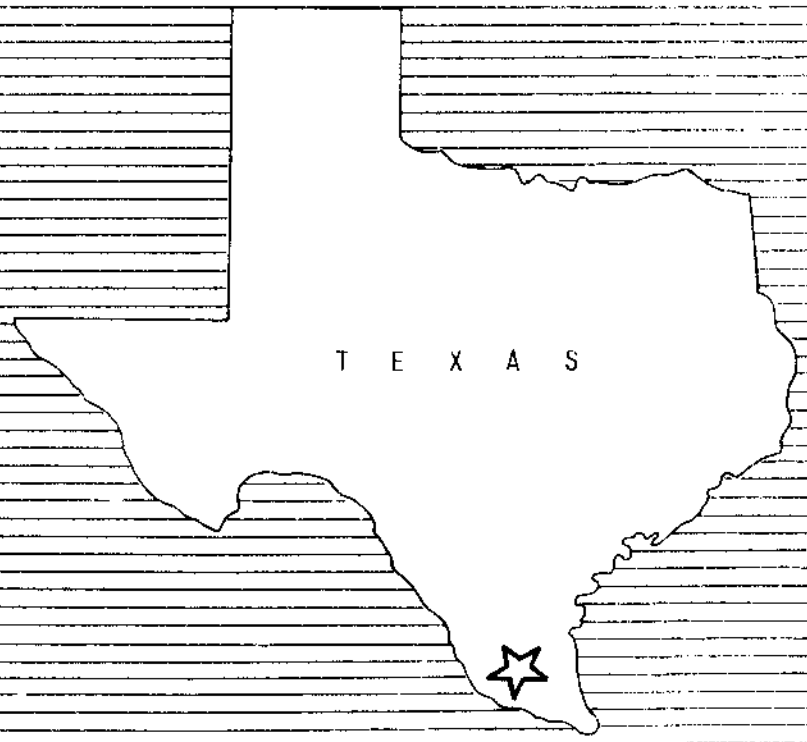
WORK PLAN

FOR WATERSHED PROTECTION,
FLOOD PREVENTION AND AGRICULTURAL WATER MANAGEMENT

OLMITOS AND GARCIAS CREEKS WATERSHED

STARR COUNTY, TEXAS



August 1959

WATERSHED WORK PLAN AGREEMENT

between the

Starr County Soil Conservation Distriot
Local Organization

Commissioners Court of Starr County
Local Organization

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 Olmitos and Garcias Creeks 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 Olmitos and Garcias Creeks 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 5 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 $ 62,386 .)

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)
Site # 1	0	100	19,303
Site # 2	0	100	89,684
Site # 3	0	100	40,878
Site # 4	0	100	91,867
Site # 5	0	100	136,092
Site # 6	0	100	81,629
Site # 7	0	100	122,064
Channel Improvement Garcias Creek	0	100	119,664
Channel Improvement Olmitos Creek	8.2	91.8	61,871

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. (Estimated cost $ 220,157.)

   The Service will bear 45 percent of the cost of installation services applicable to works of improvement for agricultural water management and the Sponsoring Local Organization will bear 55 percent of the cost of such services. (Estimated cost $ 2,685.)

   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 $ 4,500.)

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.

Starr County Soil Conservation District
Local Organization

By John L. Shufford

Title Chairman

Date December 17, 1959

The signing of this agreement was authorized by a resolution of the governing body of the Starr County Soil Conservation District
Local Organization

adopted at a meeting held on December 15, 1959

Ubaldo Salinas
(Secretary, Local Organization)

Date December 17, 1959

Commissioners Court of Starr County
Local Organization

By M J Rodriguez

Title County Judge

Date December 17, 1959

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

adopted at a meeting held on December 17, 1959

(Secretary, Local Organization)

Date December 17, 1959

Local Organization

By

Title

Date

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

adopted at a meeting held on

(Secretary, Local Organization)

Date

Soil Conservation Service
United States Department of Agriculture

By
Administrator

Date

WORK PLAN

FOR

WATERSHED PROTECTION, FLOOD PREVENTION, AND AGRICULTURAL WATER MANAGEMENT

OLMITOS AND GARCIAS CREEKS WATERSHED
Starr 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: Starr County Soil Conservation District
(Cosponsor)

Commissioners Court of Starr County
(Cosponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
August 1959

TABLE OF CONTENTS

	Page
SECTION 1 - WATERSHED WORK PLAN	1
SUMMARY OF PLAN	1
General Summary	1
Land Treatment Measures	1
Structural Measures	1
Damages and Benefits	2
Provisions for Financing Construction	2
Operation and Maintenance	2
DESCRIPTION OF WATERSHED	3
Physical Data	3
Economic Data	4
WATERSHED PROBLEMS	5
Floodwater Damage	5
Sediment Damages	6
Erosion Damage	6
Problems Relating to Water Management	8
EXISTING OR PROPOSED WORKS OF IMPROVEMENT	8
WORKS OF IMPROVEMENT TO BE INSTALLED	8
Land Treatment Measures for Watershed Protection	8
Structural Measures	9
BENEFITS FROM WORKS OF IMPROVEMENT	14
COMPARISONS OF BENEFITS AND COSTS	15
ACCOMPLISHING THE PLAN	16
Land Treatment Measures	16
Structural Measures for Flood Prevention and Agricultural Water Management	17
Schedule of Obligation	17
PROVISIONS FOR OPERATION AND MAINTENANCE	19
Land Treatment Measures	19
Structural Measures	19
COST-SHARING	20
CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS	21

TABLE OF CONTENTS - Continued

	Page
SECTION 2 - INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES	22
INVESTIGATIONS AND ANALYSES	22
Project Formulation	22
Project Objectives	22
Land Treatment Measures	22
Structural Measures	22
Hydraulic and Hydrologic Investigations	27
Sedimentation Investigations	29
Sediment Source Studies	29
Effect of Watershed Treatment on Sediment Yields	30
Geologic Investigations	30
Economic Investigations	31
Determination of Annual Benefits from Reduction in Damages	31
Details of Methodology	33

List of Tables and Figures

Table 1 - Estimated Project Installation Cost	10
Table - Unnumbered - Crop Distribution and Net Returns for Those Areas on Which Restoration, Changed Land Use, and Intensification were Claimed	32A
Table 2 - Estimated Structure Cost Distribution	34
Table 3 - Structure Data - Floodwater Retarding Structures	35
Table 3A - Structure Data - Structures	36
Table 3B - Structure Data - Stream Channel Improvement	37
Table 4 - Summary of Physical Data	38
Table 5 - Summary of Plan Data	39
Table 6 - Annual Cost	40
Table 7 - Monetary Benefits from Structural Measures	41
Table 8 - Benefit Cost Analysis	42
Table 8A - Benefits and Costs by Construction Units	43
Table 9 - Allocation of Installation Costs of Structural Measures	44
Figure 1 - Problem Location Map	7
Figure 2 - Section of a Typical Floodwater Retarding Structure	12
Figure 3 - Planned Structural Measures Map	13
Figure 4 - Typical Floodwater Retarding Structure - General Plan and Profile	24
Figure 4A - Typical Floodwater Retarding Structure - Structure Plan and Section	25

SECTION 1

WATERSHED WORK PLAN

OLMITOS AND GARCIAS CREEKS WATERSHED
Starr County, Texas
August 1959

SUMMARY OF PLAN

General Summary

The work plan for watershed protection, flood prevention, and agricultural water management for the Olmitos and Garcias Creeks watershed was prepared by the Starr County Soil Conservation District and the Commissioners Court of Starr County as cosponsoring organizations. Technical assistsnce was provided by the Soil Conservation Service of the United States Department of Agriculture.

The work plsn covers an area of approximately 156 square miles, or 99,840 acres, in Starr County, Texas. Approximately 7.3 percent of the watershed is cropland, 90 percent is grassland, and 2.7 percent is in miscellaneous uses, such as stream channels, towns, roads, and railroads.

There are no Federal lands in the watershed.

The work plan proposes installing, in a 5-year period, a project for the protection and development of the watershed at a total estimated installation cost of $2,263,885. The share of this cost to be borne by Public Law 566 funds is $995,664. The share to be borne by other than Public Law 566 funds is $1,268,221. In addition, local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

The cost for land treatment measures is estimated to be $1,211,105, of which the other than P. L. 566 share is $1,194,805, including $17,100 to be spent by the Soil Conservation Service under its going program for technical assistance during the project period. The Public Law 566 share, consisting entirely of accelerated technical assistance, is $16,300. The work plan includes only the land treatment measures that will be installed during the 5-year project period.

Structural Measures

The structural measures included in the plan consist of 7 floodwater retarding structures having a total sediment storage and floodwater detention capacity of 20,210 acre-feet and 9.2 miles of channel improvement, with appurtenant structures, of which 3.9 miles is on Olmitos Creek and 5.3 miles on Garcias Creek. The total cost of structural measures is $1,052,780, of which the local

share is $73,416 and the Public Law 566 share is $979,364. The local share of cost of structural measures includes: land, easements and rights-of-way, 85.0 percent; construction, 6.9 percent; installation services, 2.0 percent; and administering contracts, 6.1 percent. The 7 floodwater retarding structures will be installed during a 3-year period.

Damages and Benefits

The estimated average annual floodwater, sediment, and indirect damages without the project total $42,737 at long-term price levels. The estimated average annual floodwater, sediment, and indirect damages with the project installed, including land treatment and structural measures amount to $773, a reduction of approximately 98 percent.

The average annual primary benefits accruing to structural measures are $54,374, which are distributed as follows:

Floodwater damage reduction	$31,460
Sediment damage reduction	1,219
Indirect damage reduction	6,515
Benefits from changed use of land	9,213
Benefits from more intensive use of land	5,967

The ratio of the average annual benefits ($54,374) to the average annual cost of structural measures ($41,353) is 1.3 to 1.

The benefits of land treatment measures were not evaluated in monetary terms since experience has shown that these soil and water conservation measures produce benefits in excess of their costs.

Provisions for Financing Construction

The Commissioners Court of Starr County has powers of taxation and eminent domain under applicable State laws. An ad valorem tax has been voted in this county and is presently being collected. Revenue from this tax will be available and is adequate for financing the local share of the structural cost.

Operation and Maintenance

Land treatment measures for watershed protection will be operated and maintained by the landowners or operators of the farms on which the measures are installed under agreements with the Starr County Soil Conservation District.

The 7 floodwater retarding structures and the 9.2 miles of channel improvement and appurtenant structures will be operated and maintained jointly by the Commissioners' Court of Starr County and the Starr County Soil Conservation District. Revenue from the ad valorem tax is available and adequate for this purpose. The estimated average annual cost of operation and maintenance of all structural measures is $4,235.

DESCRIPTION OF WATERSHED

Physical Data

Garcias Creek (figure 1) heads approximately 20 miles northeast of Rio Grande City, Texas and flows approximately 22 miles in a southerly direction before entering a series of old river channels, or resacas, previously occupied by the meandering Rio Grande.

Olmitos Creek (figure 1) heads approximately 10 miles northeast of Rio Grande City and flows approximately parallel to Garcias Creek for 15 miles before entering the Rio Grande.

The area of the watershed is 99,840 acres.

The geologic formations occurring within the watershed are the Goliad, Catahoula, and the Rio Grande alluvium and terrace deposits. The Goliad and Catahoula belong to the Tertiary system while the alluvium and terrace deposits of the Rio Grande are in the Quaternary system.

The Goliad formation caps the entire watershed except for the extreme southern portion occupied by the Rio Grande alluvial valley. The Goliad is characterized by caliche conglomerate, ranging from 2 to 15 feet in thickness, at or near the surface. This caliche caprock usually is found at the higher elevations. The material beneath the caprock ranges from very light silty clay to fine silty sand. The Goliad formation is thin in this area and the underlying ashy red clay of the Catahoula formation can be reached at a relatively shallow depth.

The topography ranges from nearly level to gently rolling over the major portion of the watershed. There is a narrow band of rather strong relief in the lower portion of the watershed where the upland abruptly meets the nearly level Rio Grande alluvial valley. The flood plains and stream channels are very poorly defined. Elevations range from 529 feet to 120 feet above mean sea level.

The watershed lies within the Rio Grande Plain Land Resource Area. The soils of the upland are primarily deep, moderately permeable, fine sandy loams. Very shallow soils, underlain with caliche and/or gravel, are found on low rolling to steeply sloping hills and ridges. The soils of the Rio Grande alluvial valley are deep, moderately permeable silt loams and silty clay loams. The physical condition of the soils ranges from poor to good with the majority of the area being in fair physical condition.

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

Land Use	Acres	Percent
Cropland	7,298	7.3
Grassland	89,856	90.0
Miscellaneous 1/	2,686	2.7
Total	99,840	100.0

1/ Includes roads, highways, railroads, stream channels, urban areas, etc.

The hydrologic cover condition of the rangeland is 57 percent poor, 33 percent fair, and 10 percent good.

About 1,666 acres of the watershed is flood plain which will be benefited by the project. The flood plain as described herein is the area inundated by the 25-year frequency storm runoff. Land use in the flood plain is 71 percent cropland; 22 percent range, brush or pasture; and 7 percent miscellaneous.

The average annual rainfall is 17.5 inches as recorded at U. S. Weather Bureau gage at Rio Grande City. The monthly average ranges from 0.83 inch in January to 3.07 inches in September.

Monthly normal temperatures range from 86.2 degrees in July to 58.1 degrees in January. Extreme temperatures are 115 and 7 degrees above zero. The normal frost-free period of 297 days extends from February 8 through December 2.

In the upper portion of the watershed all water for domestic use is supplied by wells. In the lower portion domestic water must either be hauled from Rio Grande City or obtained from the Rio Grande. Water for livestock is supplied primarily by stock ponds. Practically all of the irrigation water is obtained from the Rio Grande, with some supplemental water being obtained from shallow wells.

Economic Data

The area in which this watershed is located is one of the oldest settled regions in Texas. Settlement was started in the early eighteenth century and in 1767 the Viceroy of Spain partitioned the land along the Rio Grande into porciones (the old Spanish term for land apportionments) each approximately 15 miles long and three-fourths of a mile wide, fronting on the river.

The economy of the watershed is based primarily on agricultural production. Production of petroleum products, however, is significant in the upper two-thirds of the watershed.

In the extreme lower portion of the watershed, below U. S. Highway No. 83, lies the alluvial valley of the Rio Grande. In this area production of irrigsted crops is predominant. Approximately 25 percent of the irrigated acreage is devoted to cotton production, with the remaining acreage utilized for the production of vegetables and melons, principally for northern and eastern markets. Because of the favorable climatic conditions, a double cropping system is followed on most of the irrigated land, with both fall and spring plantings made of vegetables. Production of livestock is the predominant enterprise of farm and ranch operators above the Rio Grande Valley. Beef cattle is the most important class of livestock in the watershed, but there is also some production of sheep and goats.

The average size of the agricultural units is approximately 600 acres. However, there is a great range in the size of individual units, particularly in the irrigated area where many of the farms are less than 20 acres. In recent years many of these smaller units have been leased to form larger, more economic units.

There are no incorporated towns in the watershed. Three rural communities, La Puerta, with an estimated population of 300, and La Casita-Garciasville, with a combined estimated population of 1500, are located in the lower part of the watershed. Rio Grande City, population 5,500, is located approximately five miles west of the irrigated section of the watershed and is the principal market and supply center for the project area.

The watershed is served by 65 miles of Federal, State, and county roads of which 33 miles are hard surfaced. In addition, there are numerous private farm, ranch and oil field roads serving the area. Rail service is provided by the Missouri Pacific Railroad with loading facilities available in Rio Grande City.

WATERSHED PROBLEMS

Floodwater Damage

Flooding occurs frequently in the Olmitos and Garcias Creeks watershed and cause severe damage. During the 35-year period studied, 1923 to 1957, inclusive, which is representative of normal rainfall in this area, there were 12 major floods that inundated more than half of the flood plain (figure 1) as well as 52 minor floods. Due to the year-around cropping pattern in the irrigated section of the watershed, all 64 floods occurring in the evaluation series caused severe crop damage. Truck crops are extremely susceptible to flood damage and commonly have values as high as $300 per acre in the field. Costs of producing these crops range from $50 per acre to as high as $160 per acre, exclusive of harvesting costs.

For the floods experienced during the period studied, the total direct floodwater damages were estimated to average $34,078 annually at long-term price levels, of which $33,585 is crop and paature damage and $493 is other agricultural damages. Also, there are numerous indirect damages such as losses suffered by processors, shippers and dealers in the area, loss of labor income suffered by those persons engaged in the vegetable and melon harvesting operations, and similar losses, all of which are estimated to average $7,053 per year.

Floodwaters from the Rio Grande can flood portions of the watershed even though no runoff occurs within the watershed. With the installation of Falcon Dam this hazard has been reduced greatly. When the proposed Amistad (Diablo) Dam is constructed, the frequency of flooding from the Rio Grande should be reduced to a chance of less than once during the evaluation period.

Irrigated cotton land being flooded from floodwaters from Olmitos Creek during flood of May 1957.

Sediment Damages

Overbank deposition in the flood plain has damaged only 112 acres on Garcias Creek and 54 acres on Olmitos Creek. This damaging sediment, which is low in organic matter, consists primarily of fine sand and silt, and is estimated to have reduced crop and pasture production by 5 percent on 142 acres; 10 percent on 16 acres; and 20 percent on 8 acres. This amounts to an average annual monetary damage of $1,606 at long-term price levels.

Erosion Damage

Erosion rates in the watershed are low to moderate. This is due primarily to the topography in the most part ranging from nearly level to gently rolling, a high percent of the watershed being in grassland, and the cultivated area in the lower portion being on flat terrain. Sheet erosion accounts for 96.5 percent of the total gross erosion while streambank and gully erosion account for 3.5 percent. The amount of flood plain scour is negligible.

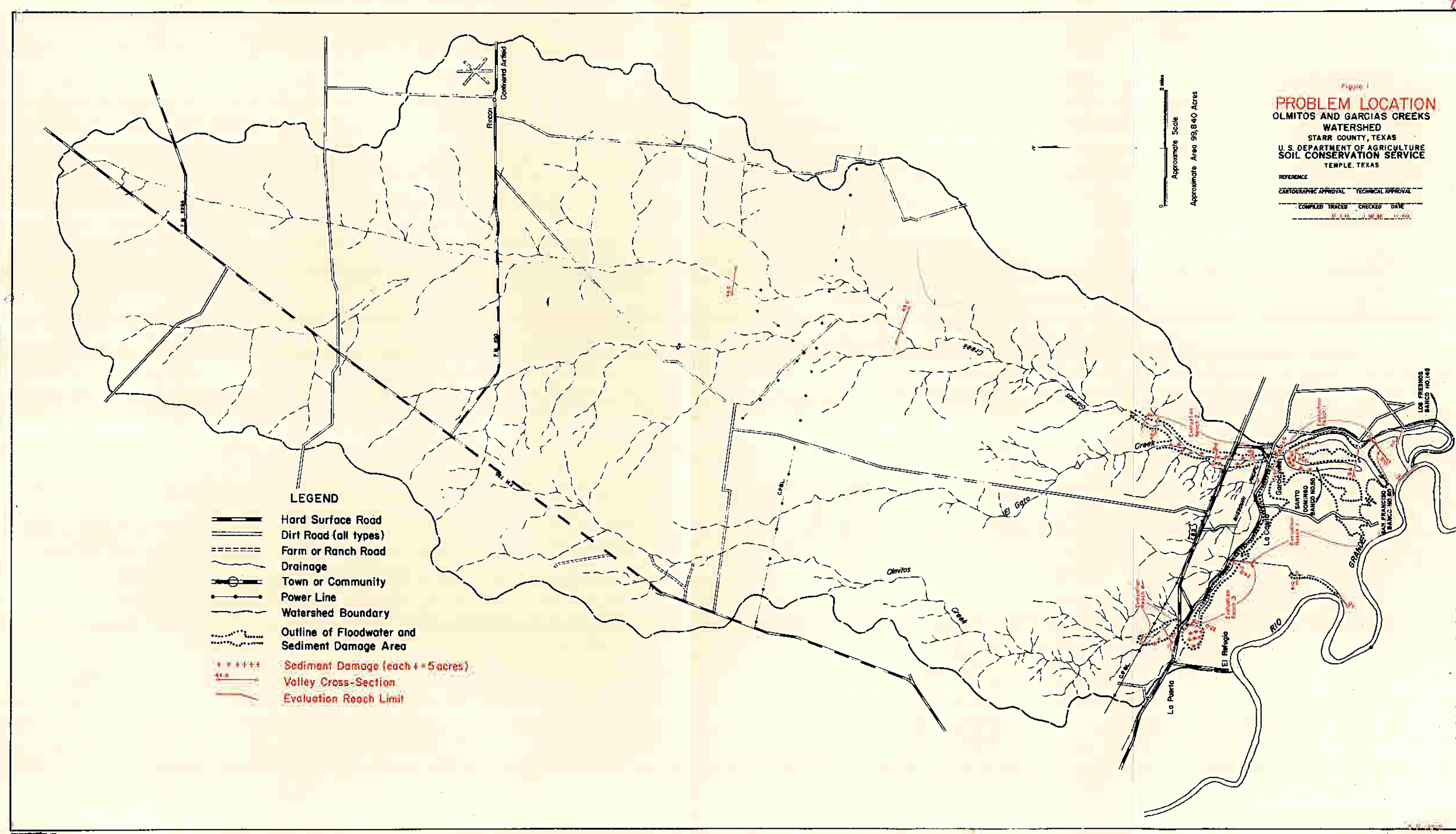


Figure 1
PROBLEM LOCATION
OLMITOS AND GARCIAS CREEKS
WATERSHED
STARR COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS
REFERENCE
CARTOGRAPHIC APPROVAL
TECHNICAL APPROVAL
COMPILED
TRACED
CHECKED
DATE
Approximate Scale
2 Miles
Approximate Area 99,840 Acres
LEGEND
Hard Surface Road
Dirt Road (all types)
Farm or Ranch Road
Drainage
Town or Community
Power Line
Watershed Boundary
Outline of Floodwater and Sediment Damage Area
Sediment Damage (each + = 5 acres)
Valley Cross-Section
Evaluation Reach Limit
Rincon
Continental Airfield
F.M. 2294
F.M. 490
Garcias
Creek
El Gato
Olmitos
Creek
La Puerta
El Refugio
La Casita
Garciasville
SANTO DOMINGO BANCO NO.56
SAN FRANCISCO BANCO NO.80
LOS FRESNOS BANCO NO.145
RIO
GRANDE
MISSOURI
PACIFIC
Compiled from uncontrolled mosaic 4R-12763

Problems Relating to Water Management

There is some activity relative to drainage, but considerably more activity relative to irrigation in the watershed. Approximately 4,900 acres are irrigated from release flows into the Rio Grande from Falcon Reservoir. No individual landowner or group of landowners has indicated an interest in providing additional storage in any of the floodwater retarding structures for irrigation purposes. The Commissioners Court of Starr County did indicate interest in providing additional storage in one of the floodwater retarding structures for municipal water supply for the communities of La Puerta, La Casita and Garciasville. After analyzing all possible alternatives, County officials determined that a more dependable and economical supply of water could be obtained from the Rio Grande.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

The watershed is served by the Soil Conservation Service work unit at Rio Grande City assisting the Starr County Soil Conservation District. This work unit has assisted farmers and ranchers in preparing 33 soil and water conservation plans on 76,379 acres (80 percent of the agricultural land) within the watershed and in giving technical assistance in establishing and maintaining planned measures. Approximately 25 percent of the needed conservation practices have been applied.

There are no organized drainage or irrigation districts functioning in the watershed. All existing drainage and irrigation systems are privately owned and operated. Irrigation water is obtained primarily from the Rio Grande by individual pumping units. Some limited amounts of supplemental irrigation water is obtained from shallow wells.

There are no existing or proposed works of improvement of other agencies in the watershed.

Falcon Dam has been constructed by the International Boundary and Water Commission, United States and Mexico, on the Rio Grande approximately 48 miles upstream from this watershed. They expect to construct Amistad (Diablo) Dam below the confluence of Devils River and the Rio Grande. These structures will greatly reduce the possibility of flooding in this watershed by the Rio Grande.

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 Starr County Soil Conservation District, is necessary for a sound 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 accelerating the establishment of land treatment practices which have a measurable effect on the reduction of floodwater, sediment, and erosion damages.

Of the total watershed area of 99,840 acres, 86,860 acres lie above planned floodwater retarding structures. Land treatment is especially important for protection of these watershed lands to support and supplement the structural measures. There are another 11,314 acres of upland and Rio Grande alluvium in the watershed for which no structural control has been planned and for which the establishment of land treatment constitutes the only planned measures in the plan. Land treatment measures on the 1,666 acres of flood plain also are important in reducing floodwater and sediment damage.

The amounts and estimated costs of the 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 $1,211,105, including $16,300 from Public Law 566 funds, and $1,194,805 from other funds. The Public Law 566 funds will be used during the 5-year installation period for the acceleration of technical assistance to landowners and operators in speeding up the planning and application of conservation practices.

Land treatment measures will decrease erosion damage and sediment production from fields, range areas, and pastures by providing improved soil-cover conditions. These measures include cover cropping, use of rotation hay and pasture, crop residue utilization for cropland, and pasture planting to establish good cover on grassland and formerly cultivated lands. They also include range seeding and brush control to allow grass stands to replace the poor brushy cover; construction of farm ponds to provide watering places for livestock and uniform distribution of grazing; and proper use of rangelands to provide improvement, protection and maintenance of grass stands. These measures also effectively improve soil conditions which allow rainfall to soak into the soil at a more rapid rate.

In addition to the soil improvement and cover measures, land treatment includes contour farming, terracing, diversion construction, and waterway development to serve these measures, which in combination have a measurable effect in reducing peak discharge by slowing runoff water from fields. These measures also serve in reducing erosion damage and sediment production.

Structural Measures

A system of 7 floodwater retarding structures and 9.2 miles of channel improvement will be installed in the watershed. Six floodwater retarding structures and 5.3 miles of channel improvement, including a flood gate structure, will be located on Garcias Creek. One floodwater retarding structure and 3.9 miles of channel improvement, including appurtenant structures, will be located on Olmitos Creek. The purpose of these structural measures is to provide protection for flood plain lands

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/

Olmitos and Garcias Creeks Watershed, Texas
Price Base: 1959

Installation Cost Item	Unit	No. to be Applied Non-Federal Land	Estimated Cost P. L. 566 Funds	Other Funds	Total
			(dollars)	(dollars)	(dollars)
AND TREATMENT FOR					
Watershed Protection					
Soil Conservation Service					
Contour Farming	Acre	2,000	-	1,500	1,500
Cover Cropping	Acre	5,000	-	50,000	50,000
Crop Residue Utilization	Acre	7,298	-	14,596	14,596
Rotation Hay and Pasture	Acre	2,000	-	26,000	26,000
Brush Control	Acre	60,000	-	600,000	600,000
Deferred Grazing	Acre	60,000	-	60,000	60,000
Pasture Planting	Acre	2,000	-	26,000	26,000
Proper Use	Acre	50,000	-	100,000	100,000
Range Seeding	Acre	60,000	-	240,000	240,000
Diversion Construction	Mile	1.5	-	1,584	1,584
Pond Construction	Each	50	-	50,000	50,000
Terracing	Mile	35	-	4,025	4,025
Waterway Development	Acre	20	-	4,000	4,000
Technical Assistance			16,300	17,100	33,400
SCS Subtotal			16,300	1,194,805	1,211,105
OTAL LAND TREATMENT			16,300	1,194,805	1,211,105
TRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Struc.	No.	7	581,517	-	581,517
Channel Improvement with Appurtenant Structures	Mile	9.2	176,481	5,054	181,535
SCS Subtotal			757,998	5,054	763,052
Subtotal - Construction			757,998	5,054	763,052
nstallation Services					
Soil Conaervation Service					
Engineering Services			151,599	1,011	152,610
Other			69,767	465	70,232
SCS Subtotal			221,366	1,476	222,842
Subtotal - Installation Services			221,366	1,476	222,842
:her Costs					
Land, Easements & R/W			-	62,386	62,386
Administration of Contracts			-	4,500	4,500
Subtotal - Other			-	66,886	66,886
TAL STRUCTURAL MEASURES			979,364	73,416	1,052,780
TAL PROJECT			995,664	1,268,221	2,263,885
MMARY					
Subtotal SCS			995,664	1,268,221	2,263,885
TAL PROJECT			995,664	1,268,221	2,263,885

No Federal lands involved.

August 1959

which cannot be provided by land treatment measures alone. Appurtenant structures will be constructed to restore irrigation facilities disturbed by installation of flood prevention structures. Figure 2 shows a section of a typical floodwater retarding structure. The locations of the structural measures are shown on the Planned Structural Measures, figure 3.

The 7 floodwater retarding structures will have a total floodwater detention capacity of 17,529 acre-feet, with 12,931 acre-feet in the 6 structures on Garcias Creek and 4,598 acre-feet in the structure on Olmitos Creek. These structures will temporarily detain runoff from 87 percent of the total watershed. An average of 2.42 inches of runoff will be detained from the watershed area above the planned structures. This is the equivalent of 2.11 inches of runoff from the entire 99,840-acre watershed.

Sufficient channel capacity will be provided in the improved channels to carry the release flows from the floodwater retarding structures plus capacity to handle the runoff that would result from the largest storm such as occurred during the 35-year period of study from the contributing uncontrolled areas.

Concrete structures, Sites 101 and 106, with flap-type gates to prevent backwater from the Rio Grande entering the improved channels will be constructed on the lower ends of Garcias and Olmitos Creeks. In addition, the following appurtenant structures will be constructed on Olmitos Creek:

Site 102 - Concrete inverted siphon to carry the flow of an existing irrigation ditch under the improved channel. A culvert for a private road to cross the improved channel below this siphon will be constructed by the local people. The cost of this culvert, $3,500, is included in land, easements, and rights-of-way costs, tables 1 and 2.

Site 103 - Concrete inverted siphon to carry the flow of an existing underground concrete irrigation pipeline under the improved channel.

Site 104 - Concrete culvert to carry the flow of the improved channel under an existing irrigation ditch and a private road. The local people will pay for the portion of the culvert to be installed under the private road. This cost, $2,145, is included in land, easements, and rights-of-way costs, tables 1 and 2.

Site 105 - Concrete inverted siphon to carry the flow of an existing irrigation ditch under the improved channel.

The costs of Sites 102, 103, 104, and 105, which are necessary for continued agricultural water management, are estimated to total $11,875. This amount will be shared $5,345 by Public Law 566 funds and $6,530 by other than Public Law 566 funds.

The total estimated cost of establishing all structural works of improvement is $1,052,780, of which $73,416 will be borne by local interests and $979,364 by Public Law 566 funds (table 1). The estimated annual equivalent cost for installation is $37,118 and the estimated annual operations and maintenance cost is $4,235, making a total annual cost of $41,353.

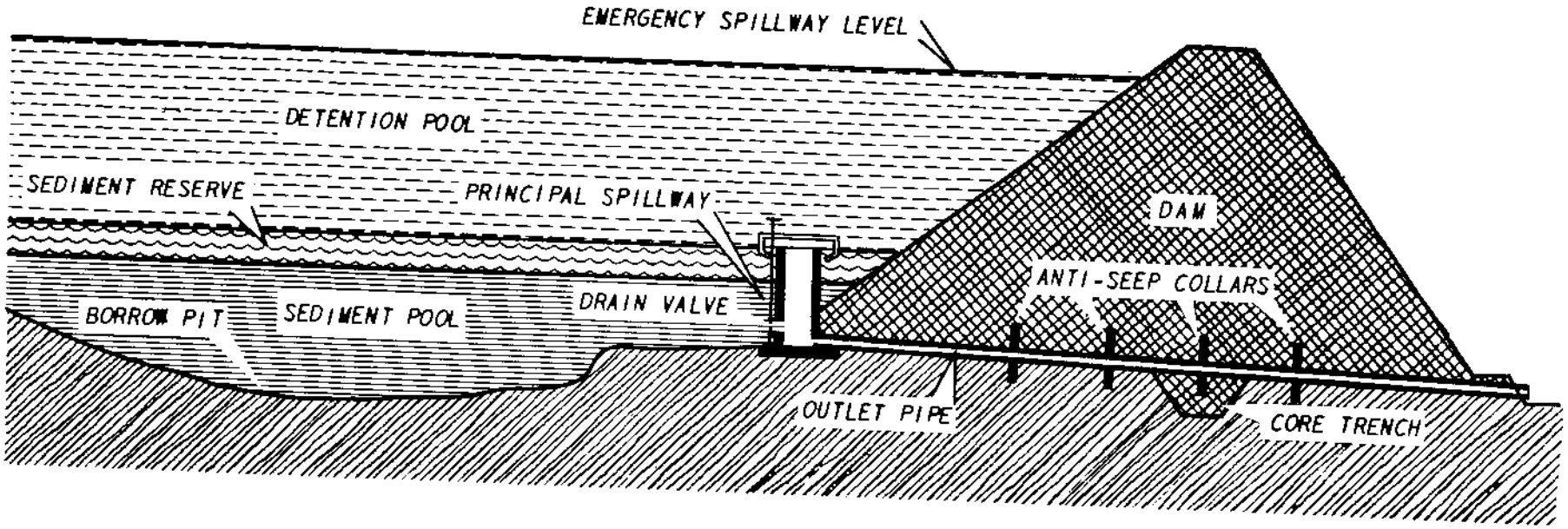


Figure 2
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

Revised 10-24-57 A-L-10,071

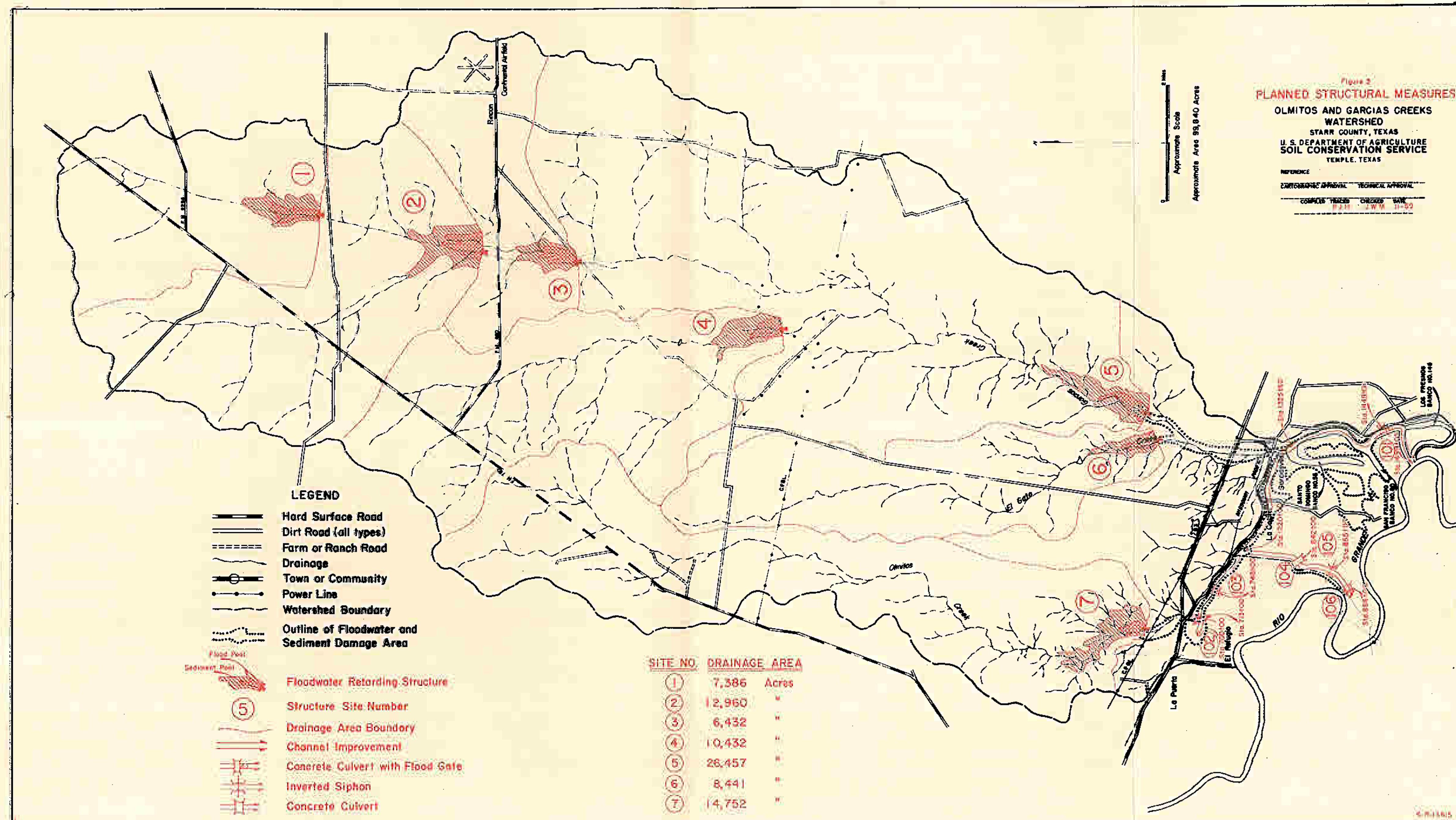


Figure 3
PLANNED STRUCTURAL MEASURES
OLMITOS AND GARCIAS CREEKS
WATERSHED
STARR COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS
Approximate Scale
Approximate Area 99,840 Acres
LEGEND
Hard Surface Road
Dirt Road (all types)
Farm or Ranch Road
Drainage
Town or Community
Power Line
Watershed Boundary
Outline of Floodwater and Sediment Damage Area
Flood Pool
Sediment Pool
Floodwater Retarding Structure
Structure Site Number
Drainage Area Boundary
Channel Improvement
Concrete Culvert with Flood Gate
Inverted Siphon
Concrete Culvert
SITE NO. DRAINAGE AREA
1 7,386 Acres
2 12,960 "
3 6,432 "
4 10,432 "
5 26,457 "
6 8,441 "
7 14,752 "
Rincon
Continental Airfield
El Gato
Olmitos
Creek
Garcias
La Puerta
El Refugio
La Casita
SANTO DOMINGO BANCO NO.56
SAN FRANCISCO BANCO NO.90
LOS FRESNOS BANCO NO.146
RIO GRANDE
101
102
103
104
105
106
Compiled from uncontrolled mosaic 4R-12763

Sufficient detention storage can be developed at all structure sites to make possible the use of vegetative spillways, thereby effecting a substantial reduction in cost over concrete or similar types of spillways.

All applicable State water laws will be complied with in the design and construction of the floodwater retarding structures.

BENEFITS FROM WORKS OF IMPROVEMENT

The combined program of land treatment and structural measures described above would confine damage from all of the 64 storms, such as occurred in this watershed from 1923 to 1957, to areas of 280 acres or less. All of the 12 major floods that inundated more than one-half the flood plain would be reduced to minor floods. Average annual flooding would be reduced from 1,036 acres to 257 acres. Evaluation Reaches 1 and 3 (figure 1) will be flood-free from all storms such as occurred in the evaluation series.

The most damaging flood to occur during recent years was caused by the storm of April 9-10, 1954. This storm inundated 1,762 acres of flood plain and caused an estimated $97,829 of direct floodwater damage. If the complete program for watershed protection and flood prevention had been installed, only 277 acres would have been inundated and floodwater damage would have been reduced to an estimated $871.

The area on which sediment damage from overbank deposition will occur annually can be expected to be reduced from 166 acres to 16 acres, a reduction of 90 percent. About 18 percent of the expected reduction will result from land treatment and 82 percent from the structural measures.

With the planned land treatment program, total gross erosion from the watershed will be reduced from an average of 143.90 acre-feet to 126.25 acre-feet annually, a reduction of 12 percent.

The estimated average annual monetary floodwater, sediment and indirect damages within the watershed would be reduced from $42,737 to $773, a 98 percent reduction. About 93 percent of the expected reduction in the average annual damage would result from the system of floodwater retarding structures and channel improvement.

The general locations of the benefits from reduction in flooding to be brought about by the combined program of land treatment and structural measures are presented in the following tables:

Average Annual Area Inundated

Evaluation Reach (Fig.1)	Location	Without Project (acres)	With Project (acres)	Reduction (percent)
1	Garcias Creek Resaca Area	587	0	100.0
2	Upper Garcias Creek	270	252	6.7
3	Lower Olmitos Creek	115	0	100.0
4	Upper Olmitos Creek	64	5	92.2
	Total	1,036	257	75.2

Average Annual Damages

Evaluation Reach (Figure 1)	Location	Without Project (dollars)	With Project (dollars)	Reduction (percent)
1	Garcias Creek Resaca Area	32,807	109 1/	99.7
2	Upper Garcias Creek	790	635	19.6
3	Lower Olmitos Creek	8,997	25 1/	99.7
4	Upper Olmitos Creek	143	4	97.2
	Total	42,737	773	98.2

1/ Remaining damage with project is discounted lag in recovery of sediment damage (overbank deposition).

Operators of flood plain lands say that if adequate flood protection is provided, they will restore land now idle to production of high value crops such as grain sorghum, corn, cotton and irrigated vegetables and melons. All of this land previously has been in production of cultivated crops, but is now idle because of excessive floodwater damage. It is estimated that the net increase in income from such restoration of productivity will amount to $5,612 (long-term price levels) annually. This loss from the original production has been considered a crop and pasture damage and its restoration a benefit in table 7. It is expected, also, that landowners will convert to high value crops more land that is at present uneconomical for agricultural production because of frequent flooding. This changed land use will result in an additional $9,213 in net income annually. Operators further state that if flood protection is adequate they would be able to utilize more fully some of the land presently in production of irrigated crops. This more intensive use of flood plain land will result in a further increase in net income of $5,967 annually. Consideration was given to the effect of acreage allotment restrictions in the analysis of benefits from restoration, changed land use, and more intensive use of land. The calculations exclude increases in the acreage of these crops above present restrictions.

The total average annual flood prevention benefits, as a result of structural measures are estimated to be $54,374.

The works of improvement to be installed in this watershed do not eliminate the possibility of flooding in Reaches 1 and 3 from the Rio Grande. However, with Falcon Dam presently installed and after Amistad (Diablo) dam is in operation, flooding from the Rio Grande can be expected to be infrequent. This will not constitute a sufficient hazard to prevent agricultural development of the flood plain. Allowance was made for the minor effects of Rio Grande flooding in project evaluation by using conservative estimates of yields.

COMPARISONS OF BENEFITS AND COSTS

The average annual cost of the structural measures (converted from total installation cost, plus operation and maintenance) is estimated to be

$41,353. The structural measures are expected to produce average annual benefits of $54,374, or $1.31 for each dollar of cost. In addition to the direct monetary benefits, there are other substantial values which will accrue from the project, such as an increased opportunity for recreation, improved wildlife conditions, better living conditions and an increased sense of economic security, none of which has been used for project justification.

The benefits of land treatment measures were not evaluated in monetary terms since experience has shown that these soil and water conservation measures produce benefits in excess of their costs.

ACCOMPLISHING THE PLAN

Federal assistance for carrying out the works of improvement on non-Federal land, 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 5-year period in cooperation with the Starr County Soil Conservation District, which is giving assistance in the planning and application of these measures under its going program. This assistance will be accelerated to assure application of the planned measures within the 5-year project installation period.

The governing body of the Starr County Soil Conservation District will assume aggressive leadership in getting an accelerated land treatment program underway. The landowners within the watershed will be encouraged to adopt and carry out soil and water conservation plans on their farms. District-owned equipment will be made available to the landowners in accordance with existing arrangements for equipment usage in the District. The Soil Conservation District governing body will make, or cause to be made, periodic inspections of the completed conservation measures within the watershed. The Soil Conservation Service will provide additional technical assistance to the Starr County Soil Conservation District to assist landowners and operators cooperating with the district in accelerating the preparation and application of soil, plant, and water conservation plans.

The soil and water conservation loan program of the Farmers Home Administration is available to all eligible farmers and ranchers in the area. Educational meetings will be held in cooperation with other agencies to outline the services available and eligibility requirements. Any present FHA clients will be encouraged to cooperate in the program.

The county ASC Committee will cooperate with the governing body of the Soil Conservation District by selecting and providing financial assistance for 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 in the watershed. This activity will help to get the project for watershed protection and flood prevention carried out.

Structural Measures for Flood Prevention and Agricultural Water Management

The Commissioners Court of Starr County has the right of eminent domain under applicable State laws and will obtain the necessary land, easements, and rights-of-way; will 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 and permits, for construction of the 7 floodwater retarding structures and 9.2 miles of channel improvement and appurtenant structures. Funds for the local share of the project cost including lsnd, easements, rights-of-way, and administration of contracts will be available from an existing ad valorem tax.

The easements will be dedicated jointly to the Starr County Commissioners Court and the Starr County Soil Conservation District. The Commissioners Court of Starr County will provide a court order for the necessary improvement of the low water crossings on county roads to make them passable during prolonged release flows from the structures, or granting permission to inundate road crossings where equal alternate routes are designated for use during periods of inundation.

The 6 floodwater retarding structures (Sites 1 through 6) and 5.3 miles of channel improvement on Garcias Creek, constitute a single construction unit, and all land, easements, and rights-of-way for this unit will be obtained before Public Law 566 funds are made available.

The floodwater retarding structure (Site 7) and 3.9 miles of channel improvement on Olmitos Creek constitute a single construction unit. All easements and rights-of-way for this unit will be obtained before Public Law 566 funds are made available.

The estimated schedule of obligation for the complete 5-year installation period, covering installation of both land treatment and structural measures is as follows:

Fiscal Year	Measure	P. L. 566 Funds	Other Funds	Total
		(dollars)	(dollars)	(dollars)
1st	Sites 6 and 7	263,180	9,949	273,129
	Channel Improvement (Olmitos)	73,411	17,622	91,033
	Land Treatment	5,433	238,961	244,394

Schedule of Obligation - Continued

Fiscal Year	Measure	P. L. 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
2nd	Sites 1, 2, 3, and 4	312,327	24,363	336,690
	Land Treatment	5,433	238,961	244,394
3rd	Site 5	175,836	8,637	184,473
	Channel Improvement (Garcias)	154,610	12,845	167,455
	Land Treatment	5,434	238,961	244,395
4th	Land Treatment	-	238,961	238,961
5th	Land Treatment	-	238,961	238,961
	Total	995,664	1,268,221	2,263,885

This schedule will be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desired, and in the light of appropriations and accomplishments actually made.

The structural measures will be constructed during a 3-year installation period pursuant to the following conditions:

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

2. The necessary land, easements, rights-of-way, and permits have been obtained.

3. Court orders have been obtained from the Starr County Commissioners Court granting permission to temporarily inundate the low water crossings on county roads provided alternate routes equal to the road being inundated are available for use by all people concerned during periods when these crossings are impassable due to prolonged flow from the principal spillways of the floodwater retarding structures. If equal alternate routes are not available, the court order will specify that necessary improvements will be made, at no cost to the Federal Government, to make the crossings passable during prolonged periods of release flows from the structures.

4. The contrscting agency is prepared to discharge its responsibilities.

5. Operation and maintenance agreements have been executed.

6. Public Law 566 funds are available.

Technical assistance will be provided by the Soil Conservation Service to assist in the 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.

The various features of cooperation between the 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 maintained by landowners and operators of the farms on which the measures are applied, under agreement with the Starr County Soil Conservation District. Representatives of the District will make periodic inspections of the land treatment measures to determine maintenance needs and encourage landowners and operators to perform management practices and maintenance. They will make district-owned equipment available for this purpose.

Structural Measures

The 7 floodwater retarding structures and 9.2 miles of channel improvement with appurtenant structures will be operated and maintained by the Starr County Soil Conservation District. The cost of operations and maintenance will be borne by the Starr County Commissioners Court. Funds for this purpose will come from an ad valorem tax in Starr County which is available for this use. The Starr County Commissioners Court will establish a permanent reserve fund for this purpose in the following manner and amounts: As the structural works of improvement are completed, $200 per year per floodwater retarding structure and $500 per year per mile of channel improvement will be placed in a fund for operation and maintenance. The portion of this fund not needed for current operation and maintenance will be placed in a reserve fund until the sum of $1,000 per floodwater retarding structure, and $1,000 per mile of channel improvement is established. This will amount to $16,200 when all floodwater retarding structures and channel improvement are completed. Thia reserve fund will be kept available for abnormally costly maintenance activities that may result from excessive storms or other causes. When it becomes necessary to use any of the reserve fund for maintenance expenditures, the county will take appropriate action to replenish the fund in the shortest feasible time.

All structural measures will be inspected at least annually and after each heavy rain by representatives of the Starr County Commissioners Court and Starr County Soil Conservation District. A Soil Conservation Service representative will participate in these inspections at least annually. For the floodwater retarding structures, items of inspection will include,

but not be limited to, the conditions of the principal spillway and its appurtenances, the emergency spillway, the earth fill, the vegetative cover of the earth fill and the emergency spillway, and fences and gates installed as part of the floodwater retarding structures.

For channel improvement and appurtenant structures, items of inspection will include, but not be limited to, the degree of scour, silting, and bank erosion; obstruction to flow caused by debris lodged against bridges, fences, and water gates; excessive brush and tree growth within the channel; and any repairs necessary to provide proper function of the gated outlets.

The Soil Conservation Service, through the Starr County Soil Conservation District, will participate in operation and maintenance activities only to the extent of furnishing technical assistance.

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

The cosponsoring local organizations will maintain a record of all maintenance inspections made and maintenance performed and have it available for inspection by Soil Conservation Service personnel.

The cosponsoring local organizations fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitation to bid on the construction of the structural measures.

The estimated annual operation and maintenance cost of all structural measures is $4,235, based on long-term prices. The necessary maintenance work will be accomplished either by contract, force account, or equipment owned by the cosponsoring organizations.

COST-SHARING

Public Law 566 funds will provide technical assistance in the amount of $16,300 during the 5-year installation period to accelerate the installation of land treatment measures included in the plan for watershed protection. These measures will be installed through funds other than Public Law 566 at an estimated cost of $1,194,805 (table 1). This cost includes ACPS payments based on present program criteria and technical assistance under the going district program.

The entire construction and installation services cost of the flood prevention structures, $974,019, will be borne by Public Law 566 funds. The local interests will provide the land, easements, and rights-of-way, $62,386, and administer the contracts, $4,500.

The construction and installation services costs of the structural

measures for agricultural water management, $11,875, will be shared $5,345 (45 percent) by Public Law 566 funds and $6,530 (55 percent) by other funds. The ratio of direct identifiable benefits to total benefits accruing in the area benefited by agricultural water management measures is 47.2 percent. The sharing of costs by the local sponsors was increased to 55 percent to be equivalent to that required by the Federal Government for other similar project-type programs.

The total project cost of $2,263,885 will be shared 44 percent ($995,664) by Public Law 566 funds and 56 percent ($1,268,221) by other than Public Law 566 funds.

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

This project plan conforms to all Federal laws and regulations and will have no known detrimental effects on any downstream projects which are now in existence or that might be constructed in the future.

SECTION 2

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

INVESTIGATIONS AND ANALYSES

Project Formulation

Project Objectives

Flood problems and project objectives were reviewed with representatives of the Starr County Soil Conservation District and Starr County Commissioners Court. The desired objectives of the project, as expressed by the local cosponsoring organizations, were to provide a degree of flood protection that would result in a reduction of damages of at least 80 percent, an investigation of the possibilities of nonagricultural water management in the form of municipal water supply for the several rural communities and schools in the lower part of the watershed, and sub-surface drainage, if needed, for the irrigated portion of the watershed.

Land Treatment Measures

The estimate of needed land treatment for the watershed, as shown in table 1, was developed by the Soil Conservation Service work unit at Rio Grande City. Conservation needs data were compiled from existing conservation plans within the watershed. These data were expanded to represent the conservation needs of the entire watershed and computed for each land treatment practice which contributes directly to flood prevention to be applied during the 5-year installation period. The hydraulic, hydrologic, sedimentation and economic investigations provided data as to the effects of these measures in terms of the reduction of flood damages resulting from land treatment. Although significant benefits would result from application of these needed land treatment measures, it was apparent that other flood prevention measures would be required to attain the degree of watershed protection and flood damage reduction desired by the local people.

Structural Measures

Determinations then were made of structural measures for flood prevention and agricultural water management needed to attain the project objectives that could not be accomplished by land treatment measures alone. The study and the procedures used in that determination were as follows:

1. A base map of the watershed was prepared showing watershed boundary, drainage pattern, system of roads and railroads, and other pertinent information. A stereoscopic study of 4-inch consecutive aerial photographs located all probable floodwater retarding structure sites, the limits of the flood plain, and the locations at which valley cross sections

should be surveyed for the determination of hydraulic characteristics and for flood-routing purposes. This information was placed on the watershed base map for use in field surveys. Cross sections of the flood plain were surveyed at the selected locations. Data developed from these cross sections permitted the computation of peak discharge-damage 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 all probable floodwater retarding structure sites previously located stereoscopically. Structures which did not have sufficient storage capacities were dropped from further consideration. From the remaining structure sites, a system of floodwater retarding structures was selected for further consideration and detailed survey. Structures at sites 1, 2, and 3 are in series with the structure at Site 5, also the structure at Site 4 is in series with the Site 5 structure. This series of structures is necessary because no other sites are available to give the needed degree of control and because of the very limited storage possibilities at Sites 2, 3, and 5. Plans of a floodwater retarding structure, typical of those planned for the watershed, are illustrated by figures 4 and 4A.

3. A topographic map was made of the pool, dam, and spillway areas of each of the proposed structures to determine the storage capacity of the structure, the estimated cost of the dam including spillway, the pool areas, and the area involved in the dam and spillway. The height of the dams and the size of the pools were determined by the criteria outlined in Soil Conservation Service, Washington Engineering Memorandum No. 27, and Texas State Manual Supplement 2404.2. The limits of the flood and sediment pools of the proposed floodwater retarding structures and the flood plain of the stream were drawn to scale on a copy of the base map.

   Structure data tables were developed from engineering surveys to show for each structure the drainage area, the capacity needed for floodwater detention and for sediment storage in acre-feet and in inches of runoff from the drainage area, the release rate of the principal spillway, the acres of flood plain and upland inundated by the sediment and detention pools, the volume of fill in the dams, the estimated cost of the structures, and other pertinent data (tables 2 and 3).

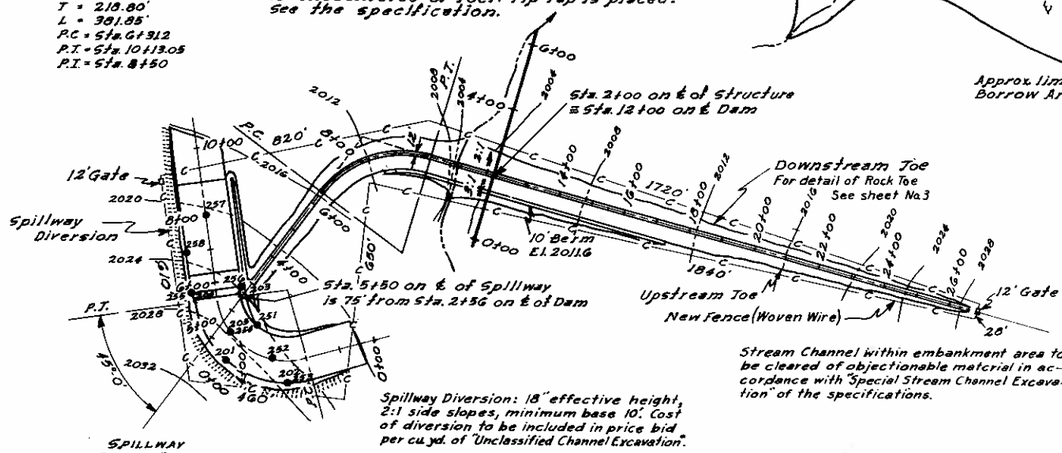
4. A detailed analysis was made of State, County, and farm roads that cross the streams below the floodwater retarding structures, and which have low-water road crossings. Where there are no equal alternate routes, determination was made of the improvements required to provide passage during periods of prolonged

C.	Clay	Clayey	Cal.	Calcareous
Si.	Silt	Silty	Vug.	Vugular
Ch.	Chalk	Chalky	Fc.	Fractured
S.	Sandy	Sandy	Fri.	Friable
Gr.	Gravel	Gravelly	Fi.	Firm
M.	Marl	Marly	V.	Very
Ls.	Limestone		So.	Soft
Flg.	Flagstone		H.	Hard
Mas.	Massive		Cob	Cobbles
Mat	Matrix			

LEGEND OF BORINGS

EMBANKMENT CURVE DATA
Δ = 69°-0'
D = 18°04.3'
R = 318.36'
T = 218.80'
L = 381.85'
P.C = Sta. 6+31.2
P.I. = Sta. 10+13.05
P.I. = Sta. 8+50

A minimum of 6" of topsoil to be placed in spillway and on all embankment, dike, spillway slopes and waste area except where rock is encountered or rock rip rap is placed. See the specification.



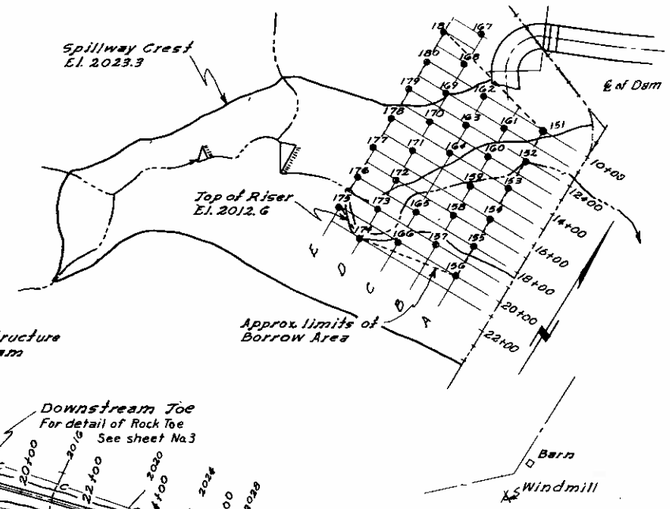
Spillway Diversion: 18" effective height, 2:1 side slopes, minimum base 10'. Cost of diversion to be included in price bid per cu. yd. of "Unclassified Channel Excavation".

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

SPILLWAY CURVE DATA
Δ = 98°0'
D = 28°0'
R = 206.68'
L = 330.0'
P.C. = Sta. 2+00
P.T. = Sta. 5+50

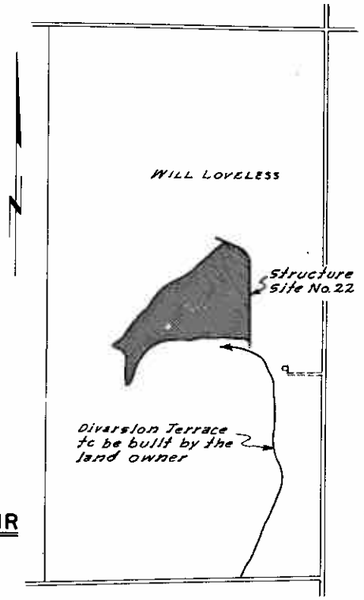
PLAN OF EMBANKMENT AND SPILLWAY

0 200 400 1000
SCALE IN FEET



GENERAL PLAN OF RESERVOIR

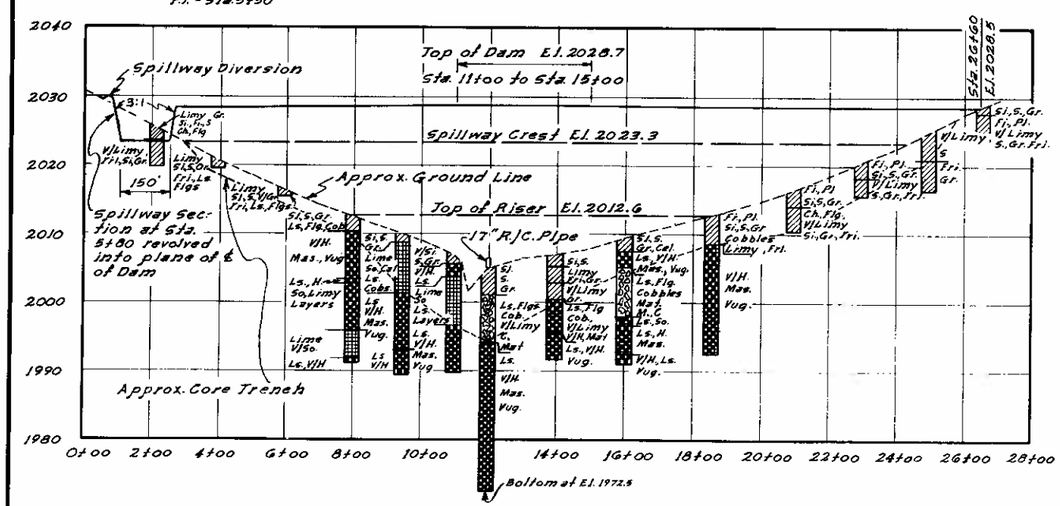
0 400 800 1600
SCALE IN FEET



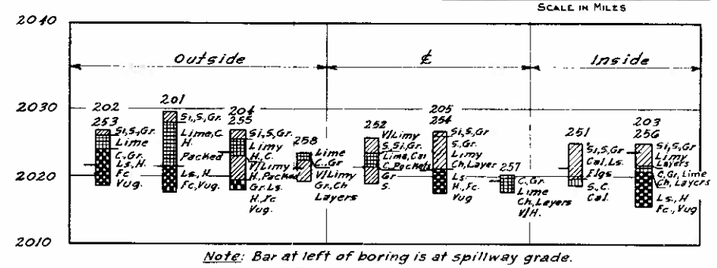
Located 5½ mi. East and 4 mi. South of Eden, Concho County, Texas

VICINITY MAP

0 ¼ ½ 1
SCALE IN MILES



PROFILE ON ℄ OF DAM



Note: Bar at left of boring is at spillway grade.

LOG OF SPILLWAY BORINGS

SEE PLAN OF EMBANKMENT AND SPILLWAY

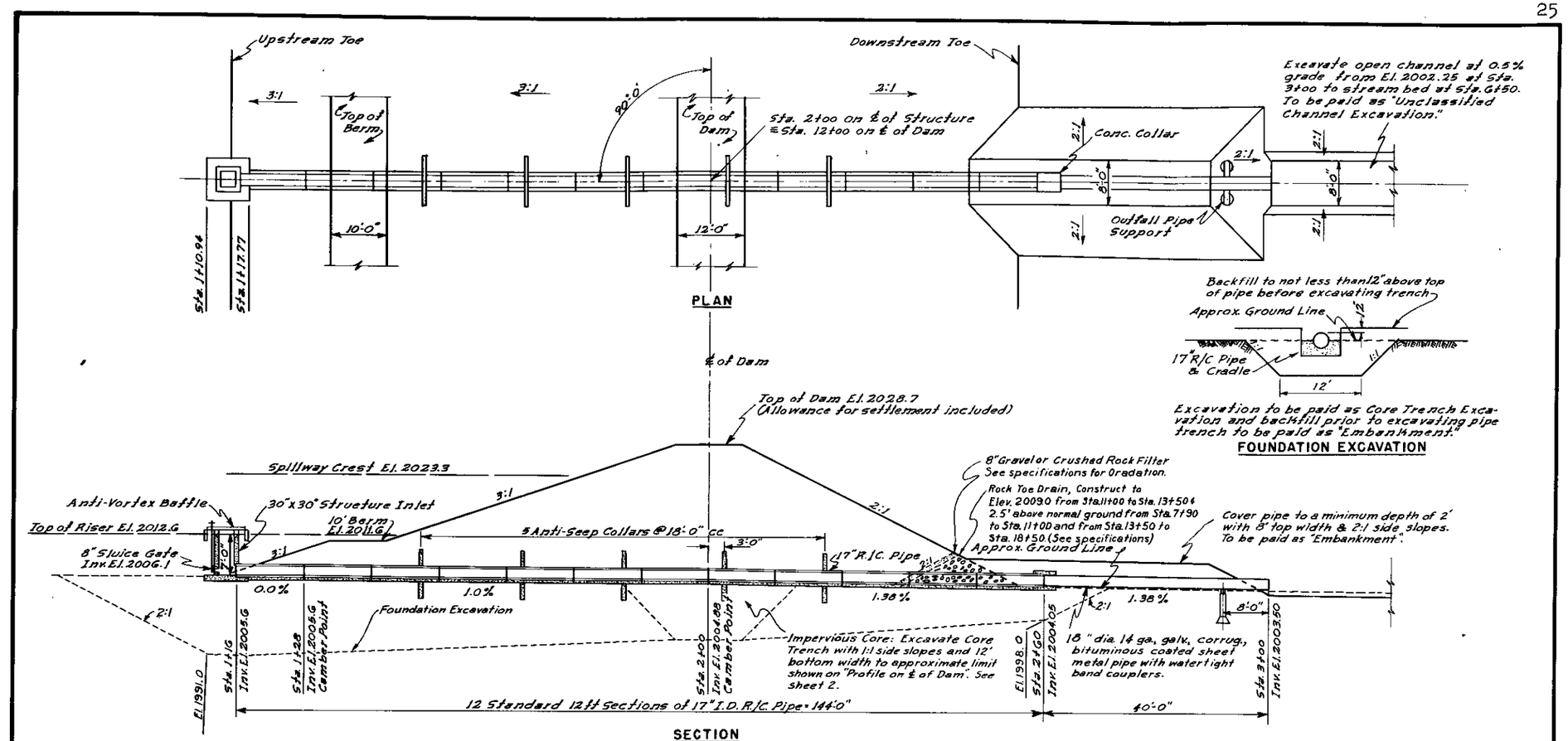
Elevation	Surface Acres	Storage Acre Ft.	Storage Inches
2012.6	16.84	51.70	0.50
2016.0	30.76	132.66	1.28
2020.0	54.21	302.60	2.92
2023.3	74.94	513.68	5.00
2024.0	79.33	569.68	5.50
2028.0	108.17	944.68	9.13

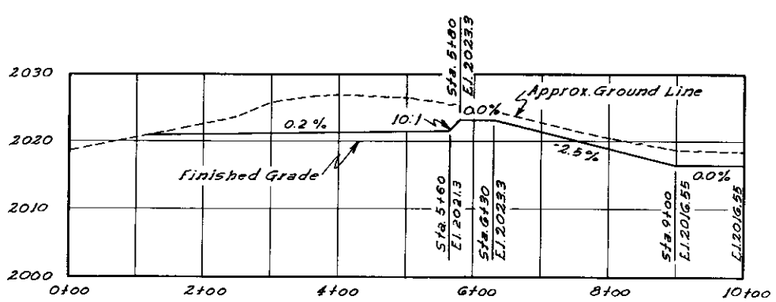
Top of Dam (Effective) Elev.	2028.5
Spillway Crest Elev.	2023.3
Top of Riser Elev.	2012.6
Sediment Pool Elev.	2012.6
Drainage Area, Acres	1242.0
Sediment Storage, Ac. Ft.	51.7
Floodwater Storage, Ac. Ft.	464.0

Figure 4
TYPICAL FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

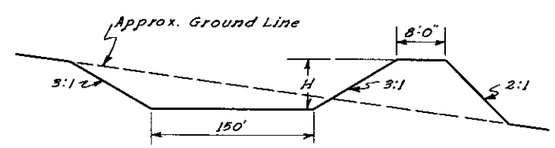
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	H.C.N.	8-56	Approved by W. M. HEAD ENGINEERING & WATERSHED PLANNING UNIT FORT WORTH, TEXAS
Drawn	H.C.N. & G.R.	8-56	STATE CONSERVATION ENGINEER S.C.S. BEAVER, TEXAS
Traced	G.R.	8-56	Sheet No. 2 of 7
Checked	H.C.N. & H.H.L.	9/56	Drawing No. 4-E-10,760





PROFILE ON ℄ OF SPILLWAY



Top of Dike, El. 2028.55 from Sta. 5+00 to Sta. 6+30 12 ft. top width with 10:1 end slope. Transition from El. 2028.55 at Sta. 6+30 to 4 ft. height at Sta. 7+00, top width 8 ft. H = 4 ft. from Sta. 7+00 to Sta. 9+00, top width 8 ft. with 10:1 end slope.

TYPICAL SPILLWAY SECTION

Figure 4A

TYPICAL FLOODWATER RETARDING STRUCTURE

PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date		
Designed	H.C.N.	8-56	Approved by	
Drawn	H.C.N. & G.R.	8-56		
Traced	G.R.	8-56		
Checked	H.C.N. & H.H.L.	9/56	Sheet No. 3 of 7	Drawing No. 4-E-10,760

floodwater release from structures.

5. Additional representative cross sections of Garcias Creek, Olmitos Creek, and the abandoned channels of the Rio Grande were selected and surveyed to aid in determining the size and cost of improving the channels to provide capacity for the release flows from all floodwater retarding structures upstream, plus the runoff from the uncontrolled areas of the watershed. The needed measures for reconstruction of existing irrigation facilities after installation of flood prevention structures were determined.

6. Investigations were made to determine the need for subsurface drainage on the irrigated land in the watershed. These investigations included soil profile studies, water table determinations, soil salinity determinations, and field hydraulic conductivity tests. Conclusions based on these studies indicate that there is no need for subsurface drainage at this time.

7. Studies made by the Commissioners Court of Starr County revealed that a more dependable and economical source of municipal water would be from the Rio Grande. At their request, the storage of water for nonagricultural purposes was dropped as a project objective.

8. Damages resulting from floodwater and sediment were determined from damage schedules, surveys of sample areas, and flood routings under present conditions. Reductions in these damages resulting from the proposed works of improvement were estimated on the basis of reduction in peak discharges as determined by flood routings under future conditions for which it was assumed that the proposed works of improvement had been installed. Benefits so determined were allocated to individual measures or groups of interrelated measures on the basis of the effects of each on reduction of damages. Further analysis indicated that, due to the restrictions that hinder Garcias Creek and Olmitos Creek from flowing into the Rio Grande, channel improvement on both creeks would be necessary to effect the desired reduction in floodwater damages.

   Such channel improvements were considered as appurtenances to the floodwater retarding structures they serve. Therefore, it was not feasible to allocate benefits to individual structures or to the channel improvement as independent measures. All floodwater retarding structures and the channel improvement necessary to serve them on Garcias Creek were considered one system of interdependent measures. The floodwater retarding structure on Olmitos Creek and necessary channel improvement were considered another system of interdependent measures. Alternate sites and groups of sites in conjunction with channel

improvement were investigated until a system of six floodwater retarding structures in combination with channel improvement was developed which would maximize net benefits while providing the desired degree of flood plain protection for Garcias Creek. The same procedure was followed for the system selected on Olmitos Creek.

When the structural measures for flood prevention and agricultural water management had been determined, a table was developed to show the cost of each type of measure. The summation of the total costs for all works of improvement represented the estimated cost of the planned watershed protection and flood prevention project (table 1). 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 6).

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 tabulated from Climatological Bulletins, Water Supply Papers, Water Bulletins of the International Boundary and Water Commission, and other sources were analyzed to determine average precipitation, the historical series to be used in the evsluation of the project, and the relationship of geology, soils and climate to runoff depth-frequency for single storm events.

2. The present hydrologic condition of the watershed was determined by the hydrologist, geologist, work unit conservationist, and soil scientists working in the area, on the basis of existing land treatment, soil groups, and crop distribution within the watershed. The future hydrologic condition was determined by obtaining from the work unit conservationist the changes in land use and treatment that could be expected with an accelerated land treatment program during the project installation period. Runoff curves were computed from the soil-cover complex data and used with Figure 3.10-1, National Engineering Handbook, Section 4, Supplement A, to determine the depth of runoff from individual storms in the historical storm series. Monthly soil moisture indices were used. Adjustments were made for transpiration and transportation losses by seasons.

3. Cross section rating curves were computed from field survey data for Reaches 2 and 4. The relationship of flood stage and area inundated was determined for these reaches.

4. In Reaches 1 and 3 (figure 1), the area flooded is not a function of peak discharge but rather a function of runoff volume. Evaluation was made by converting inches of runoff, corrected for transmission and transpiration losses by seasons, to volume and determining a volume-area inundation relationship for each runoff producing storm in the historical series.

5. Determinations were made of the area that would be inundated by each runoff-producing storm in the evaluation series under the following conditions:

   a. The present conditions of the watershed.

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

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

6. The appropriate spillway design storm pattern was selected from Figures 3.21-1 and 3.21-4, NEH Section 4, Supplement A, in accordance with criteria contained in Washington Engineering Memorandum, SCS No. 27, and Texas State Manual Supplement 2404.2

7. Spillway design storm hydrographs were developed for each of the floodwater retarding structures by the distribution graph method. The combination of emergency spillway width, depth, and elevation for the most economical structure design was obtsined by the Goodrich flood-routing method described on page 5.8-12 NEH, Section 5 and using Hydrology Memorandum EWP-4 dated March 19, 1959 for flood routing of structures in series.

8. Emergency spillway capacities were designed in accordance with Washington Engineering Memorandum No. 22; Technical Release No. 2 (Tentative) Washington Design Section, dated October 1, 1956; Supplement A to Tentative Technical Release No. 2, dated May 13, 1957; Section 3.21 of the Hydrology Guide; and Texas State Manual Supplement 2404.2.

9. Runoff computations were made, giving due consideration to antecedent moisture conditions for each runoff-producing storm that occurred during the evaluation period. The Gumbel Method after Ven Te Chow was used to develop a runoff frequency line.

The rain which produced the largest runoff during the 35 year period was a storm of 3.90 inches on August 23-24, 1944. Assuming Soil Moisture Condition II, the computed runoff from a storm of this size is 1.52 inches. The runoff frequency line developed indicated a frequency of 35 years for this storm.

From the runoff frequency line it was found that 1.33 inches represented a 25-year frequency runoff. A storm of 3.62 inches, assuming Moisture Condition II, will produce 1.33 inches of runoff. This storm would flood 1,666 acres of flood plain under present conditions. With the land treatment measures, floodwater retarding structures and channel improvement installed only 275 acres of the flood plain would be inundated.

Reaches 1 and 3 will have channel improvement located within their confines. These channels were designed to carry the release rates from the floodwater retarding structures plus the runoff from the intervening uncontrolled area.

The minimum floodwater detention volume requirements as determined in accordance with Washington Engineering Memorandum SCS No. 27, is approximately the same volume as that determined in accordance with Texas State Manual Supplement No. 2404.2 based on regional analysis of gaged runoff. This volume ranges from 1.28 inches to 1.59 inches for Class A structures, depending on the size of the drainage area. All structures in this watershed were placed in the Class A category. The detention storage volume for Site 4 exceeded the normally recommended volume so the spillway crest could be located on rock, thereby obtaining a more economical structure. Detention volumes of Sites 1, 2, 3, 5, 6, and 7 exceeded the minimum requirements in order to decrease the percent chance of use of the emergency spillway because of erodible soils in the exit channel.

The capacities of the channels throughout the watershed were such that it necessitated a low release from all structures. A release rate of five CSM was used on all structures.

Sedimentation Investigations

The field survey of the sedimentation problems of the watershed was made in accordance with methods prescribed in the "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans", Water Conservation-6, SCS, Region 4, Revised February 1954. Field studies for overbank deposits, flood plain scour, streambank erosion, and the nature of the channels and valleys were made. Physical damage was determined by areal mapping of the entire flood plain. The nature and thickness of the sediment deposits were studied and classified as to percent loss of productivity. These figures were used by the economist as the basis for calculating monetary damages.

Sediment Source Studies

The sediment derived from sheet erosion was estimated by the use of a formula shown in "Suggested Criteria for Estimating Gross Sheet Erosion

and Sediment Delivery Rates for the Blackland Prairie Problem Area in Soil Conservation", Soil Conaervation Service, Region 4, February 1953.

The sediment derived from gully and streambank erosion was estimated by field studies and the use of aerial photographs.

The total annual sediment yield above the 7 planned floodwater retarding structures was calculated to be 46.37 acre-feet, or 0.37 acre-foot per square mile of drainage area.

Effect of Watershed Treatment on Sediment Yields

Analysis of present conditions indicated that the major portion of the annual sediment production results from sheet erosion of rangeland. Areas damaged by overbank deposition should regain full productivity after installation of works of improvement.

Geologic Investigations

Reconnaissance geologic investigations were made at all of the planned floodwater retarding structure sites. These investigations included studies of the valley slopes, alluvium, channel banks, and exposed rock outcrops. Hand auger borings were made in the channel beds and representative areas of the spillway, borrow, and foundation of the dam sites. Preliminary core-drill borings were made in the foundation and borrow areas of 3 sites to determine the nature and depth of foundation material and the nature and extent of fill materials.

All planned floodwater retarding structure sites have abutments on the Goliad formation. Embankment materials are predominantly silty, sandy clays with variable amounts of gravel. Laboratory analyses of soil samples taken during the preliminary core-drill investigation of Site 3 indicate that the soluble salt content is relatively high. This will necessitate special design to insure strength and atability. Recommendations are for a 2.5:1 slope on the downstream side of the dam instead of the standard 2:1 slope, and berms on both upstream and downstream slopes. Because of the similarity of materials, Sites 1, 2, and 4 will require the same treatment as Site 3. Resulta obtained from laboratory analyses of soil samples taken from Site 5, indicate that there will be no necessity for berms on downstream slopes, or flatter than normal side slopes on embankments at Sites 5, 6, and 7. The foundations of Sites 5 and 7 are clays of the Catahoula formation with relatively high plasticity and gravelly horizons. At Site 6 permeable materials extend to a depth of approximately 45 feet and foundation drains probably will be required. Bentonitic materials, if encountered will be placed in the embankment only if laboratory teats indicate they are suitable as fill material.

Due to the close arrangement of joint and bedding planes in the highly indurated caliche conglomerate, no explosives should be necessary for spillway excavation except on Sites 4 and 7.

Before construction, detailed investigations with core drilling equipment will be made on all sites. Laboratory tests will be made to determine the stability of foundation strata and the suitability and methods of handling the materials to be used in the embankment.

Economic Investigations

Determination of Annual Benefits from Reduction in Damages

Damage schedules covering approximately 55 percent of the flood plain area of Garcias and Olmitos Creeks were obtained from landowners or operators. These schedules covered land use and crop distribution, yields and historical data on flooding and flood damages. Most of the flood damage information obtained was for floods which occurred in 1954, 1957, and 1958. Analysis of the information contained therein formed the basis for determining damage rates for various depths and seasons of flooding. In the calculation of crop and pasture damage, expenses saved, such as cost of harvesting and other production inputs, were deducted from the gross value of the damage. Information was obtained from county and state highway officials and others concerning nonagricultural damages. From this information it was determined that there were negligible nonagricultural damages in the watershed.

The proper rates of damage were applied, flood by flood, for the floods included in the evaluation period 1923 to 1957, and adjustments were made to take into account the effect of recurrent flooding where more than one flood occurred within the same cropping season.

The flood plain land use was mapped in the field and supplemental data was obtained from operators to reflect the intensive, two-crop system of truck crop production followed in the irrigated section. Estimates of normal flood-free yields were based on data obtained from schedules, supplemented by information obtained from other agricultural workers in the area.

In analyzing flood plain land use, yields, and frequency of flooding, it was found that significant variations existed with respect to location within the watershed. Therefore, the flood plain was divided into four evaluation reaches as shown in figure 1, each with its own damageable value.

Evaluation Reach No. 1 - From lower end of Garcias Creek, including resaca area, upstream to Garciasville.

Evaluation Reach No. 2 - Garcias Creek from Garciasville upstream to floodwater retarding structures 5 and 6.

Evaluation Reach No. 3 - From lower end of Olmitos Creek upstream to U. S. Highway No. 83.

Evaluation Reach No. 4 - Olmitos Creek from U. S. Highway No. 83 upstream to floodwater retarding structure 7.

The area subject to overflow above and between the floodwater retarding structures was considered in the damage evaluations. An investigation of preliminary examination scope was made to determine if damages were significant. This investigation indicated that the area subject to overflow is almost entirely brushy rangeland and that damages were not significant enough to warrant a detailed hydrologic and economic evaluation.

The monetary value of the physical damage to the flood plain from deposition of sediment was based on the value of production lost, taking into account the time lag for recovery and the cost of operations necessary to speed recovery.

Indirect damages in this watershed primarily involve losses suffered by dealers, processors, and shippers of vegetables in the area; loss of labor income by those engaged in harvesting operations; additional travel time for farmers; and costs for extra feed during and following flood periods. Upon analysis it appears that these damages are about 20 percent of the direct damage for Evaluation Reaches 1 and 3, and 10 percent for Reaches 2 and 4.

Farmers in the flood plain were asked to describe changes made in land use as a result of past flooding. Operators also were asked what changes they would make in their use of flood plain lands if flooding were reduced. Analysis of these responses indicated that benefits from restoration of lands to their former use, changed land use, and more intensive use of lands would result from the anticipated reduction in flooding. Factors considered in this analysis were the size and location of the areas affected, land capability, reduction in frequency of flooding, and similar factors. All benefits from restoration of production, changed land use, and more intensive use of land are net benefits remaining after production, harvesting, and all other allied costs were considered. Benefits from restoration of production are included as crop and pasture benefits and discounted for an expected 5-year lag in conversion. Benefits from land use change were discounted for an expected 7-year lag in conversion, and benefits from more intensive use of land were discounted for a 5-year lag in conversion. Benefits from these sources were calculated on an incremental basis as described in Chapter 4, Economics Guide, to preclude the possibility of duplication.

Consideration was given to the effect of acreage allotment restrictions in the analysis of benefits from all changed land use categories and it was determined that benefits are not dependent upon production increases in restricted crops.

Crop Distribution and Net Returns
For Those Areas on Which Restoration, Changed
Land Use, and Intensification were Claimed

Land Use and Crop Distribution	Without Project			With Project			
	Acres	Yield	Net Return	Acres	Yield	Net Return	Discounted 1/ Difference in Net Return
			(dollars)			(dollars)	(dollars)
Irrigated Cotton	380	700 Lb.Lint	16,667	380	700 Lb.Lint	16,667	-
Irrigated Cantaloupe	258	80 Crates	23,605	343	80 Crates	31,381	6,971
Irrigated Watermelon	44	10 Tons	4,185	90	10 Tons	8,560	3,866
Irrigated Tomatoes (Spring)	95	5 Tons	8,022	109	5 Tons	9,204	1,047
Irrigated Tomatoes (Fall)	116	5 Tons	8,589	129	5 Tons	9,440	769
Irrigated Onions	94	300 Sacks	15,634	107	300 Sacks	17,796	1,916
Irrigated Peppers	50	300 Bushels	7,188	67	300 Bushels	9,723	2,323
Irrigated Carrots	39	8 Tons	1,130	86	8 Tons	2,493	1,220
Irrigated Lettuce	48	350 Boxes	6,671	71	350 Box	9,865	2,852
Irrigated Beans	141	2.5 Tons	6,221	193	2.5 Tons	8,516	2,053
Irrigated Cabbage	48	10 Tons	3,670	75	10 Tons	5,733	1,849
Dryland Cotton	51	150 Lb.Lint	530	57	150 Lb.Lint	593	45
Dryland Grain Sorghum	29	12.5 CWT	394	33	12.5 CWT	447	48
Dryland Corn	29	18 Bu.	256	32	18 Bu.	282	24
Dryland Feed Crops	18	1.2 Tons	168	20	1.2 Tons	186	16
Dryland Miscellaneous Crops (Spring)	18	$40.00/Ac.	270	20	$40.00/Ac.	300	27
Dryland Miscellaneous Crops (Fall)	18	$40.00/Ac	270	20	$40.00/Ac.	300	27
Miscellaneous Land Use	114	-	-	118	-	-	-
Brush Land	203	-	-	82	-	-	-
Idle	95	-	-	18	-	-	-
Total	1,888		103,470	2,050		131,486	25,053

1/ Discounted for expected lag in conversion.

Discounted difference in net returns	$25,053
Less associated costs	4,261
Net benefits from restoration, changed land use and intensification	$20,792

Areas that will be inundated by the sediment and detention pools of floodwater retarding structures were excluded from the damage calculation. An estimate was made however, of the value of production lost in those areas after the installation of the program. In this appraisal it was considered that there would be no production in the sediment pools. The land covered by the detention pools was assumed to be converted to grassland under project conditions.

The cost of land, easements, and rights-of-way for the 7 floodwater retarding structures and channel improvement were determined by individual appraisal in conjunction with representatives of the cosponsoring organizations. Floodwater retarding structure site costs were based on appraisals of the value of the easements with consideration of the values that will remain after the land is devoted to project purposes. The average annual net loss in production, based on long-term prices, within the sites and land needed for channel improvement was calculated and this value compared with the amortized cost of the structure sites and rights-of-way for channel improvement. The larger amount was used in the economic evaluation of the program to assure a conservative appraisal.

Details of Methodology

Details of the procedures used in the investigations are described in the Soil Conservation Service, Economic Guide for Watershed Protection and Flood Prevention, December 1958.

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

Olmitos and Garcias Creeks Watershed - Texas
Price Base: 1959

Structure Number	Installation Cost - Public Law 566 Funds: Construction: Engineer's Estimate (dollars)	Construction: Contingencies (dollars)	Installation Services: Engineering (dollars)	Installation Services: Other (dollars)	Total Public Law 566 (dollars)	Installation Cost - Other Funds: Construction: Engineer's Estimate (dollars)	Construction: Contingencies (dollars)	Installation Services (dollars)	Adm. of Contracts (dollars)	Easements and R/W (dollars)	Total Other (dollars)	Total Installation Cost (dollars)
1	17,548	1,755	3,861	1,777	24,941	-	-	-	500	4,800	5,300	30,241
2	81,531	8,153	17,937	8,255	115,876	-	-	-	500	6,575	7,075	122,951
3	37,162	3,716	8,175	3,762	52,815	-	-	-	500	4,988	5,488	58,303
4	83,516	8,351	18,373	8,455	118,695	-	-	-	500	6,000	6,500	125,195
5	123,720	12,372	27,218	12,526	175,836	-	-	-	500	8,137	8,637	184,473
6	74,208	7,421	16,326	7,513	105,468	-	-	-	500	3,962	4,462	109,930
7	110,967	11,097	24,413	11,235	157,712	-	-	-	500	4,987	5,487	163,199
Subtotal	528,652	52,865	116,303	53,523	751,343	-	-	-	3,500	39,449	42,949	794,292
Channel Improvement Garcias Creek	108,786	10,878	23,932	11,014	154,610	-	-	-	500	12,345	12,845	167,455
Channel Improvement Olmitos Creek	47,892	4,789	10,536	4,849	68,066	-	-	-	500	10,592	11,092	79,158
Concrete Siphons and Culverts 1/ Olmitos Channel	3,760	376	828	381	5,345	4,595	459	1,476	-	-	6,530	11,875
Subtotal	160,438	16,043	35,296	16,244	228,021	4,595	459	1,476	1,000	22,937	30,467	258,488
GRAND TOTAL	689,090	68,908	151,599	69,767	979,364	4,595	459	1,476	4,500	62,386	73,416	1,052,780

1/ Includes 3 concrete siphons (102, 103, and 105), and one concrete culvert (104) for the purpose of passing existing irrigation ditches under or over improved channel.

August 1959

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES

Olmitos and Garcias Creeks Watershed, Texas

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	Total
Drainage Area	Sq.Mi.	11.54	1/20.25	1/10.05	16.30	1/41.34	13.19	23.05	135.72
Storage Capacity									
Sediment Pool	Ac.Ft.	200	200	200	200	200	200	200	1,400
Sediment Reserve Below Riser	Ac.Ft.	46	135	0	52	506	74	156	969
Sediment in Detention Pool	Ac.Ft.	37	43	25	[illegible]	88	35	49	312
Floodwater Detention	Ac.Ft.	856	2,160	831	2,0[illegible]9	4,982	2,033	4,598	17,529
Total	Ac.Ft.	1,139	2,538	1,056	2,356	5,776	2,342	5,003	20,210
Surface Area									
Sediment Pool (Top of Riser)	Acre	83	118	80	68	103	48	51	501
Floodwater Detention Pool	Acre	277	380	195	272	380	165	314	1,983
Volume of Fill	Cu.Yd.	43,870	177,430	71,920	208,790	309,300	185,520	249,730	1,246,160
Elevation Top of Dam	Foot	417.3	394.4	370.0	327.0	209.6	208.2	199.7	xxx
Maximum Height of Dam	Foot	18	22	18	28	44	38	42	xxx
Emergency Spillway									
Crest Elevation	Foot	412.5	389.8	365.0	322.0	204.9	203.5	194.8	xxx
Bottom Width	Foot	180	400	300	240	500	180	200	xxx
Type	-	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 2/	-	3.9	2.0	2.8	2.0	1.7	1.4	1.0	xxx
Average Curve Number Condition II	-	72	71	71	75	74	75	74	xxx
Emergency Spillway Hydrograph									
Storm Rainfall (6 Hr.) 4/	Inch	4.65	6/ 4.26	7/4.13	4.52	4.13	4.60	4.39	xxx
Storm Runoff	Inch	1.93	1.59	1.49	2.06	1.70	2.12	1.89	xxx
Velocity of Flow (Vt) 3/	Ft./Sec.	3.8	0	0	0	0	0	0	xxx
Discharge Rate 3/	c.f.s.	300	0	0	0	0	0	0	xxx
Maximum Water Surface Elevation 3/	Foot	413.4	xxx	xxx	xxx	xxx	xxx	xxx	xxx
Freeboard Hydrograph									
Storm Rainfall (6Hr.) 5/	Inch	9.30	6/ 8.51	7/8.25	9.04	8.25	9.20	8.78	xxx
Storm Runoff	Inch	5.85	5.10	4.79	5.98	5.15	6.13	5.63	xxx
Velocity of Flow (Vc) 3/	Ft./Sec.	8.3	8.0	8.5	8.8	8.6	8.3	6.0	xxx
Discharge Rate 3/	c.f.s.	3,200	6,400	5,700	5,000	10,300	3,200	1,500	xxx
Maximum Water Surface Elevation 3/	Foot	416.3	393.4	369.0	326.0	208.7	207.2	196.9	xxx
Principal Spillway									
Capacity Low Stage	c.f.s.	58	159	209	82	498	66	115	xxx
Capacity Equivalents									
Sediment Volume	Inch	0.46	0.35	0.42	0.33	0.36	0.44	0.33	xxx
Detention Volume	Inch	1.39	2.00	1.55	2.38	2.26	2.89	3.74	xxx
Spillway Storage	Inch	3.05	1.97	2.36	1.87	0.93	1.22	1.48	xxx
Class of Structure	-	A	A	A	A	A	A	A	xxx

1/ Exclusive of any area above other structures.
2/ Based on regional analysis of gaged runoff.
3/ Maximum during passage of hydrograph.
4/ For Class A structures 0.5 X P of the 6-hour rainfall shown by Figure 3.21-1, NEH-4, Supplement A.
5/ For Class A structures 1.0 X P of the 6-hour rainfall shown by Figure 3.21-1, NEH-4, Supplement A.
6/ Rainfall adjusted for combined drainage area of Sites 1 and 2.
7/ Rainfall adjusted for combined drainage area of Sites 1, 2, and 3.

TABLE 3A - STRUCTURE DATA

STRUCTURES

Olmitos and Garcias Creeks Watershed, Texas

	Structure Number and Location					
	101 Garcias Creek 2/	102 Olmitos Creek 3/	103 Olmitos Creek 3/	104 Olmitos Creek 3/	105 Olmitos Creek 3/	106 Olmitos Creek 2/
Location (Station)	1449+00	713+00	748+00	842+50	865+00	886+00
Uncontrolled Drainage Area	4,420	-	-	3,256	-	3,256
Type	Concrete Culvert With Flood Gate	Concrete Invert Siphon	Concrete Invert Siphon	Concrete Culvert	Concrete Invert Siphon	Concrete Culvert With Flood Gate
Size	(2) 7'x7'	18"	18"	10'x6'	18"	(2) 5'x5'
Length	44'	40'	40'	104'	50'	80'
Head	2'	-	-	1.4'	-	1.8'
Coefficient of Discharge	0.80	-	-	0.75	-	0.76
Required Capacity c.f.s. 1/	850	-	-	413	-	413
Design Capacity c.f.s.	886	-	-	426	-	413

1/ Includes release flow from floodwater retarding structures where applicable.

2/ Concrete culvert with flood gate to protect works of improvement from flood flows of the Rio Grande.

3/ Structure for modification of existing irrigation facilities.

August 1959

TABLE 3B - STRUCTURE DATA

STREAM CHANNEL IMPROVEMENT

Olmitos and Garcias Creek Watershed, Texas

Channel Designation	Station Numbering For Reach: Station (100 ft.)	Station Numbering For Reach: Station (100 ft.)	Watershed Area 1/ (acres)	Required Channel Capacity 2/ (c.f.s.)	Planned Channel Capacity (c.f.s.)	Bottom Width (foot)	Side Slope (H:V)	Depth (foot)	Fall (ft./ft.)	Velocity at Design Depth (ft./Sec)	Volume Excavation (1000 cu.yd.)
La Casita Resaca (Garcias Creek)	1220+00	1291+00	120	22	22	4	2:1	2.2	.00070	1.20	9
	1291+00	1325+60	3,382	260	263	10	2:1	5.8	.00060	2.10	20
Garcias Creek	1325+60	1449+00	6,184	829	870	24	1.5:1	9.0	.00025	2.58	320
	1449+00	1499+05	6,390	854	890	42	1.5:1	7.0	.00025	2.43	126
Margo Tributary (Olmitos Creek)	700+00	713+00	812	55	76	4	2:1	4.0	.00053	1.90	5
Olmitos Creek	698+00	713+00	1,347	252	262	10	2:1	4.0	.00270	3.64	6
	713+00	768+00	2,482	346	346	12	1.5:1	6.0	.00053	2.76	23
	768+00	891+00	3,256	413	409	15	1.5:1	6.0	.00053	2.84	144

1/ Uncontrolled drainage area.

2/ Includes release from floodwater detention structures.

August 1959

TABLE 4 - SUMMARY OF PHYSICAL DATA

Olmitos and Garcias Creeks Watershed, Texas

Item	Unit	Quantity Without Project	Quantity With Project
Watershed Area	Sq.Mi.	156	xxx
Watershed Area	Acre	99,840	xxx
Area of Cropland	Acre	7,298	7,340
Area of Grassland	Acre	89,856	89,241
Area of Miscellaneous Use	Acre	2,686	3,259
Overflow Area Subject to Damage	Acre	1/ 1,666	1/ 275
Area Damaged Annually by:			
Sediment	Acre	2/ 166	3/ 16
Streambank Erosion	Acre	1.31	1.31
Annual Rate of Erosion			
Sheet	Ac.Ft.	138.94	121.63
Gully	Ac.Ft.	2.11	1.77
Streambank	Ac.Ft.	2.85	2.85
Average Annual Rainfall	Inch	17.5	xxx

1/ Area inundated from the runoff of a 25-year frequency storm.

2/ Acres on which some production loss is occurring each year.

3/ The area on which production loss will occur each year after all recovery has taken place; and equilibrium has been reached. This applies to all flooding up to the area inundated by the storm as listed in 1/.

August 1959

TABLE 5 - SUMMARY OF PLAN DATA

Olmitos and Garcias Creeks Watershed, Texas

Item	Unit	Quantity
Years to Complete Project	Year	5
Total Installation Cost		
Public Law 566 Funds	Dollar	995,664
Other	Dollar	1,268,221
Annual O & M Cost		
Public Law 566 Funds	Dollar	0
Other	Dollar	4,235
Average Annual Monetary Benefits 1/	Dollar	54,374
Agricultural	Percent	100.0 2/
Nonagricultural	Percent	0.0
Structural Measures		
Floodwater Retarding Structures	Each	7
Channel Improvement and Appurtenant Structures	Mile	9.2
Area Inundated by Structures		
Flood Plain		
Sediment Pool	Acre	0
Detention Pool	Acre	0
Upland		
Sediment Pool	Acre	561
Detention Pool	Acre	1,422
Watershed Area Above Structures	Acre	86,860
Reduction of Floodwater Damages	Dollar	33,505
By Land Treatment Measures		
Watershed Protection	Percent	6.0
By Structural Measures	Percent	92.3
Reduction of Sediment Damage	Dollar	1,486
By Land Treatment Measures		
Watershed Protection	Percent	16.6
By Structural Measures	Percent	75.9
Flood Prevention Benefits From Changed Land Use	Dollar	9,213
Flood Prevention Benefits From More Intensive Use of Land	Dollar	5,967

1/ From Structural Measures.
2/ Secondary benefits not included.

August 1959

TABLE 6 - ANNUAL COST

Olmitos and Garcias Creeks Watershed, Texas

Measures	Amortization of Installation Cost 1/	Operation and Maintenance Costs 2/			Total
		Public Law 566	Other	Total	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Floodwater Retarding Structures 1 through 6 in combination with Channel Improvement	28,155	0	2,885	2,885	31,040
Subtotal	28,155	0	2,885	2,885	31,040
Floodwater Retarding Structure No. 7 in combination with Channel Improvement	8,963	0	1,350	1,350	10,313
Subtotal	8,963	0	1,350	1,350	10,313
TOTAL	37,118	0	4,235	4,235	41,353

1/ Price Base: 1959 prices amortized for 50 years at 2.5 percent.

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

August 1959

TABLE 7 - MONETARY BENEFITS FROM STRUCTURAL MEASURES

Olmitos and Garcias Creeks Watershed, Texas
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	33,585	31,592	515	31,077
Other Agricultural	493	441	58	383
Subtotal	34,078	32,033	573	31,460
Sediment Damage				
Overbank Deposition	1,606	1,339	120	1,219
Subtotal	1,606	1,339	120	1,219
Indirect Damage	7,053	6,595	80	6,515
Total, All Damage	42,737	39,967	773	39,194
Changed Land Use to Crop Production	xxx	xxx	xxx	9,213
More Intensive Use of Land	xxx	xxx	xxx	5,967
TOTAL PRIMARY BENEFITS	xxx	xxx	xxx	54,374
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	54,374

1/ As projected by ARS, September 1957.

August 1959

TABLE 8 - BENEFIT COST ANALYSIS

Olmitos and Garcias Creeks Watershed, Texas

Measures	AVERAGE ANNUAL BENEFITS 1/						Average Annual Cost 2/	Benefit-Cost Ratio
	Floodwater	Sediment	Indirect	Changed Land Use	More Intensive Use of Land	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
STRUCTURAL MEASURES FOR FLOOD PREVENTION AND AGRICULTURAL WATER MANAGEMENT								
Floodwater Retarding Structures 1 through 6 in combination with Channel Improvement 3/	24,725	827	5,100	9,213	2,542	42,407	31,040	1.4:1
Floodwater Retarding Structure No. 7 in combination with Channel Improvement 4/	6,735	392	1,415	-	3,425	11,967	10,313	1.2:1
GRAND TOTAL	31,460	1,219	6,515	9,213	5,967	54,374	41,353	1.3:1

1/ Price Base: Long-term prices as projected by ARS, September 1957.
2/ Derived from installation costs based on 1959 price level and operations and maintenance cost based on long-term price levels, as projected by ARS, September 1957.
3/ All floodwater retarding structures and channel improvement on Garcias Creek are interdependent.
4/ Floodwater retarding structure and channel improvement on Olmitos Creek are interdependent.

August 1959

TABLE 8A - BENEFITS AND COSTS BY CONSTRUCTION UNITS

Olmitos and Garcias Creeks Watershed, Texas

Construction Unit and Structures	Annual Benefits 1/	Annual Costs 2/
	(dollars)	(dollars)
Construction Unit No. 1 Floodwater Retarding Structures 1 through 6 and Channel Improvement Garcias Creek	42,407	31,040
Construction Unit No. 2 Floodwater Retarding Structures No. 7 and Channel Improvement Olmitos Creek	11,967	10,313

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

2/ Derived from installation costs based on 1959 price levels and operations and maintenance cost based on long-term prices, as projected by ARS, September 1957.

August 1959

TABLE 9 - ALLOCATION OF INSTALLATION COSTS OF STRUCTURAL MEASURES

Olmitos and Garcias Creeks Watershed, Texas
Price Base: 1959

Item	PURPOSE: Flood Prevention (dollars)	PURPOSE: Agricultural Water Management (dollars)	Total (dollars)
STEP A			
Single Purpose Sites 1 through 7	794,292	-	794,292
Channel Improvement (Garcias Creek)	167,455	-	167,455
Channel Improvement (Olmitos Creek)	79,158	-	79,158
Concrete Culvert and Siphons (Olmitos Creek)	-	11,875	11,875
Total	1,040,905	11,875	1,052,780
STEP B			
Public Law 566	974,019	5,345	979,364
Other	66,886	6,530	73,416
Total	1,040,905	11,875	1,052,780

August 1959