and bridges. In addition, there are numerous indirect damages, such as interruption of travel, losses sustained by dealers and industries in the area, and other losses estimated to average $8,373 annually. The average annual monetary flood damages are summarized in table 5.

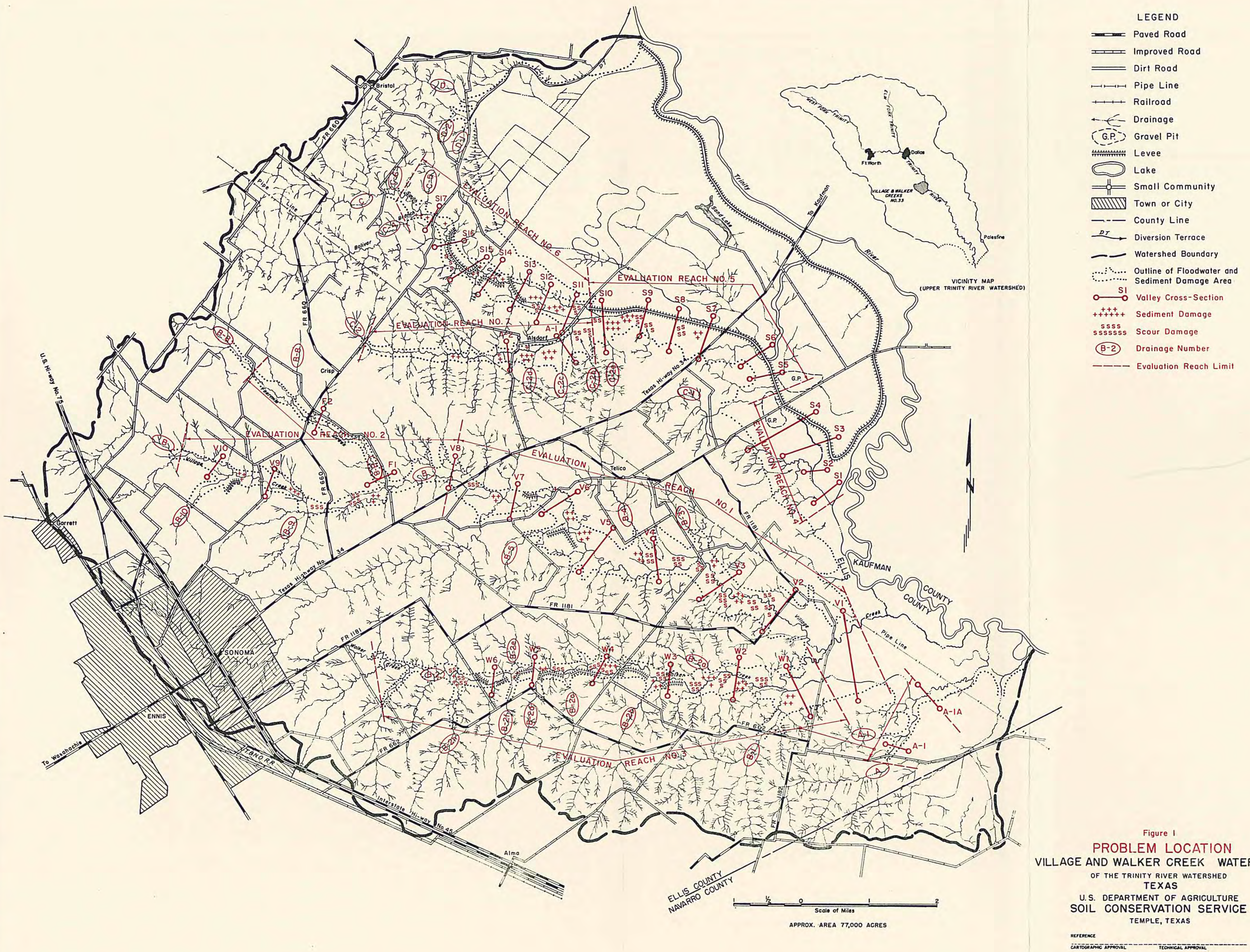


Figure 1

PROBLEM LOCATION

VILLAGE AND WALKER 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 J.E.L. — CHECKED J.W.M. — DATE 7-29-60 — 4-R-14100

Revised 10-60 — W.Q.B. 12-15-49. Base 4-R-7563

Due largely to the frequency of flooding, approximately 11 percent of the flood plain is not being cultivated and 10 percent is being used for Johnsongrass hay production.

Upland Erosion Damage

The erosion rates are low to very high, ranging from 1.13 acre-feet to 7.68 acre-feet per square mile annually. Most of the erosion damage is caused by sheet erosion on cultivated land. In the upland areas of the watershed, sheet erosion represents 93 percent and gully and streambank erosion, 7 percent of the annual gross erosion.

Flood Plain Erosion Damage

There are 213 acres, approximately 4 percent of flood plain, that have been damaged by scour. Examination of the scoured areas and interviews with flood plain owners and operators indicate that this type damage is in equilibrium, that is, new damage occurring each year is balanced by recovery of other damaged areas. The degree and extent of scour damage is divided as follows:

Extent of Damage (Acres)	50	40	66	44	12	1
Degree of Damage (Percent)	10	30	50	60	75	90

The average annual value of this damage is estimated to be $4,205.

Sediment Damage

Overbank sediment deposits have damaged 2,239 acres, or 39 percent of the flood plain. The degree of damage is low since the deposition is similar to the original alluvium but is lower in organic matter and plant nutrients. As in the case of scour damage, indications are that damage due to deposition of sediment is approximately in equilibrium. It is estimated that crop and pasture production has been reduced about 5 percent on 1,459 acres and about 10 percent on 780 acres as a result of this damage. The average annual value of this damage is estimated to be $5,884.

Stream channels of the flood plain are filling at an accelerated rate, thereby reducing channel capacity and increasing frequency of flooding.

Problems Relating to Water Management

Needs for drainage improvements are major on the 10,400 acres of Trinity River bottom land protected by levees. The landowners and the sponsoring local organizations indicated considerable interest in applying and maintaining conservation practices within this area. They recognize the need for a legal organization with adequate funds to carry out such a project effectively. Action has been initiated for the sponsoring local organization to participate in the development of an agricultural water management project.

The Ellis-Prairie Soil Conservation District and the sponsoring local organizations have indicated that they will request the Soil Conservation Service to evaluate this agricultural water management project and to amend the work plan to include drainage improvements as part of the project in this watershed if it is found to be feasible.

There has been no indication of desire by local people to provide additional capacity in the floodwater retarding structures for irrigation, municipal water supply or recreation. Needs for water management for fish and wildlife resources are minor and do not warrant a study at this time.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

With the exception of leveeing in the Trinity River bottom, there has been little or no effort by groups or individuals to prevent or control flooding. Soil Conservation district cooperators are attempting to protect their lands through the preparation of farm and ranch conservation plans and application of conservation measures.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and the treatment of each acre in accordance with its needs is essential to a sound flood prevention program on the watershed. A program under the leadership of the two soil conservation districts is now underway. The establishment and maintenance of all applicable soil and water conservation and management practices necessary for proper land use and treatment is basic to reaching the objective. Emphasis will be placed on accelerating the establishment of land treatment measures which have a measurable effect on reducing floodwater and sediment damage.

Of the 77,000 acres in the watershed, 26,061 acres lie above the 18 planned floodwater retarding structures. This constitutes 33.8 percent of the entire watershed. Eight structures on Smith Creek will control 50.6 percent of the drainage area above valley section S-1. The remaining 10 structures will control 46.4 percent of the drainage area of Village and Walker Creeks above valley section V-1. It is especially important that land treatment be planned and applied to support and supplement the control by the floodwater retarding structures.

Land treatment measures, at an estimated non-Federal cost of $343,200, exclusive of Agricultural Conservation Program Service reimbursements, and a Federal expenditure of $63,400 of flood prevention funds, have been established by landowners prior to work plan development. The Federal funds expended for this work were for accelerating technical assistance in helping landowners plan and apply land treatment measures. During the project installation period, additional land treatment measures are to be established at an estimated non-Federal cost of $657,520 and a Federal expenditure of $80,600 (table 1).

Land treatment measures will serve principally to improve soil and cover conditions, thereby decreasing erosion damage to croplands and pastures. Such measures for cropland include conservation cropping systems, cover cropping, rotation hay and pasture, and crop residue use. Measures such as pasture planting, grassland renovation, pasture improvement, and brush control will be used on the grasslands. These measures, properly managed, will effectively improve the physical condition of the soils and reduce erosion.

In addition to the measures related directly to the improvement of soil and cover conditions, other land treatment practices include contour farming, terracing, diversion construction, pond construction, and grassed waterways. These practices, properly applied and maintained, have a measurable effect in reducing peak discharge by extending the course of runoff water. These conservation practices also supplement and support the soil and cover improvement measures to reduce erosion damage and sediment production.

Structural Measures

A system of 18 floodwater retarding structures and 12.69 miles of stream channel improvement comprises the works of improvement needed to provide the desired protection to flood plain lands that cannot be provided by land treatment measures alone.

The 18 structures will have a sediment storage capacity of 3,261 acre-feet and a floodwater detention capacity of 14,349 acre-feet. The detention capacity is the equivalent of 6.61 inches of runoff from the combined drainage areas of 26,061 acres, or the equivalent of 2.24 inches from the entire drainage area of the watershed.

Figure 2 is a schematic drawing of a structure typical of the 18 planned floodwater retarding structures.

Land, easements, rights-of-way, and necessary road and utility changes, estimated value $159,170, will be provided by the sponsoring local organizations at no cost to the Federal Government. The land easement costs of $155,950 were determined through local appraisal, giving full consideration to the real-estate values involved. The amortized current value of the land in structure sites exceeds the average value of the loss of production within the sites at long-term levels. The higher figure was used in evaluating the economic justification of the project. The sediment pools of the 18 structures will inundate 157 acres of flood plain and 506 acres of upland. The detention pools will temporarily inundate an additional 314 acres of flood plain and 1,011 acres of upland.

The locations of the planned floodwater retarding structures and stream channel improvement are shown on Figure 3, and the structure data in tables 3 and 3A.

Sufficient detention capacity has been provided in all floodwater retarding structures to assure a 4 percent or less chance of use of the emergency spillways. This will permit the use of vegetative spillways, thereby effecting a substantial reduction in cost.

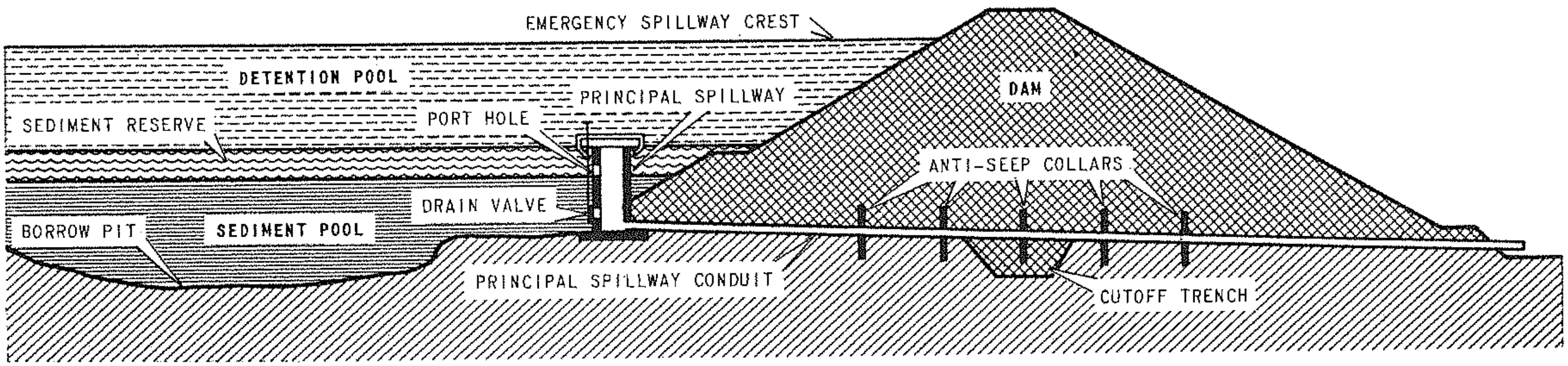
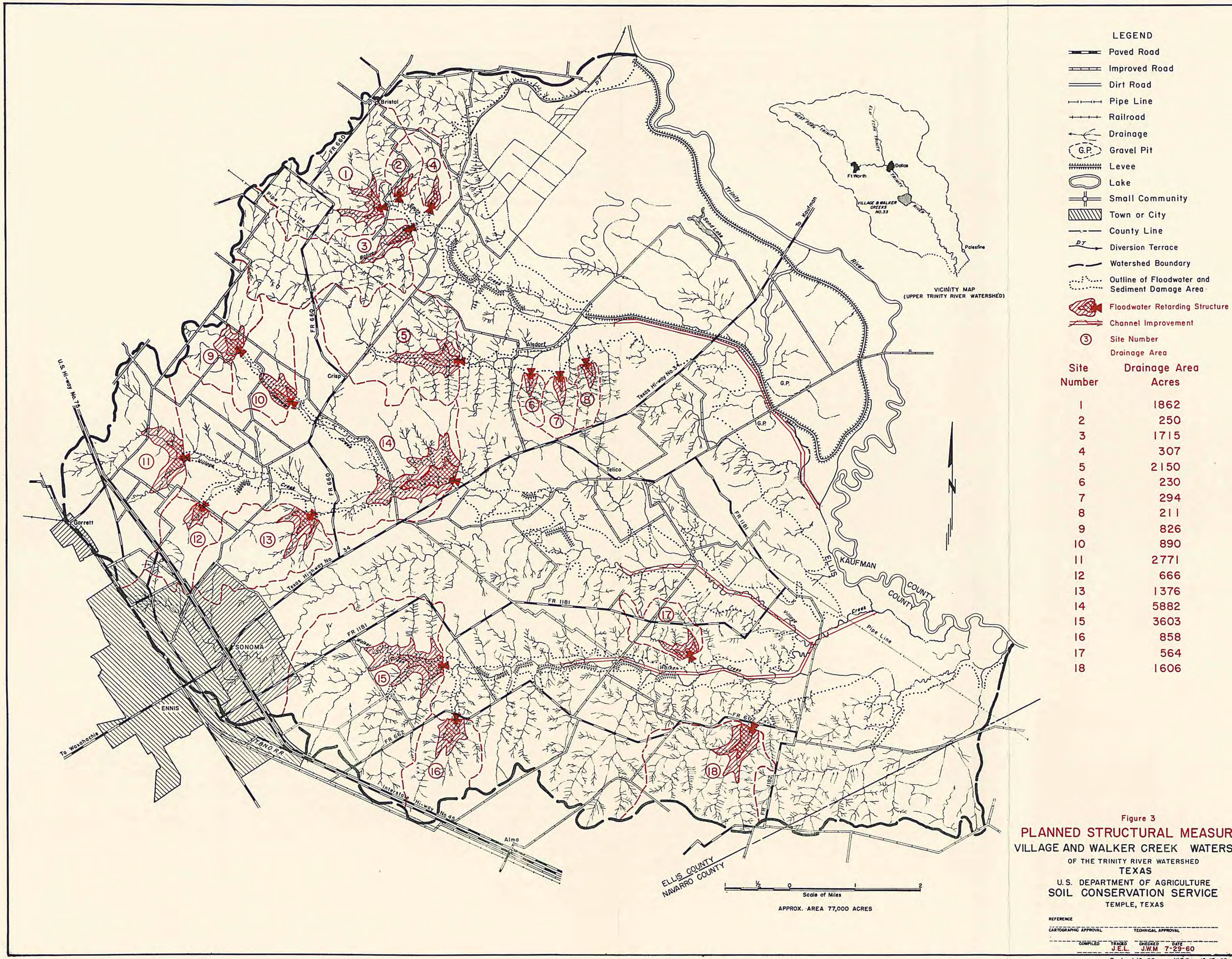


Figure 2

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Revised 10-31-60 4-L-10,071



Site Number	Drainage Area Acres
1	1862
2	250
3	1715
4	307
5	2150
6	230
7	294
8	211
9	826
10	890
11	2771
12	666
13	1376
14	5882
15	3603
16	858
17	564
18	1606

Figure 3

PLANNED STRUCTURAL MEASURES

VILLAGE AND WALKER 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 J.E.L. CHECKED J.W.M DATE 7-29-60 4-R-14101

Revised 10-60 W.Q.B. 12-15-49. Base 4-R-7563

The estimated Federal cost of installing the floodwater retarding structures is $715,354, and for installing the stream channel improvement is $194,264, a total Federal cost of $909,618. The non-Federal cost for installing the floodwater retarding structures is $127,150, and for installing stream channel improvement is $32,020, a total non-Federal cost of $159,170, and a grand total of $1,068,788. The total annual equivalent cost, including operation and maintenance, is $45,360.

BENEFITS FROM WORKS OF IMPROVEMENT

The combined program of land treatment and structural measures would have prevented flood damages from 44 of the 117 floods which occurred during the 30-year evaluation period. In addition, all but one of the major floods would have been reduced to minor floods.

The largest runoff-producing rain considered during the 30-year period studied was a storm of 5.94 inches, which approximated a 30-year frequency storm, extending over a 2-day interval. A rain of this magnitude, assuming Moisture Condition III, would produce 5.48 inches of runoff under present conditions and would inundate 5,718 acres of flood plain. If such a rain were to occur after land treatment practices had been applied, it is estimated that the area inundated would be reduced to 5,682 acres. With land treatment measures applied and structural measures installed, it is estimated that the flood plain inundated would be reduced to 2,827 acres, excluding all flood plain areas in floodwater retarding structure pools. Storms expected to occur on an average of once in 3 years will flood approximately 19 percent of the flood plain and storms expected to occur on an average of once in 30 years will flood approximately 50 percent of the flood plain after installation of works of improvement.

A monetary reduction of 96 percent in flood plain sediment damage will result from the project, with 34 percent resulting from land treatment measures and the remaining 62 percent from structural measures.

A monetary reduction of 94 percent in flood plain scour damage will result from the project, with 6 percent due to land treatment measures and 88 percent attributed to structural measures.

A monetary reduction of 74 percent in floodwater damages will result from the project, with 5 percent resulting from land treatment measures and 95 percent accruing from structural measures.

The application of needed land treatment measures will reduce the present annual sediment yield by an estimated 32 percent.

It is expected that idle land which will not be subject to flooding more often than once in 3 years, after the project is installed, will be returned to crop production. Some lands now in Johnsongrass and open pasture will be returned to higher value crop production. In addition, it is expected that some areas of trees and brush will be cleared and restored to productivity as cropland or pasture.

Restoration of a portion of the flood plain land to its former level of productivity will be made possible by the reduced frequency, area and depth of flooding and by the reduction of sediment deposition. The benefits allocable to the structural measures from the restoration of these flood plain lands are estimated to average $16,652 annually. The loss in original production has been considered a crop and pasture damage and the increased net income from restoration a benefit in table 5.

The estimated average annual floodwater, erosion, sediment, and indirect damage in the watershed will be reduced from $92,102 to $9,892, a reduction of 89 percent. About 94 percent of the expected reduction will result from the structural measures. Annual damage reductions attributable to the project, including those from land treatment, average $60,693 for crop and pasture damage, $3,400 for other agricultural damage, $1,064 for road and bridge damage, $3,945 for flood plain scour, $5,634 for damage from overbank deposition, and $7,474 for indirect damage.

The total flood prevention benefits, including floodwater damage reduction, reduction of sediment deposition on flood plain lands, the reduction in flood plain scour damage, and the reduction of indirect damages, are estimated to average $82,210 annually, of which $77,099 will be the result of structural measures.

The general location of the benefits from the combined program of land treatment and structural measures is presented in table A.

COMPARISON OF BENEFITS AND COSTS

The average annual equivalent cost of the structural measures (converted from total installation cost, plus operation and maintenance) is estimated to be $45,360. When the structures are installed, they are expected to produce average annual benefits of $77,099, a benefit of $1.70 for each dollar of cost. There are other substantial values which will accrue from structural measures, such as increased opportunity for recreation, improved wildlife conditions, and a sense of security, which have not been used for project justification.

ACCOMPLISHING THE PLAN

Land Treatment Measures

Over a 10-year period the farmers and ranchers of the watershed, as cooperators of the Ellis-Prairie and Navarro-Hill Soil Conservation Districts, will apply the needed land treatment measures as shown in table 1. The cost of applying these measures will be borne by the owners and operators of the land. This cost is exclusive of reimbursement from the Agricultural Conservation Program Service or other Federal programs. Technical assistance is available to soil conservation district cooperators from the Soil Conservation Service. This assistance is for planning and applying conservation measures on farms and ranches. For several years technical assistance has been made available from

TABLE A - GENERAL LOCATION OF BENEFITS

	Evaluation Reach (Figure 1)							
	1	2	3 1/	4	5	6	7	Total or Average
Average Annual Acres Flooded								
Without Project - Acres	1,556	321	2,257	138	2,026	392	158	6,848
With Project - Acres	171	1	247	10	172	57	5	663
Percent Reduction	89	100	89	93	92	85	97	90
Average Annual Damages 2/								
Without Project - Dollars	29,468	3,460	30,471	2,158	16,655	6,686	3,204	92,102
With Project - Dollars	2,167	8	5,806	113	1,281	475	42	9,892
Percent Reduction	93	98	81	95	92	93	99	89
Area Flooded by Largest Storm								
Without Project - Acres	1,779	470	1,281	108	722	401	231	4,992 3/
With Project - Acres	801	36	841	46	620	122	106	2,572
Percent Reduction	55	92	34	57	14	70	54	49
Damages by Largest Storm 4/								
Without Project - Dollars	30,568	4,371	23,112	2,535	9,712	7,116	2,945	49,791
With Project - Dollars	13,207	194	10,550	681	6,380	1,355	879	33,246
Percent Reduction	57	96	54	73	34	81	70	33
Area Flooded 1 year in 3								
Without Project - Acres	1,210	282	1,015	86	675	342	142	3,752
With Project - Acres	160	0	330	17	96	56	0	659
Percent Reduction	87	100	67	80	86	84	100	82
Damages 1 year in 3								
Without Project - Dollars	18,842	1,874	17,710	1,588	8,878	4,479	1,828	55,199
With Project - Dollars	6,174	0	3,094	97	530	532	0	10,427
Percent Reduction	67	100	83	94	94	88	100	81
Number of Major Floods in Evaluation Series 5/								
Without Project - Number	17	11	50	33	22	19	29	29
With Project - Number	0	0	4	0	5	0	0	1
Percent Reduction	100	100	92	100	77	100	100	97

1/ Area above structures included in this reach.
2/ Includes restoration.
3/ Does not include 726 acres in and above floodwater structures and in isolated areas of bottom lands of laterals draining directly into the Trinity River.
4/ Floodwater damages only.
5/ Inundates more than 50 percent of the flood plain.

flood prevention funds to apply conservation measures at an accelerated rate preparatory to the installation of planned structural measures. This assistance will be continued to assure application of the planned land treatment measures within the 10-year installation period of the project.

The two soil conservation districts will encourage landowners and operators to prepare, adopt and carry out basic conservation plans on their farms and ranches. This will be done through individual contacts and by conducting scheduled meetings of landowners and operators. District-owned equipment will be made available for use by landowners and operators in applying conservation measures.

The Extension Service will assist with the educational phase of the program by conducting informational meetings, handling radio and newspaper releases, and by individual contacts with landowners and operators in the watershed.

The Agricultural Stabilization and Conservation County Committee will cooperate with the soil conservation districts by offering cost-sharing assistance for those Agricultural Conservation Program Service conservation practices which will accomplish the objective in the shortest possible time.

The Farmers Home Administration will assist by encouraging its clients to become soil conservation district cooperators and through the use of the Soil and Water Conservation Loan Program now available to eligible farmers and ranchers.

Structural Measures

The Soil Conservation Service will contract for the construction of the 18 floodwater retarding structures and 12.69 miles of stream channel improvement (figure 3). The Soil Conservation Service will prepare plans and specifications, supervise construction, prepare contract payment estimates, make final inspections, certify completion, and perform related tasks for the installation of these structural measures.

The sponsoring local organizations will furnish all necessary land, easements and rights-of-way, and arrange for necessary road and utility changes for all structural measures at no cost to the Federal Government.

The watershed is divided into three construction units. It is necessary that all easements and rights-of-way be secured within a given construction unit prior to the expenditure of Federal funds for construction within that construction unit. Benefits that accrue within each construction unit exceed the cost of structures within such construction unit.

The cooperating parties have agreed on an installation schedule of 5 years for the structural measures.

This schedule may be adjusted if mutually desirable and in view of appropriations and accomplishments.

INSTALLATION SCHEDULE
(June 1960 - June 1970)

Fiscal Year	Measures	Land Treatment: Federal 1/ (dollars)	Land Treatment: Non-Federal (dollars)	Land Treatment: Total (dollars)	Structural Measures: Federal 1/ (dollars)	Structural Measures: Non-Federal (dollars)	Structural Measures: Total (dollars)	Totals: Federal 1/ (dollars)	Totals: Non-Federal (dollars)	Grand Totals (dollars)
1st	Floodwater Retarding Structures 1 through 8; and Land Treatment	8,060	65,752	73,812	194,040	26,730	220,770	202,100	92,482	294,582
2nd	Floodwater Retarding Structures 15 through 18; Smith Creek Channel Improvement; and Land Treatment	8,060	65,752	73,812	205,960	39,690	245,650	214,020	105,442	319,462
3rd	Floodwater Retarding Structures 11 and 12; Walker Creek Channel Improvement; Lower 6,700 Lin. Ft. of Village Creek Channel Improvement; and Land Treatment	8,060	65,752	73,812	219,643	33,053	252,696	227,703	98,805	326,508
4th	Floodwater Retarding Structures 9, 10, 13 and 14; and Land Treatment	8,060	65,752	73,812	262,713	54,680	317,393	270,773	120,432	391,205
5th	Village Creek Channel Improvement (remaining 18,650 Lin. Ft.); and Land Treatment	8,060	65,752	73,812	27,262	5,017	32,279	35,322	70,769	106,091
Subtotal - Structure Installation Period		40,300	328,760	369,060	909,618	159,170	1,068,788	949,918	487,930	1,437,848
6th through 10th	Land Treatment	40,300	328,760	369,060	0	0	0	40,300	328,760	369,060
Grand Total - Installation Period		80,600	657,520	738,120	909,618	159,170	1,068,788	990,218	816,690	1,806,908

1/ Flood Prevention funds.

The structural measures will be installed pursuant to the following conditions:

1. Flood prevention funds are available.

2. The required land treatment in the drainage areas above structures has been, or is in the process of being installed.

3. All land easements and rights-of-way have been secured within a given construction unit.

4. Operation and maintenance agreements have been executed.

The various features of cooperation between cooperating 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 farmers and ranchers as cooperators with the two soil conservation districts. Representatives of the soil conservation districts will make periodic inspections of the land treatment measures to determine the need for and encourage the performance of maintenance. District-owned equipment will be made available for use in maintaining land treatment measures.

Structural Measures

The Ellis-Prairie Soil Conservation District and the Ellis County Commissioners Court will be jointly responsible for the operation and maintenance of all floodwater retarding structures and stream channel improvement and have entered into an agreement with the Soil Conservation Service which provides that full and complete responsibility for operation and maintenance will be assumed.

All structural measures will be inspected at least annually and after each heavy rain or heavy streamflow by representatives of the Ellis-Prairie Soil Conservation District and the Ellis County Commissioners Court. A representative of the Soil Conservation Service will participate in the annual inspection. Items of inspection will include the condition of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the emergency spillway and the earth fill, and fences installed as part of the structures.

The sponsoring local organizations will maintain a written record of all maintenance inspections and work done. Reports will be prepared of inspections and maintenance performed and copies furnished to the Soil Conservation Service.

Free ingress and egress to all structural measures and appurtenances will be provided to representatives of the Soil Conservation Service and sponsoring local organizations at all times.

Based on long-term price levels, the estimated operation and maintenance cost is $5,730 annually. The necessary maintenance work will be financed by the Ellis County Commissioners Court. They fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of any invitation to bid.

CONFORMANCE OF PLAN TO FEDERAL AND STATE LAWS AND REGULATIONS

This project plan conforms to all Federal, State and local laws and regulations, and will have no known detrimental effect on existing downstream projects or any that might be constructed in the future.

SECTION 2

WORK PLAN DEVELOPMENT

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

INVESTIGATIONS AND ANALYSES

Project Objectives

A reconnaissance survey of the watershed was made by specialists of the Planning Party and representatives of the State, Area and Work Unit offices. The purpose was to obtain sufficient information to estimate planning requirements and to furnish the local people with technical information needed for their determination of project objectives.

At a series of meetings with the local people, the flood prevention program and reconnaissance survey data were discussed. Considering this information, together with their needs and desires, it was found that a complete watershed program on Village and Walker Creek is desired.

The over-all objective of the people of the watershed is to establish and maintain a complete conservation program on all their land and to reduce floodwater and sediment damage to the extent feasible on flood plain land and improvements in the flood plain. Specific objectives of the local people are as follows:

1. Attain a reduction of at least 65 percent of average annual floodwater and sediment damage.

2. Establish remaining land treatment measures which contribute directly to flood prevention.

Land Treatment

The status of land treatment measures for the Village and Walker Creek watershed was secured from the records of the Ellis-Prairie and Navarro-Hill Soil Conservation Districts. This information was expanded with assistance from personnel of the Soil Conservation Service Work Units at Ennis, and Corsicana, Texas, to represent the needed land treatment measures for the watershed. Estimates were made of the amounts of practices that will be applied during the 10-year installation period for the entire watershed (table 1). Trends in farming operation, amounts of land treatment practices already applied, soil conditions, grassland cover conditions, and other pertinent data were used in estimating these future land treatment needs. The estimated cost of applying the land treatment measures was based on current costs and going program criteria.

Structural Measures

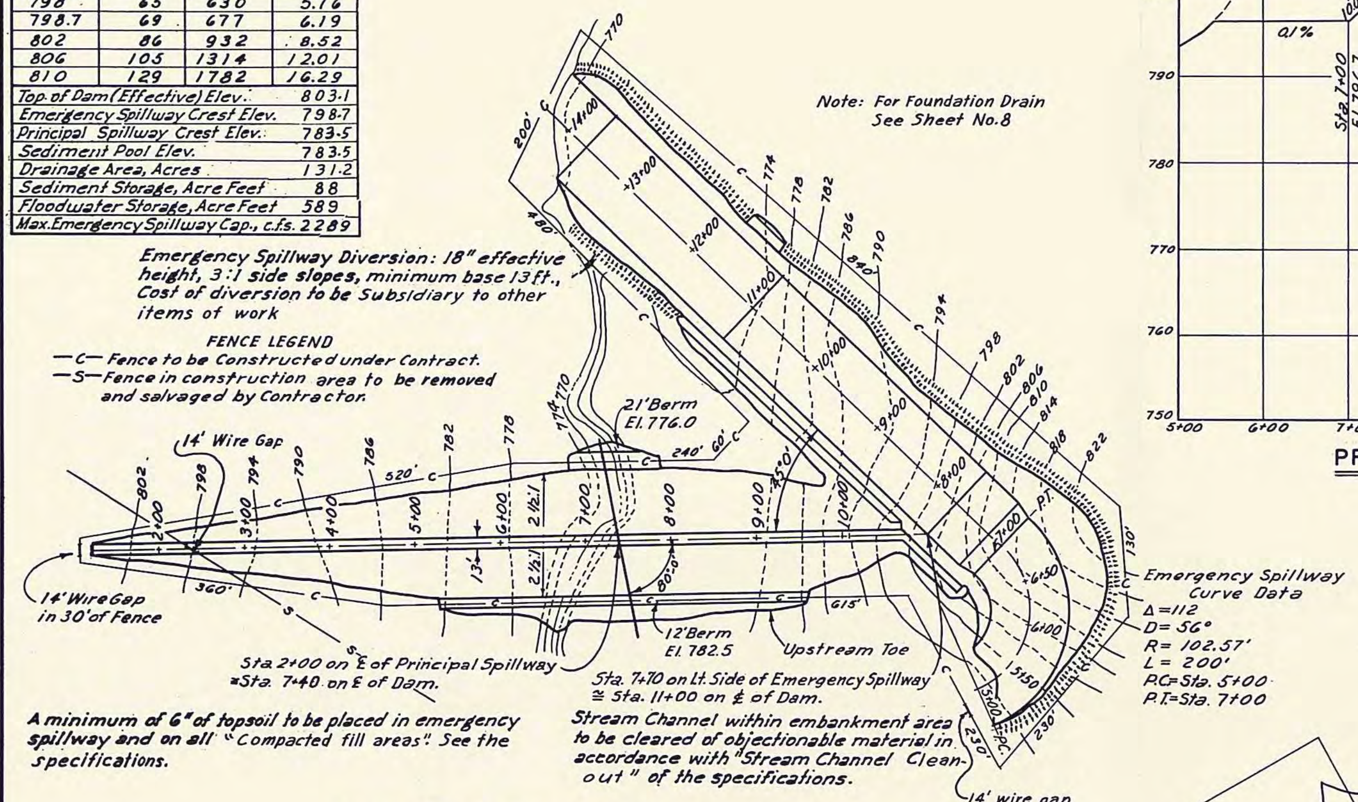
Determination was then made of structural measures for watershed protection and flood prevention which would be feasible to install to meet the objectives of the sponsoring local organizations. The procedures used in that determination were as follows:

1. A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads, and other pertinent information. A stereoscopic study of consecutive 4-inch aerial photographs located all probable floodwater retarding structure sites, the limits and the area of the flood plain and points where valley cross sections should be taken for the determination of hydraulic characteristics of the channel and valley and for flood routing purposes. A field reconnaissance was made to substantiate further the location of these sections. This information was placed on the watershed base map for use in field surveys. Cross sections of the flood plain were surveyed at the selected locations (figure 1). Data developed from these cross sections permitted the computation of stage-area inundated relationships for various flood flows. A map was prepared of the flood plain on which land use, cross section locations and other pertinent information were recorded.

2. A field examination was made of 36 probable floodwater retarding structure sites previously located stereoscopically. Sites which did not show good storage possibilities or which would inundate highways or costly improvements for which the cost of relocation could not be economically justified were dropped from further consideration. Twenty-four sites were selected for further consideration and detailed survey. Plans of a floodwater retarding structure, typical of those planned for this watershed, are illustrated by figures 4 and 4A.

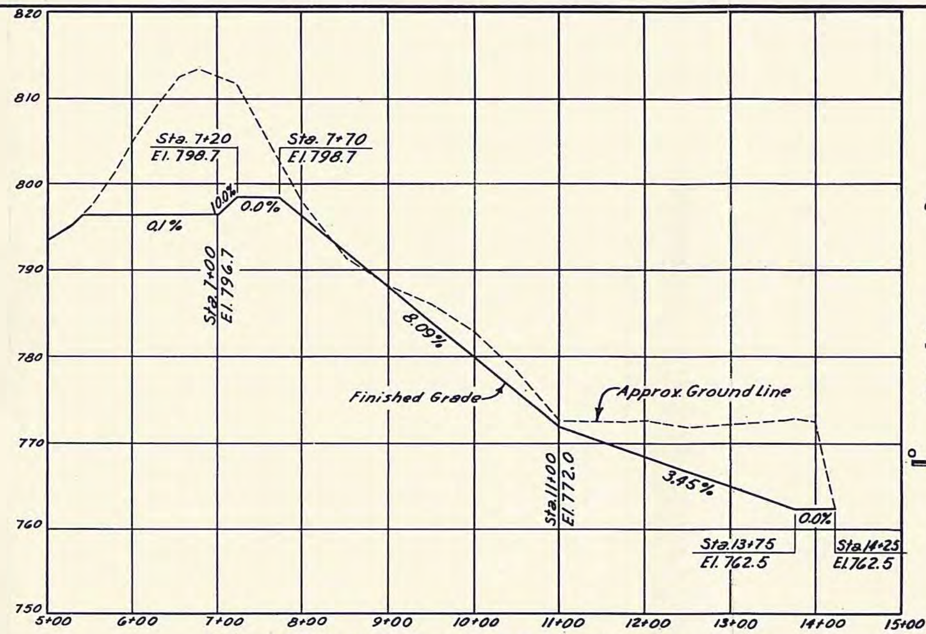
3. A topographic map was made of the pool area of each of the proposed sites to determine the storage capacity of the site, the estimated cost of the dam and the areas of flood plain and upland that would be inundated by the sediment and detention pools. The heights of the dams and the sizes of the pools were determined by the storage volume needed to temporarily detain the runoff from the design storm and to provide the additional storage needed for sediment, with due consideration to site differences and minimization of costs. The limits of the detention 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. Structure data tables were developed to show, for each structure, the drainage area, the storage capacity needed for floodwater detention and for sediment storage in acre-feet and in inches of runoff from the drainage areas, the release rate of the principal spillway, the acres inundated

Elevation	Surface Acres	Storage	
		Acre Feet	Inches
774	1	2	.02
778	7	18	.16
782	12	56	.51
783.5	15	76	.69
786	21	122	1.12
790	34	232	2.12
794	50	400	3.66
798	65	630	5.76
798.7	69	677	6.19
802	86	932	8.52
806	105	1314	12.01
810	129	1782	16.29
Top of Dam (Effective) Elev.			803.1
Emergency Spillway Crest Elev.			798.7
Principal Spillway Crest Elev.			783.5
Sediment Pool Elev.			783.5
Drainage Area, Acres			131.2
Sediment Storage, Acre Feet			88
Floodwater Storage, Acre Feet			589
Max. Emergency Spillway Cap., c.f.s.			2289

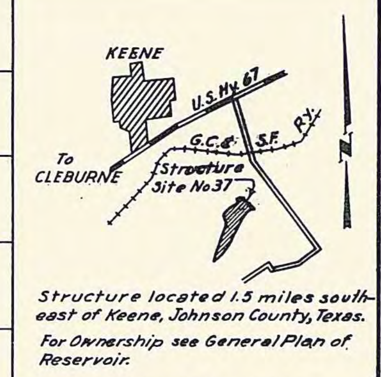


PLAN OF EMBANKMENT AND SPILLWAYS

SCALE IN FEET

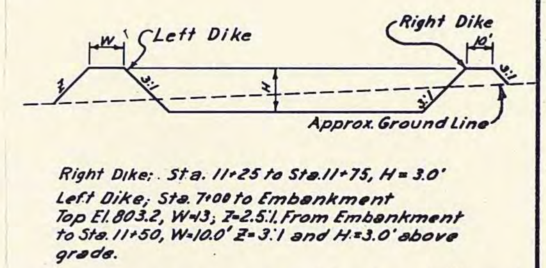


PROFILE ON ℄ OF EMERGENCY SPILLWAY

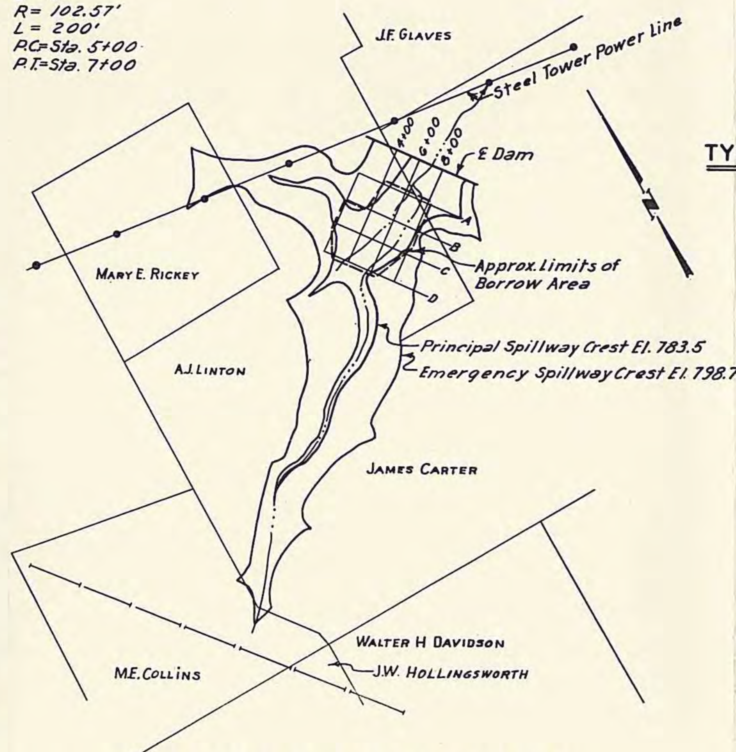


VICINITY MAP

SCALE IN MILES

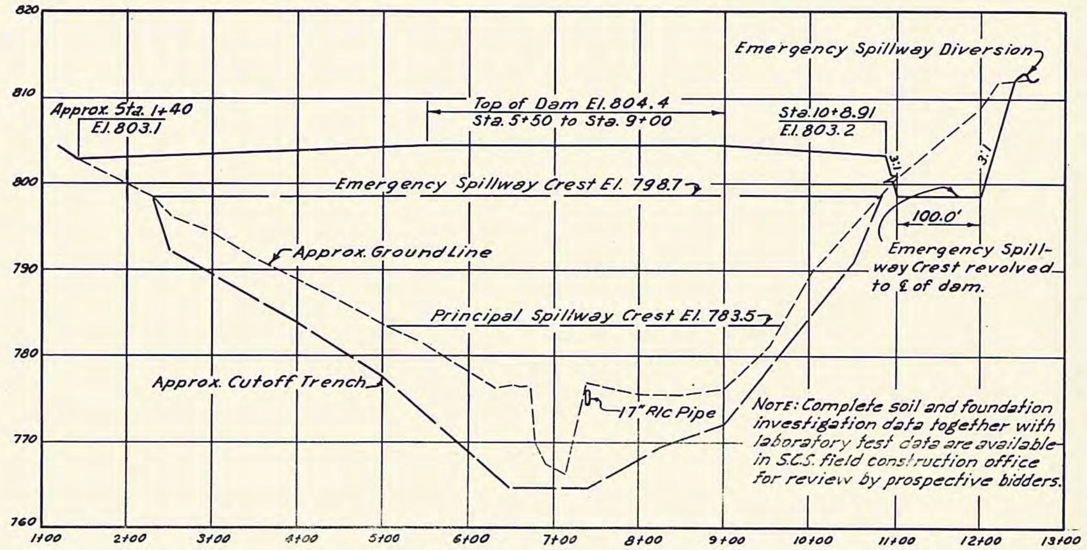


TYPICAL SECTION – EMERGENCY SPILLWAY



GENERAL PLAN OF RESERVOIR

SCALE IN FEET

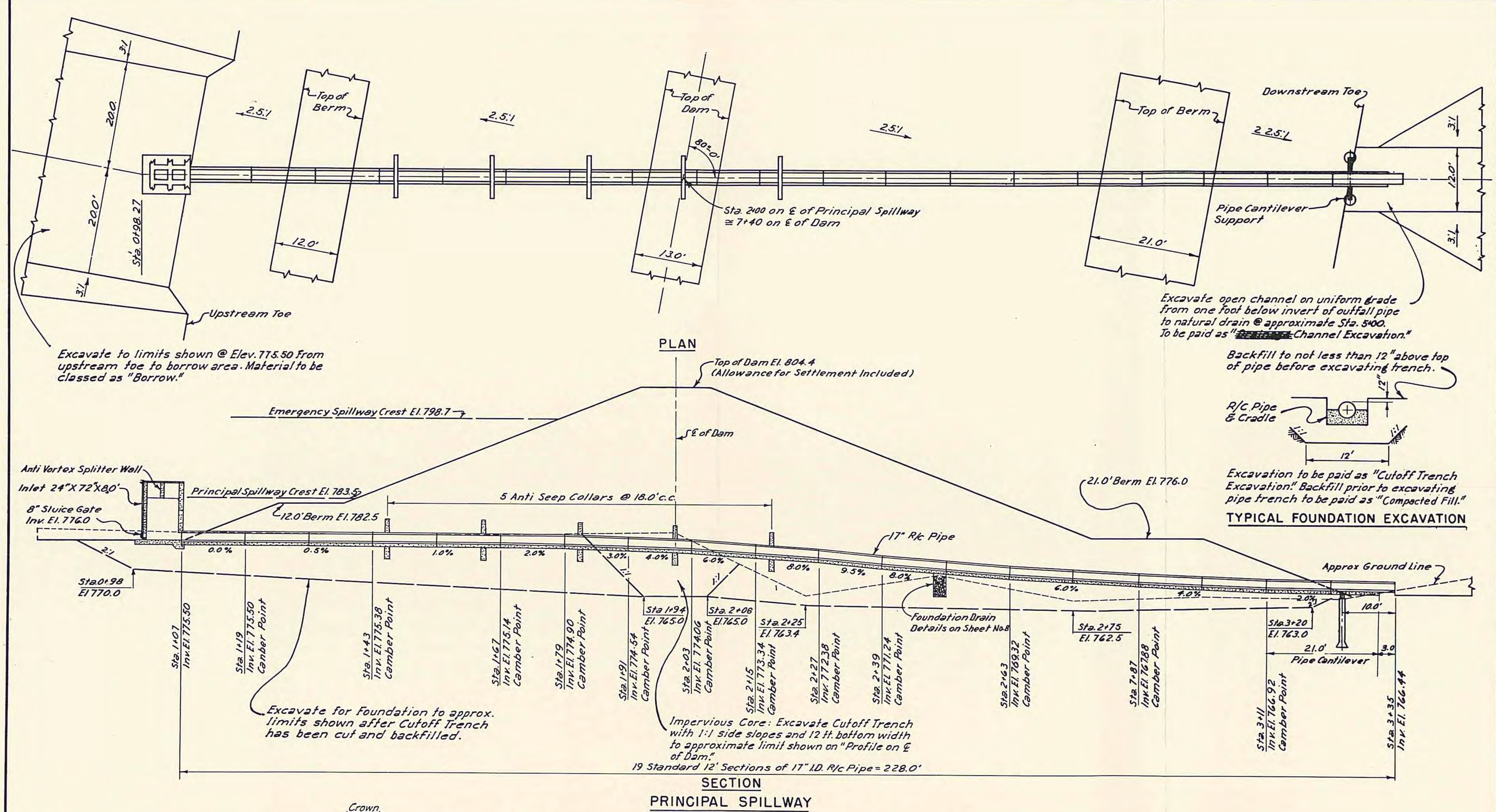


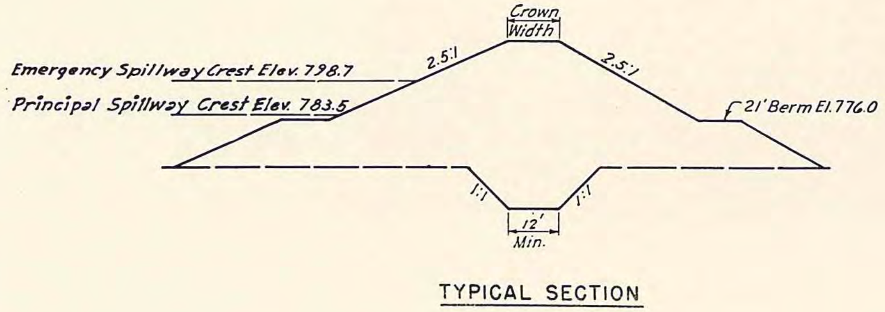
PROFILE ON ℄ OF DAM

Figure 4
TYPICAL
FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	W.E.C.	3-60	Approved by
Drawn	W.E.C. & F.C.S.	4-60	
Traced	F.C.S.	4-60	Temple, Texas
Checked	W.E.C. & G.W.T.	4-60	Sheet No. 2 of 8 — Drawing No. 4-R-14489





EMBANKMENT SECTION		REQUIRED COMPACTION DATA: SOURCE OF FILL MATERIAL			LAB. TEST		COMPACTION REQUIREMENTS			Lab. Curve
Sec. No.	Description	Location	Ave. Depth Feet		Modified		Min. Dry Density	Moisture Range		
			From	To	Max Dry Den.	Opt'm Moist	Lbs. Per Cu. Ft.	Percent From	Percent To	No.
	Cutoff Trench or Center Section	Borrow Zone B	1	6	119.0	14.0	107.0	13	up	3
		Emergency Spillway	1	5	117.0	14.5	105.0	13	up	4
		Emergency Spillway	5	Grade	119.5	13.0	107.0	12	up	5
	Outside Section	Cutoff Excavation	1	6	126.0	10.5	113.0	9	up	1
		Borrow Zone A	2	11	126.0	10.5	113.0	9	up	2

Note: Material represented by Curve 2 is to be used in conjuction with Foundation Drain see sheet No. 8. See Geologic Investigations, Sheet No. 1 for Borrow Zones.

If the material being placed in the fill contains ¼ inch or larger material in amounts differing from the percentages found in the laboratory sample, the minimum dry density and moisture requirement shown above will be corrected for this variation.

EMBANKMENT DATA

Figure 4a
TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	W.E.C.	3-60
Drawn	W.E.C. & F.C.S	4-60
Traced	F.C.S.	4-60
Checked	W.E.C. & G.W.T.	4-60

Approved by H. M. — Head, Engineering & Watershed Planning Unit, Fort Worth, Texas
[signature] — State Conservation Engineer, S. C. S., Temple, Texas

Sheet No. 3 of 8 — Drawing No. 4-R-14489 by the sediment and detention pools, the volume of fill in the dams, the width and depth of flow of the emergency spillways, and the estimated cost of the structures (tables 2 and 3).

4. Damages resulting from floodwater, sediment and erosion were determined from damage schedules and field surveys of flood plain areas and flood routing under present conditions. Reductions in these damages resulting from the proposed works of improvement were estimated on the basis of reduction of area inundated and depth of inundation as determined by flood routing under future conditions, assuming that the works of improvement had been installed. Benefits so determined were allocated to individual measures or groups of interdependent measures on the basis of the effect of each on reduction of damages. In this manner it was determined that the 24 proposed floodwater retarding structures with planned land treatment measures would not reduce average annual flood damages to meet the project objective of 65 percent reduction. Furthermore, release from the floodwater structures would cause prolonged flooding of portions of the flood plain.

5. To meet project objectives, stream channel improvement was planned to provide sufficient capacity to carry the structural release plus 2 inches of runoff from the areas not controlled by floodwater retarding structures. A 3-year frequency storm will produce approximately 2 inches of runoff.

6. Studies were then made to determine the cheapest combination of floodwater retarding structures and channel improvement that would attain the project objectives. It was found that six floodwater retarding structures could be eliminated by increasing channel capacities at a saving in cost. The remaining 18 floodwater retarding structures and channel improvement represent the least costly alternative necessary to meet project objectives. These individual and interdependent groups of structural measures have favorable benefit-cost ratios and are included in the plan.

When the land treatment measures and those structural measures for flood prevention had been determined, a table was developed to show the total cost of each type of measure. The summation of the total costs for all needed measures represented the estimated cost of the planned flood prevention project (tables 1 and 2). A second cost table was developed to show separately the annual installation cost, annual maintenance cost, and total annual cost of the structural measures (table 4).

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated and analyzed.

2. Engineering surveys were made to collect information on selected stream reaches, including valley cross sections, channel capacities and other hydraulic characteristics, and on proposed structure sites to collect data used in design.

3. Determination was made of the hydrologic conditions of the watershed, taking into consideration such factors as geology, soils, land use, topography, cover and climate. The soil-cover complex data were developed from a 13 percent sample of the watershed. The soil units and slopes were mapped on cropland, together with the amount of terraced land, small grains, legumes and soil conditions. On pastureland the soils were grouped by cover conditions. Future conditions were determined by conservation needs based on soil capability units. For sampling purposes, the watershed was divided into four areas and soil-cover complex curve numbers were developed for three of them. The other, the Trinity River Bottom and laterals, was used only to determine the land use for the entire watershed. The other three divisions were Smith Creek, Village Creek, and Walker Creek.

4. Determination was made of the rainfall-runoff relationship, using the soil-cover complex data. The frequency of occurrence of meteorologic events and the relationship of precipitation to runoff, peak discharge, flood stage, and area inundated were determined.

5. Determination was made of peak discharges and ares inundated under conditions which would exist due to:

   a. Present conditions of the watershed.

   b. Effect of land treatment measures.

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

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

   e. Consideration of combinations of measures.

6. Inflow hydrographs for structure sites were developed.

From a graph showing cumulative departures from normal precipitation, the rainfall for the period 1928 to 1957, inclusive, was selected as most representative of a normal rainfall period for the watershed.

After investigation and analysis of the meteorologic, hydraulic, hydrologic, geologic, and economic characteristics of the watershed, it was determined that a structural program was feasible.

The largest runoff-producing rain considered during the 30-year period of study was a storm of 5.94 inches extending over a 2-day interval. A rain of this magnitude, using Moisture Condition III, would produce 5.48 inches of runoff, under present conditions, and inundate 5,718 acres. If such a rain were to occur after land treatment practices had been applied, it is estimated that the area inundated would be reduced to 5,682 acres.

From a study of the relationship between runoff and flood stage for this watershed, it was found that a runoff of 0.10 inch was the minimum that would cause flooding to a depth of 6 inches at the smallest cross section. Due to changes in runoff-producing characteristics at different antecedent moisture conditions, rains of 0.33 inch to 1.63 inches would be required, on an average, to cause 0.10 inch of runoff.

The peak discharge from the largest runoff-producing rain in the 30-year period used in the evaluation study, under present conditions, is estimated to be 14,074 cubic feet per second at Valley Section 1, Drainage B (mouth of Village Creek). After installation and full functioning of the planned measures, the discharge from the same storm at this point would be reduced to 7,850 cubic feet per second.

In accordance with criteria set forth in Washington Engineering Memorandum SCS-27, the minimum floodwater detention volume was determined using Yarnell's 6-hour, 25-year rainfall for Class A structures and 50-year rainfall for Class B structures. The expected runoff ranged from 3.40 to 3.81 inches for Class A structures, and from 3.74 to 4.30 inches for Class B structures, depending on the soil-cover complex and size of the drainage area of each structure.

The floodwater detention volume as specified in the Texas State Manual Supplement 2441 and determined by the method set up in the Fort Worth Engineering and Watershed Planning Unit Hydrology Memorandum EWP-2 ranges from 4.96 to 5.78 inches for Class A structures and from 7.50 to 7.90 inches for Class B structures, depending on the soil-cover complex and the size of the drainage area of each structure.

The detention capacity for Site 12, computed as specified by the Texas State Manual Supplement 2441, is 7.90 inches, but because of the existence of farm improvements in the detention pool area, a detention capacity of 5.51 inches was planned for this site. The detention volume planned in all other structures met or exceeded the requirements of Texas State Manual Supplement 2441 and all structures exceeded the requirements of Washington Engineering Memorandum SCS-27.

Frequency of use of the emergency spillway was based on regional stream gage analysis and soil-cover complex of the watershed.

Inflow hydrographs for structure design were developed using the runoff that would be produced by a point rain of 14.5 to 14.8 inches in a period of 6 hours, assuming Moisture Condition II. A hydrograph of runoff was routed through each structure to determine the emergency spillway width and depth of flow. Frequency of use of the emergency spillway was based on gage analysis for a 2-day duration storm and in all cases will exceed 25 years based on a 6-hour duration storm.

Sedimentation Investigations

Field surveys to determine sedimentation and related damages in the watershed were made according to methods described in the "Sedimentation Investigations in Work Plan Development," Watersheds Memorandum EWP-7, dated August 21, 1959. Field studies included reconnaissance surveys of geology and soils, studies of overbank deposits, flood plain scour, streambank erosion, and the nature of channels and valleys on or near valley cross sections.

Estimates of sediment production in the watershed above proposed floodwater retarding structures were made according to procedures outlined in the above guide, and predictions were made for future sediment production rates based on a realistic estimate of the amount of effective land treatment measures that will be installed. Detailed sediment production rates were computed for approximately 50 percent of the sites. This information for the remaining sites was estimated, using the detailed sites as a guide. The sediment derived from sheet erosion was determined by the method presented in "Suggested Criteria for Estimating Gross Sheet Erosion and Sediment Delivery Rates for the Blackland Prairies Problem Area in Soil Conservation," Soil Conservation Service, Region 4, February 1953. The formula is based on watershed surveys including the following data:

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

2. Average farming practices (percent row crops and/or percent small grains, terraces, etc).

3. Cover condition classes on pasture and woodland.

4. Maximum 30-minute rainfall intensity to be expected once in 2 years.

Estimates also were made of sediment produced annually by gully and streambank erosion.

The average annual rate of sediment deposition in all structures is 1.54 acre-feet per square mile.

Cropland produces most of the sediment in the watershed, but pasture with poor cover is an important contributor in some areas.

Land damaged by sediment deposition and flood plain scour will recover its original productivity after it has been protected from flooding and the needed soil-improving measures have been applied.

Geologic Investigations

Reconnaissance geologic investigations were made on a large percentage of the planned floodwater retarding structure sites. These included proposed sites in all formations cropping out in the watershed in order to get a clear picture of all construction and design problems which are expected to occur. Brief lithologic and stratigraphic studies of the valley slopes, alluvium, channel banks, and exposed geologic formations were included in the investigations. Borings with a hand auger were made in the emergency spillway, channel beds, and representative areas of the borrow and foundations of the dam.

The Wolfe City and Pecan Gap formations and the Upper Taylor marl represent the Taylor group in the watershed.

The Wolfe City consists of sandy, calcareous clays and calcareous sandstones. The sandstones generally will break down under compaction, and can be used in the embankment. Sites 1 through 4 and 9 through 13 are located in this formation. Soils, as classified by the Unified Soil Classification System, are SM, SC, and CL. No major construction problems are expected.

Sites 5, 14, 15 and 16 occur in the Pecan Gap formation which is composed of bituminous, argillaceous and sandy chalks. The soils are predominantly SM, SC and CL. No major problems are anticipated in construction within this formation. Some emergency spillway areas contain highly erodible materials.

The Upper Taylor is typically made up of the blue, shaly marl. The soils are classified as CH and MH and are usually montmorillonitic and sometimes dispersed or of low shear strength. Sites within the formation are 6 through 8, 17 and 18.

The Neylandville formation represents the Navarro group in the watershed. The Neylandville is composed of calcareous clays and sandy marls. The soils are classified as ML, CH and CL and some are gypseous, montmorillonitic and moderately dispersed. There are no sites located within the outcrop of this formation.

Detailed investigations, including exploration with core drilling equipment, will be made at all floodwater retarding structure sites prior to their construction. Laboratory tests will be made to determine suitability and handling of the available embankment, cutoff wall, and foundation materials.

Economic Investigations

Flood damage schedules for approximately 60 percent of the flood plain area of the Village and Walker Creek watershed were obtained from owners and operators. Information on these schedules included land use and crop distribution, yields and historical data on flooding and flood damages. Flood plain land use was mapped in the field and estimates of normal yields were based on field data contained in schedules, supplemented by information from other agricultural workers with experience in the area.

Since land use and value of production varied considerably, and due to the drainage pattern of the watershed, the flood plain was divided into seven evaluation reaches, each with its own damageable value and characteristics of flooding. Analysis of the information obtained formed the basis for determining crop and pasture damage rates for various depths and seasons of flooding. Applicable rates of damage were applied to each flooding event recorded in the historical series and adjustment was made for recurrence of flooding within the same crop year.

Damages to other agricultural property, such as fences, livestock, levees and farm equipment were evaluated from the damage schedules taken from farmers. These damages were correlated with depth and size of floods. The major items of nonagricultural damage were roads and bridges. Although locations of road and bridge damage were often obtained from farmers, estimates of these damages were obtained from county commissioners and others who had intimate knowledge of their values.

The monetary value of damage from flood plain scour and sediment deposition was based on the value of production lost, taking into account the lag for the recovery of productivity.

All damages were calculated under conditions without the project and those which will prevail after installation of each progressive phase of the project. Benefits from reduction of floodwater damages and flood plain scour resulted from the combined effects of a smaller area flooded and reduced depth of inundation. Reduction in sediment yield and in area flooded were jointly responsible for benefits from reduction of damage by flood plain sediment deposition. Benefits attributed to structural measures were prorated according to degree of protection afforded by the structures. All calculations of damages and benefits were determined at 1957 prices which were projected to long-term levels (U.S.D.A., A.R.S., September 1957).

Indirect damages involve such items as disruption of travel to markets; additional farming expense, such as extra costs of purchasing feed for livestock; and losses in business sustained by dealers and industry in the area. Based on information obtained and data for watersheds previously analyzed, it was determined that 10 percent of the direct damage would be an equitable estimate for the indirect damage.

Areas that will be inundated by the sediment and detention pools of floodwater retarding structures were excluded from calculation of damages due to flooding. Although it is considered that there will be no production in the sediment pools after construction of floodwater retarding structures and that the land covered by detention pools will be converted to grassland under project conditions, it was determined that the annual loss of production within structure sites at long-term price levels will be less than the amortized current values of land in pool areas. Consequently, the higher figure was used in the economic evaluation of the project in order to assure a conservative benefit-cost analysis.

During field investigations, farmers were asked to state the changes made in the use of their flood plain lands as a result of past flooding. They were also asked what change they would make if flooding were reduced 50 percent. Analysis of these responses provided the basis for estimating the benefits from restoration of flood plain lands to their former use. Additional factors considered in this analysis were the size and location of the areas affected, land capability, acreage allotment restrictions, existence of available markets and reduction in frequency of flooding. All benefits from restoration to former productivity of flood plain lands were discounted over 50 years for cotton and 5-year buildup period for all other crops, following the installation period, to allow for lag in installation of the expected cropping pattern. The allowable increase for cotton under acreage allotments was not exceeded. Associated restoration expenses and added damage due to more intensive use were deducted as associated costs to obtain net benefits.

Details of the procedures used in the investigations are described in the Soil Conservation Service Economic Guide for Watershed Protection and Flood Prevention Revised December 1958. Methods described therein for use with the historical series were applied to the economic analysis for this work plan.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Applied Prior to June 1960

Item	Unit	Number Applied	Estimated Cost: Federal	Estimated Cost: Non-Federal 1/	Total
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Conservation Cropping Systems	Acre	7,570	-	-	-
Contour Farming	Acre	5,450	-	5,500	5,500
Cover Cropping	Acre	16,692	-	116,200	116,200
Crop Residue Use	Acre	10,742	-	21,500	21,500
Rotation Hay and Pasture	Acre	2,206	-	13,500	13,500
Grassland Renovation	Acre	3,500	-	32,375	32,375
Pasture Improvement	Acre	4,683	-	14,000	14,000
Pasture Planting	Acre	3,598	-	33,325	33,325
Brush Control	Acre	1,178	-	30,600	30,600
Diversion Construction	Mile	14	-	2,600	2,600
Erosion Control Structures	No.	0	-	0	0
Grassed Waterways	Acre	264	-	14,700	14,700
Pond Construction	No.	183	-	40,300	40,300
Terracing	Mile	224	-	18,600	18,600
Technical Assistance (Accel.)			63,400	-	63,400
SCS Subtotal			63,400	343,200	406,600
TOTAL LAND TREATMENT			63,400	343,200	406,600
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	-	-	-	-
Stream Channel Improvement	Mile	-	-	-	-
Subtotal - Construction		-	-	-	-
Installation Services					
Soil Conservation Service					
Engineering Services			-	-	-
Other			-	-	-
Subtotal - Installation Services			-	-	-
Other Costs					
Land, Easements and R/W			-	-	-
Legal Fees			-	-	-
Subtotal - Other			-	-	-
TOTAL STRUCTURAL MEASURES			-	-	-
Work Plan Preparation Cost			-	-	-
TOTAL PROJECT			63,400	343,200	406,600
SUMMARY					
Subtotal SCS			63,400	343,200	406,600
TOTAL PROJECT			63,400	343,200	406,600

1/ Excludes moneys that were reimbursed from Federal Funds (ACPS) to private interest.

June 1960

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Installation Period
June 1960 - June 1970

Item	Unit	Number to be Applied	Estimated Cost: Federal (dollars)	Estimated Cost: Non-Federal 1/ (dollars)	Total (dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Conservation Cropping Systems	Acre	22,740	-	-	-
Contour Farming	Acre	21,550	-	21,500	21,500
Cover Cropping	Acre	14,068	-	97,900	97,900
Crop Residue Use	Acre	19,568	-	39,120	39,120
Rotation Hay and Pasture	Acre	4,768	-	29,200	29,200
Grassland Renovation	Acre	5,500	-	50,875	50,875
Pasture Improvement	Acre	15,500	-	46,500	46,500
Pasture Planting	Acre	5,565	-	51,425	51,425
Brush Control	Acre	5,889	-	153,100	153,100
Diversion Construction	Mile	14	-	2,600	2,600
Erosion Control Structures	No.	25	-	25,000	25,000
Grassed Waterways	Acre	528	-	29,300	29,300
Pond Construction	No.	225	-	49,500	49,500
Terracing	Mile	738	-	61,500	61,500
Technical Assistance (Accel.)			80,600	-	80,600
SCS Subtotal			80,600	657,520	738,120
TOTAL LAND TREATMENT			80,600	657,520	738,120
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	18	563,282	-	563,282
Stream Channel Improvement	Mile	12.69	148,927	-	148,927
Subtotal - Construction			712,209	-	712,209
Installation Services					
Soil Conservation Service					
Engineering Services			131,177	-	131,177
Other			66,232	-	66,232
Subtotal - Installation Services			197,409	-	197,409
Other Costs					
Land, Easements and R/W			-	155,950	155,950
Legal Fees			-	3,220	3,220
Subtotal - Other			-	159,170	159,170
TOTAL STRUCTURAL MEASURES			909,618	159,170	1,068,788
Work Plan Preparation Cost			11,500	-	11,500
TOTAL PROJECT			1,001,718	816,690	1,818,408
SUMMARY					
Subtotal SCS			1,001,718	816,690	1,818,408
TOTAL PROJECT			1,001,718	816,690	1,818,408

1/ Excludes moneys that may be available from other Federal Funds (ACPS) to reimburse private interest.

June 1960

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)
Price Base: 1957

Item	Unit	Number Applied and to be Applied	Total Project Estimated Cost Federal	Total Project Estimated Cost Non-Federal 1/	Total Project Total
			(dollars)	(dollars)	(dollars)
LAND TREATMENT FOR:					
Watershed Protection					
Soil Conservation Service					
Conservation Cropping Systems	Acre	30,310	-	-	-
Contour Farming	Acre	27,000	-	27,000	27,000
Cover Cropping	Acre	30,760	-	214,100	214,100
Crop Residue Use	Acre	30,310	-	60,620	60,620
Rotation Hay and Pasture	Acre	6,974	-	42,700	42,700
Grassland Renovation	Acre	9,000	-	83,250	83,250
Pasture Improvement	Acre	20,183	-	60,500	60,500
Pasture Planting	Acre	9,163	-	84,750	84,750
Brush Control	Acre	7,067	-	183,700	183,700
Diversion Construction	Mile	28	-	5,200	5,200
Erosion Control Structures	No.	25	-	25,000	25,000
Grassed Waterways	Acre	792	-	44,000	44,000
Pond Construction	No.	408	-	89,800	89,800
Terracing	Mile	962	-	80,100	80,100
Technical Assistance (Accel.)			144,000	-	144,000
SCS Subtotal			144,000	1,000,720	1,144,720
TOTAL LAND TREATMENT			144,000	1,000,720	1,144,720
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	18	563,282	-	563,282
Stream Channel Improvement	Mile	12.69	148,927	-	148,927
Subtotal - Construction			712,209	-	712,209
Installation Services					
Soil Conservation Service					
Engineering Services			131,177	-	131,177
Other			66,232	-	66,232
Subtotal - Installation Services			197,409	-	197,409
Other Costs					
Land, Easements and R/W			-	155,950	155,950
Legal Fees			-	3,220	3,220
Subtotal - Other			-	159,170	159,170
TOTAL STRUCTURAL MEASURES			909,618	159,170	1,068,788
Work Plan Preparation Cost			11,500	-	11,500
TOTAL PROJECT			1,065,118	1,159,890	2,225,008
SUMMARY					
Subtotal SCS			1,065,118	1,159,890	2,225,008
TOTAL PROJECT			1,065,118	1,159,890	2,225,008

1/ Excludes moneys that may be available from other Federal Funds (ACPS) to reimburse private interest.

June 1960

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION 1/
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Structure Site Number	Federal Installation Cost: Construction: Engineer's Estimate	Construction: Contingencies	Installation Services: Engineering	Installation Services: Other	Total Federal	Total Non-Federal Installation Cost 2/	Estimated Total Cost
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures							
1	27,528	2,753	5,450	2,724	38,455	6,250	44,705
2	11,119	1,112	2,202	1,101	15,534	995	16,529
3	25,421	2,542	5,033	2,516	35,512	5,730	41,242
4	10,948	1,095	2,168	1,083	15,294	1,305	16,599
5	33,404	3,340	6,614	3,306	46,664	8,060	54,724
6	9,096	910	1,801	900	12,707	1,380	14,087
7	12,323	1,232	2,440	1,220	17,215	1,530	18,745
8	9,062	906	1,794	897	12,659	1,480	14,139
9	26,880	2,688	5,322	2,661	37,551	8,370	45,921
10	29,687	2,969	5,878	2,938	41,472	8,890	50,362
11	65,418	6,542	12,953	6,475	91,388	9,590	100,978
12	19,306	1,930	3,823	1,911	26,970	5,180	32,150
13	52,434	5,243	10,382	5,189	73,248	7,680	80,928
14	79,058	7,906	15,654	7,824	110,442	29,740	140,182
15	37,538	3,754	7,432	3,715	52,439	15,660	68,099
16	18,228	1,823	3,609	1,804	25,464	4,280	29,744
17	12,950	1,295	2,564	1,282	18,091	3,310	21,401
18	31,675	3,167	6,272	3,135	44,249	7,720	51,969
Subtotal	512,075	51,207	101,391	50,681	715,354	127,150	842,504
Stream Channel Improvement							
Smith Creek	45,800	4,580	10,076	5,261	65,717	8,720	74,437
Walker Creek	43,389	4,339	9,546	4,984	62,258	11,100	73,358
Village Creek	46,199	4,620	10,164	5,306	66,289	12,200	78,489
Subtotal	135,388	13,539	29,786	15,551	194,264	32,020	226,284
GRAND TOTAL	647,463	64,746	131,177	66,232	909,618	159,170	1,068,788

1/ Does not include work plan preparation cost.
2/ Includes easements, rights-of-way, legal fees, and removing obstacles.

June 1960

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8	9	10 1/
Drainage Area	Sq.Mi.	2.91	0.39	2.68	0.48	3.36	0.36	0.46	0.33	1.29	1.39
Storage Capacity											
Sediment Pool	Ac.Ft.	107	13	153	16	146	30	37	24	123	155
Sediment Reserve Below Riser	Ac.Ft.	0	0	0	0	0	0	0	0	0	0
Sediment in Detention Pool	Ac.Ft.	8	1	18	2	11	2	2	2	16	19
Floodwater Detention	Ac.Ft.	908	115	813	140	1,025	105	135	99	549	588
Total	Ac.Ft.	1,023	129	984	158	1,182	137	174	125	688	762
Surface Area											
Sediment Pool 2/	Acre	23	4	27	6	34	8	7	7	40	44
Floodwater Detention Pool	Acre	103	16	87	19	126	18	22	21	115	123
Volume of Fill	Cu.Yd.	78,650	31,770	72,630	31,280	95,440	25,990	35,210	25,890	76,800	84,820
Elevation Top of Dam	Foot	431.5	432.4	422.2	425.9	400.0	381.1	379.8	375.3	484.3	463.5
Maximum Height of Dam	Foot	34	24	37	33	36	23	25	21	18	26
Emergency Spillway											
Crest Elevation	Foot	427.5	429.2	418.0	422.4	396.0	378.0	376.5	372.5	481.3	460.0
Bottom Width	Foot	200	60	180	50	200	50	50	50	160	200
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 3/		3.9	3.2	4.0	3.6	3.9	3.0	3.6	2.7	1.9	1.9
Average Curve No. - Condition II		83	83	83	83	83	83	83	83	84	83
Emergency Spillway Hydrograph											
Storm Rainfall (6-hour) 4/	Inch	6.7	7.0	6.7	7.0	6.6	7.1	7.0	7.0	10.3	10.2
Storm Runoff	Inch	4.9	5.2	4.9	5.2	4.7	5.2	5.2	5.2	8.4	8.2
Velocity of Flow (V_c) 5/	Ft./Sec.	0	0	0	0	0	0	0	0	0.8	0.6
Discharge Rate	c.f.s.	0	0	0	0	0	0	0	0	87	73
Maximum Water Surface Elev. 5/	Foot	-	-	-	-	-	-	-	-	482.0	460.6
Freeboard Hydrograph											
Storm Rainfall (6-hour) 6/	Inch	16.1	16.9	16.0	16.8	15.8	16.9	16.8	16.9	20.5	20.5
Storm Runoff	Inch	14.1	14.9	14.0	14.8	13.7	14.8	14.8	14.9	18.6	18.2
Velocity of Flow (V_c) 5/	Ft./Sec.	8.6	7.6	8.8	8.0	8.5	7.5	7.7	7.0	7.3	7.9
Discharge Rate	c.f.s.	3,771	792	3,843	807	3,816	640	720	527	1,962	3,103
Maximum Water Surface Elev. 5/	Foot	431.5	432.4	422.2	425.9	400.0	381.1	379.8	375.3	484.3	463.5
Principal Spillway Capacity (Maximum)	c.f.s.	29	8	27	8	34	8	8	8	13	27
Capacity Equivalents											
Sediment Below Riser	Inch	0.69	0.61	1.07	0.62	0.82	1.57	1.48	1.39	1.79	2.08
Sediment in Detention Pool	Inch	0.05	0.07	0.13	0.08	0.06	0.13	0.12	0.11	0.23	0.26
Floodwater Detention	Inch	5.86	5.50	5.70	5.50	5.72	5.56	5.50	5.70	8.00	7.91
Spillway Storage 7/	Inch	3.10	2.74	2.90	2.90	3.20	3.24	3.40	3.80	5.78	7.15
Class of Structure		A	A	A	A	A	A	A	A	B	B

(Footnotes next page)

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Item	Unit	STRUCTURE NUMBER 11	12	13	14 1/	15	16	17	18	Total
Drainage Area	Sq.Mi.	4.33	1.04	2.15	9.19	5.63	1.34	0.88	2.51	40.72
Storage Capacity										
Sediment Pool	Ac.Ft.	200	113	162	200	200	93	70	186	2,028
Sediment Reserve Below Riser	Ac.Ft.	128	0	0	585	205	0	0	0	918
Sediment in Detention Pool	Ac.Ft.	41	14	21	98	33	7	5	15	315
Floodwater Detention	Ac.Ft.	1,777	305	893	3,682	1,733	422	289	771	14,349
Total	Ac.Ft.	2,146	432	1,076	4,565	2,171	522	364	972	17,610
Surface Area										
Sediment Pool 2/	Acre	78	30	33	161	83	20	18	40	663
Floodwater Detention Pool	Acre	267	69	122	431	225	65	47	112	1,988
Volume of Fill	Cu.Yd.	186,910	57,300	149,810	225,880	107,250	52,080	37,000	90,500	1,465,210
Elevation Top of Dam	Foot	487.2	486.4	448.9	415.4	413.1	426.2	368.1	372.3	xxx
Maximum Height of Dam	Foot	39	25	33	43	33	27	21	28	xxx
Emergency Spillway										
Crest Elevation	Foot	483.5	483.0	445.2	410.0	409.1	422.7	364.9	368.3	xxx
Bottom Width	Foot	350	120	200	500	295	110	115	150	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 3/		1.9	2.7	2.0	1.9	3.8	4.0	3.6	3.8	xxx
Average Curve No. - Condition II		83	83	83	83	84	83	83	83	xxx
Emergency Spillway Hydrograph										
Storm Rainfall (6-hour) 4/	Inch	9.8	10.3	10.1	9.4	6.5	6.9	6.9	6.7	xxx
Storm Runoff	Inch	7.9	8.3	8.0	7.4	4.6	5.0	5.1	4.9	xxx
Velocity of Flow (V_c) 5/	Ft./Sec.	0.8	1.9	1.7	0.5	0	0	0	0	xxx
Discharge Rate	c.f.s.	200	250	338	81	0	0	0	0	xxx
Maximum Water Surface Elev. 5/	Foot	484.1	484.1	446.2	-	-	-	-	-	xxx
Freeboard Hydrograph										
Storm Rainfall (6-hour) 6/	Inch	19.6	20.7	20.1	18.7	15.6	16.5	16.6	16.0	xxx
Storm Runoff	Inch	17.5	18.4	17.9	16.6	13.5	14.4	14.6	14.0	xxx
Velocity of Flow (V_c) 5/	Ft./Sec.	8.1	8.6	8.5	9.6	8.4	7.8	7.6	8.6	xxx
Discharge Rate	c.f.s.	5,657	2,380	3,828	13,906	6,804	1,737	1,561	2,930	xxx
Maximum Water Surface Elev. 5/	Foot	487.2	487.0	448.9	415.4	413.1	426.2	368.1	372.3	xxx
Principal Spillway										
Capacity (Maximum)	c.f.s.	43	10	22	194	56	13	9	25	xxx
Capacity Equivalents										
Sediment Below Riser	Inch	1.42	2.03	1.42	1.60	1.35	1.30	1.48	1.39	xxx
Sediment in Detention Pool	Inch	0.18	0.26	0.18	0.20	0.11	0.10	0.12	0.11	xxx
Floodwater Detention	Inch	7.70	5.51	7.80	7.51	5.77	5.92	6.15	5.77	xxx
Spillway Storage 7/	Inch	4.70	5.00	3.90	5.09	3.45	3.68	3.67	3.83	xxx
Class of Structure		B	B	B	B	A	A	A	A	xxx

1/ Excludes area from which runoff is controlled by other structures.
2/ Surface area at top of riser.
3/ Based on regional stream gage analysis and soil-cover complex characteristics of the watershed of the individual structure.
4/ For Class A structures, 0.5P adjusted to drainage area; for Class B structures, 0.75P adjusted to drainage area. Value of P from Figure 3.21-1 Supplement A, Section 4, National Engineering Handbook.
5/ Maximum during passage of hydrograph.
6/ 1.2P for Class A structures adjusted to drainage area; 1.5P for Class B structures adjusted to drainage area. Reference: Figure 3.21-1, Supplement A, Section 4, National Engineering Handbook, as modified by Hydrology Memorandum EWP-3, dated June 8, 1959.
7/ Storage from emergency spillway crest to top of dam.

June 1960

TABLE 3A - STRUCTURE DATA
STREAM CHANNEL IMPROVEMENT
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Station Numbering For Reach: Station	Station Numbering For Reach: Station	Watershed Area 1/ (acre)	Planned Channel Capacity (c.f.s.)	Bottom Width (foot)	Side Slope	Depth (foot)	Fall (ft./ft.)	Velocity at Design Depth (ft./sec.)	Volume of Excavation (1000 cu.yd.)
Smith Creek									
0 + 00	93 + 80	5,210	1,509	40	2:1	9.0	.0005	2.89	141
93 + 80	129 + 50	4,499	1,327	40	2:1	8.5	.0005	2.80	57
129 + 50	186 + 10	4,186	1,337	30	2:1	7.0	.0016	4.34	31
								Subtotal	229
Walker Creek									
0 + 00	118 + 00	7,968	2,377	22	2:1	10.0	.0020	5.66	122
118 + 00	175 + 00	7,251	2,240	20	2:1	10.0	.0020	5.60	60
175 + 00	230 + 50	3,347	1,231	16	2:1	8.0	.0020	4.81	35
								Subtotal	217
Village Creek									
0 + 00	67 + 00	22,048	3,827	40	2:1	13.0	.0008	4.46	136
67 + 00	145 + 00	11,270	2,521	24	2:1	10.0	.0020	5.73	72
145 + 00	197 + 00	10,502	2,377	22	2:1	10.0	.0020	5.66	14
197 + 00	253 + 50	8,902	2,146	22	2:1	9.5	.0020	5.51	9
								Subtotal	231
							GRAND TOTAL		677

1/ Uncontrolled area below floodwater retarding structures.

June 1960

TABLE 4 - ANNUAL COSTS 1/

Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Measures	Amortization of Installation Costs 2/ Federal	Amortization of Installation Costs 2/ Non-Federal	Amortization of Installation Costs 2/ Total	Operation & Maintenance Costs 3/ Total Non-Federal	Total
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures 1 through 8 in combination with Stream Channel Improvement 4/	9,158	1,799	10,957	2,034	12,991
Floodwater Retarding Structures 9 through 14 in combination with Stream Channel Improvement 4/	15,773	3,802	19,575	2,046	21,621
Floodwater Retarding Structures 15 through 18 in combination with Stream Channel Improvement 4/	7,140	1,958	9,098	1,650	10,748
TOTAL	32,071	7,559	39,630	5,730	45,360

1/ Does not include work plan preparation costs.

2/ Amortization period, 50 years; Federal interest rate, 2½ percent; non-Federal interest rate, 4 percent; based on 1957 prices.

3/ Based on long-term price levels as projected by ARS, September 1957.

4/ Interdependent measures.

June 1960

TABLE 5 - MONETARY BENEFITS FROM STRUCTURAL MEASURES
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)
Price Base: Long-Term 1/

Item	Estimated Average Annual Damage			Average Annual Monetary Benefits
	Without Project	After Land Treatment For W/S Protection	With Project	
	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Damage				
Crop and Pasture	68,899	66,897	8,206	58,691
Other Agricultural	3,626	3,358	226	3,132
Nonagricultural (Road and Bridge)	1,115	1,011	51	960
Subtotal	73,640	71,266	8,483	62,783
Sediment Damage				
Overbank Deposition	5,884	3,880	250	3,630
Subtotal	5,884	3,880	250	3,630
Erosion Damage				
Flood Plain Scour	4,205	3,936	260	3,676
Subtotal	4,205	3,936	260	3,676
Indirect Damage	8,373	7,909	899	7,010
Total, All Damage	92,102	86,991	9,892	77,099
TOTAL FLOOD PREVENTION BENEFITS	xxx	xxx	xxx	77,099
TOTAL PRIMARY BENEFITS	xxx	xxx	xxx	77,099
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	77,099

1/ USDA, ARS, September 1957

TABLE 6 - BENEFIT-COST ANALYSIS
Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Measures	AVERAGE ANNUAL BENEFITS 1/					Average Annual Cost 2/	Benefit-Cost Ratio
	Flood Prevention						
	Floodwater	Sediment	Erosion	Indirect	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Floodwater Retarding Structures 1 through 8 in combination with Stream Channel Improvement 3/	22,252	509	527	2,329	25,617	12,991	2.0:1
Floodwater Retarding Structures 9 through 14 in combination with Stream Channel Improvement 3/	20,842	2,402	2,667	2,592	28,503	21,621	1.3:1
Floodwater Retarding Structures 15 through 18 in combination with Stream Channel Improvement 3/	19,689	719	482	2,089	22,979	10,748	2.1:1
TOTAL	62,783	3,630	3,676	7,010	77,099	45,360	1.7:1

1/ Long-term price levels, as projected by ARS, September 1957.

2/ Installation costs based on 1957 prices; operations and maintenance costs on long-term prices as projected by ARS, September 1957.

3/ Interdependent measures.

June 1960

ADDENDUM

TABLE 6 - BENEFIT-COST ANALYSIS 1/

Village and Walker Creek Watershed, Texas
(Trinity River Watershed)

Measures	Average Annual Benefits 2/ — Flood Prevention: Floodwater	Sediment	Erosion	Indirect	Total	Average Annual Cost 3/	Benefit-Cost Ratio
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Floodwater Retarding Structures 1 through 8 in combination with Stream Channel Improvement 4/	22,252	509	527	2,329	25,617	12,703	2.0:1
Floodwater Retarding Structures 9 through 14 in combination with Stream Channel Improvement 4/	20,842	2,402	2,667	2,592	28,503	21,164	1.4:1
Floodwater Retarding Structures 15 through 18 in combination with Stream Channel Improvement 4/	19,689	719	482	2,089	22,979	10,489	2.2:1
TOTAL	62,783	3,630	3,676	7,010	77,099	44,356	1.7:1

1/ Revised to show benefit-cost comparison based on 2-5/8 percent interest rate for amortization of both Federal and non-Federal costs.

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

3/ Installation costs based on 1957 prices; operations and maintenance costs on long-term prices as projected by ARS, September 1957.

4/ Interdependent measures.

June 1960