PRELIMINARY DRAFT

OF

WATERSHED WORK PLAN

FOR

WATERSHED PROTECTION AND FLOOD PREVENTION

SECO CREEK WATERSHED

Medina, Bandera, and Uvalde Counties, Texas

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

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With Assistance By:

U.S. Department of Agriculture
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March 1970

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SUMMARY OF PLAN

The work plan for watershed protection and flood prevention for Seco Creek watershed has been prepared by the Medina Valley Soil and Water Conservation District, Nueces-Frio-Sabinal Soil and Water Conservation District, Medina County Commissioners Court, Bandera County Commissioners Court, Uvalde County Commissioners Court, and the Edwards Underground Water District as sponsoring local organizations. Technical assistance has been provided by the Soil Conservation Service, United States Department of Agriculture. The Bureau of Sport Fisheries and Wildlife, United States Department of the Interior, in cooperation with the Texas Parks and Wildlife Department, made a reconnaissance study of the fish and wildlife resources of the watershed.

Financial assistance in developing the work plan was provided by the Texas State Soil and Water Conservation Board and the Edwards Underground Water District.

Seco Creek watershed comprises an area of 268 square miles in Bandera, Medina, and Uvalde Counties. It is estimated that 86.0 percent of the watershed is rangeland, 7.3 percent is cropland, 2.2 percent is pasture and hayland, 2.7 percent is wildlife-recreation land, and 1.8 percent is in miscellaneous uses such as the town of D'Hanis, public roads, railroads, farm and ranch headquarters, and stream channels. There is no Federal land in the watershed.

The principal problem within the watershed is one of frequent and extensive flooding on portions of the 17,098 acres of flood plain which results in damages to crops, grasses, soils, agricultural properties, residential and commercial properties, roads, bridges, and railroad properties. The total floodwater, sediment, erosion, and indirect damages are estimated to average $222,688 annually.

The work plan proposes installing, in a ten-year period, needed land treatment measures and nine floodwater retarding structures. Land treatment measures included are those which contribute directly to watershed protection and reduction of floodwater damages.

The total project installation cost is estimated to be $ including $ for installation of planned land treatment and $ for structural measures. The share of total project installation cost from sources other than Public Law 566 funds is estimated to be $ and the Public Law 566 share is estimated to be $. The Public Law 566 cost share for structural measures is estimated to be $ and the local share is estimated to be $

Average annual damages will be reduced from $222,688 to $30,611 by the proposed project. Average annual benefits accruing to structural measures in the watershed will be $303,055, which includes $179,463 damage reduction benefits, $91,200 incidental ground water recharge benefits, $7,624 re-development benefits, and $24,768 secondary benefits. The ratio of total average annual benefits accruing to structural measures ($303,055) to the average annual cost of these measures ($157,956) is 1.9:1.0.

Land treatment measures will be operated and maintained by owners and operators of the land upon which the measures will be applied under agreement with the Medina Valley Soil and Water Conservation District and the Nueces-Frio-Sabinal Soil and Water Conservation District. The Commissioners Court will be responsible for operation and maintenance of the floodwater retarding structures. The cost of operation and maintenance for floodwater retarding structures is estimated to be $2,300 annually.

DESCRIPTION OF WATERSHED

Physical Data

The Seco Creek watershed lies in southwestern Texas about 50 miles west of San Antonio. Rising in southwestern Bandera County about 11 miles northwest of the community of Tarpley, Seco Creek flows south and southeast draining the northeastern corner of Uvalde County and a large portion of western Medina County. Seco Creek enters Hondo Creek in northern Frio County, about seven miles south of Medina County's southern boundary. Hondo Creek is a tributary of the Frio River which, in turn, is a tributary of the Nueces River: The Nueces River flows through Lake Corpus Christi and into Nueces Bay near Corpus Christi.

The lower limit of the watershed, as included in this work plan, is the Medina-Frio County boundary. The drainage area of Squirrel Creek is not included in the project area. The drainage area of the watershed is 268 square miles (171,520 acres). The watershed is 47 miles long and ranges from two to ten miles wide. The principal tributaries are Little Seco, Bartz Spring, Rocky, and Parker Creeks. The town of D'Hanis lies between Seco and Parker Creeks in the south-central portion of the watershed (figure 1) and is flooded by overflows from both streams.

The Balcones fault zone, a system of northeastward trending normal faults with upthrown sides generally on the northwest, crosses the watershed separating two major land resource areas. The Edwards Plateau Land Resource Area, underlain by Lower Cretaceous limestone, clay, and shale, occupies the upper 58 percent of the watershed. It is characterized by rolling to nearly mountainous topography and relatively shallow soils.

The Rio Grande Plain Land Resource Area lies mostly within and to the south of the fault zone and comprises 42 percent of the watershed. Its topography ranges from nearly level on the flood plain and stream terraces to rolling on the divides. Much of the bedrock is covered by thick alluvium dervied from the Edwards Plateau. The older alluvial deposits (Uvalde Gravel) have been dissected by erosion and presently occupy topographically high areas. Alluvium of the younger Leona Formation lies at lower elevations and has been only slightly altered by erosion. Seco Creek has cut a relatively narrow, deep channel into the alluvium of the Leona Formation downstream from D'Hanis.

Watershed elevations range from about 2,200 feet above mean sea level along the northern divide in the Edwards Plateau to about 630 feet in the Seco Creek channel at the southern end of the watershed.

Geologic strata exposed in the watershed range in age from Recent to Lower Cretaceous (figure __). The following tabulation lists the rock units which crop out within the watershed and the approximate area of each outcrop.

System	Series	Group	Formation	Lithology of Outcrop	Approximate Thickness in Watershed Vicinity (Ft.)	Approximate Area of Out-Crop Within Watershed (Ac.)
Quaternary	Recent		Alluvium	Clay, silt, sand, and gravel	0-20	37,730
	Pleistocene		Leona	Clay, silt, sand, gravel, and cobbles	0-60	
Tertiary	Pliocene		Uvalde Gravel	Gravel, cobbles, silt, clay, sand, and caliche	0-30	5,100
	Eocene	Wilcox	Indio	Poorly cemented, thin bedded, clayey sandstone, sandy shale, and siltstone	700+	5,160
	Paleocene	Midway	Kincaid	Sandy limestone and sandy clay	80+	5,150
Cretaceous	Gulf (Upper Cretaceous)	Navarro	Escondido	Shale, clayey sandstone, siltstone, and thin beds of limestone	500	10,290
			Corsicana Marl	Silty, sandy, calcarous clay	40	1,740
		Taylor	Anacacho Limestone	Limestone and calcareous clay	500	3,430
		Austin	Austin Chalk	Thin bedded to massive, chalky limestone and calcareous shale	250	12,000
		Eagle Ford	Eagle Ford	Interbedded flaggy limestone and calcareous shale	30	3,420
	Comanche (Lower Cretaceous)	Washita	Buda Limestone	Hard, massive limestone	60	5,170
			Grayson	Calcareous, shaley clay containing thin fossiliferous limestone beds and interspersed gypsum	50	1,700
			Georgetown Limestone	Hard, massive, vugular limestone	50	3,440
		Fredericksburg	Edwards Limestone	Hard, massive, vugular limestone containing flint beds, lenses, and nodules	500	32,590
			Comanche Peak Limestone	Sandy, clayey, nodular limestone	40	1,720
			Walnut Clay	Sandy, calcareous clay and limestone	5	300
		Trinity	Glen Rose Limestone	Soft, calcareous clay and shale alternating with beds of hard limestone	1,000	42,580

The harder, more pure limestone beds have undergone considerable solution, especially within the Georgetown and Edwards Formations. In the Balcones fault zone, where the limestone beds are highly fractured, a large system of interconnected cavities and caverns exists. The pattern of the system tends to be most pronounced along and parallel to the faults and fractures. Similar conditions occur along the entire Balcones fault zone, which can be traced more than 200 miles from west of Uvalde eastward to San Antonio and thence northeastward to the vicinity of Waco. A vast ground water reservoir lies beneath the surface in most of the fault zone. This reservoir is most pronounced in Kinney, Uvalde, Medina, Bexar, Comal, and Hays Counties where it is known as the Edwards Underground Reservoir. In the Seco Creek watershed this limestone reservoir is composed primarily of the Edwards Formation. Southward flowing streams which cross the fault zone, losing most of their flow, are the primary source of recharge to the aquifer.

Rains of low to moderate intensity, falling on the Seco Creek watershed above D'Hanis, mostly disappear into the porous rocks in the fault zone and contribute only meager volumes of direct runoff to the Rio Grande Plain. High intensity rains, however, produce flood flows which greatly exceed the infiltration capacity of the fault zone resulting in heavy flooding downstream.

The Leona Formation, consisting of stream terrace deposits in the valley of Seco Creek, is another important aquifer. It consists mostly of beds and lenses of gravel, sand, silt, and clay ranging up to greater than 40 feet in thickness. Downstream from D'Hanis, a small spring flows from the Leona Formation where Seco Creek has cut below the water table.

The water supply for D'Hanis is obtained from wells in the Leona Formation. Water for livestock and rural domestic use is supplied by wells in the Edwards, Leona, Glen Rose, Escondido, and Indio Formations. In the Seco Creek valley, south of D'Hanis, small supplies of water for irrigation are pumped from gravel beds of the Leona Formation.

The soils of most of the watershed are calcareous. Permeabilities range from very slow to moderately rapid. The major portion of the watershed soils are slowly to moderately permeable. Edwards Plateau soils are mostly shallow to very shallow, and consist mostly of gravelly clay, stony clay, and gravelly loam. The Rio Grande Plain soils range from very shallow to deep. Surface textures include clay, clay loam, silty clay loam, gravelly clay, loam, fine sandy loam, and gravelly loam. The predominant soil series are montell, Uvalde, Knippa, Blanco, Kimbrough, Quemado, Frio, Webb, and Duval in the Rio Grande Plain and Tarpley, Tarrant, Brackett, Valera, and Kavett in the Edwards Plateau.

The climate is semi-arid. Summers are hot, and winters are generally mild but subject to rapid temperature changes with the passage of cold fronts. The average annual precipitation is about 29 inches. Rainfall is fairly well distributed throughout the year, but the heaviest usually occurs in May, June, and September. Temperatures in the middle and lower reaches of the watershed range from a mean maximum of 96 degrees Fahrenheit in July to a mean minimum of 42 degrees in January. The normal growing season, extending from March 6 through November 24, is 263 days. Temperatures are cooler and the growing season about 28 days shorter in the northern part of the watershed.

Land use within the watershed is shown in the following tabulation.

Land Use	Acres	Percent
Cropland	12,590	7.3
Pasture and Hayland	3,876	2.2
Rangeland	147,456	86.0
Wildlife-Recreation Land	4,562	2.7
Miscellaneous 1/	3,036	1.8
Total	171,520	100.0

1/ Includes roads, highways, railroad rights-of-way, urban areas, farmsteads, stream channels, etc.

Hydrologic cover conditions on grassland range from poor to good. An estimated 55 percent is in fair hydrologic condition, 25 percent is in good condition, and 20 percent is in poor condition. Range sites within the watershed include Clay Flat, Clay Loam, Loamy Bottomland, High Lime, Gravelly Ridge, Shallow Ridge, Sandy Loam, Low Stony Hills, Shallow, and Steep Rocky. When these sites are in excellent condition, the dominant grasses include cane bluestem, plains bristlegrass, plains lovegrass, sideoats grama, lovegrass tridens, Arizona cottontop, vine-mesquite, trichloris, pink pappusgrass, curlymesquite, fall witchgrass, Texas bristlegrass, buffalograss, slim tridens, and perennial threeawns. Woody plants make up a small percentage of climax vegetation on several range sites. Some examples are guajillo on the Gravelly Ridge site; large elm, oak, and pecan on the Loamy Bottomland site; kidneywood and guajillo on the Shallow Ridge site; live oak on the Low Stony Hills site; and oaks and ash juniper on the Steep Rocky site.

Overgrazing has caused invasion of such plants as red grama, hairy tridens, Halls panic, threeawns, mesquite, whitebrush, cacti, catclaw, coyotillo, blackbrush, ash juniper, mescalbean, and oak.

Economic Data

The agricultural economy of the watershed is dependent on the production and sale of cash crops and livestock. The most important crops produced for direct dale are grain sorghum and small grains. The remaining agricultural land is used primarily for the grazing of cattle, sheep, goats, and wildlife. The sale of livestock and livestock products accounted for approximately 58 percent of the total agricultural income in the watershed in 1968.

There are approximately 160 farms and ranches, wholly or partially within the watershed, averaging 1,075 acres in size. About 54 percent are smaller than 600 acres. About 20 percent of the farms and ranches in the watershed, gross less than $2,500 annually from agricultural sales. Approximately 40 percent of the farm and ranch operators worked off-the-farm for 100 days or more in 1969.

It is estimated that less than 10 percent of the agricultural land in the benefited area is devoted to farms and ranches using 1-1/2 man-years or more of hired labor.

The average value of land and buildings per farm in Medina County, which is typical of the watershed, is estimated at about $67,300 (based on 1964 agricultural census data). The estimated current market price of land ranges from $100 to $400 per acre. The range in land prices depends primarily on location, accessibility, and productive capability. Agricultural land is largely owner-operated with about 10 percent being leased or rented.

The town of D'Hanis, located in the center of the watershed, has an estimated population of 506. It is unincorporated. The economy of the watershed is influenced by the production of brick and tile in D'Hanis.

The cities of Hondo and San Antonio, located 9 miles east and 49 miles east of D'Hanis, respectively, offer excellent employment opportunities for residents of the watershed. There is a need for additional employment opportunities within the watershed area.

The watershed is served adequately by U.S. Highway 90 and Farm Roads 470, 1796, and 2200. There are also numerous county roads which provide access to all parts of the watershed. However, there are several low water crossings which are frequently impassable.

Land Treatment Data

Farmers and ranchers operating 87 percent of the agricultural land in the Seco Creek watershed are practicing soil and water conservation in cooperation with the Medina Valley, the Bandera, and the Nueces-Frio-Sabinal Soil and Water Conservation Districts. The Soil Conservation Service work units at Hondo, Uvalde, and Bandera are assisting the districts in preparing and applying soil and water conservation plans.

There are no critical sediment source areas and no improper use of watershed land.

There are 163 operating units wholly or partially within the watershed, of which 148 are under district agreement. There are 147 conservation plans covering 86 percent of the agricultural land. Soil surveys have been completed on 107,371 acres. It is estimated that 68 percent of the needed land treatment practices have been installed and that more than 80 percent of the watershed is adequately protected from erosion. Needed land treatment measures have been applied to date at an estimated expenditure of ____________ by landowners and operators (table 1A). The level of accomplishment for needed land treatment practices is expected to reach 90 percent in ten years as a result of the planned land treatment program.

Fish and Wildlife Resource Data

The fish and wildlife aspects of the watershed, as described by the Bureau of Sport Fisheries and Wildlife, are as follows:

> "The watershed is in the Edwards Plateau and South Texas Brushlands Game Regions. Wildlife species in the watershed include white-tailed deer, javelina, wild turkey, mourning dove, white-winged dove, bobwhite, fox squirrel, cottontail, jackrabbit, raccoon, ring-tailed cat, and armadillo.
>
> The watershed is breeding range for the Golden-cheeked warbler, which is on this Bureau's list of rare and endangered fish and wildlife of the United States. There are also a few exotic species such as black buck antelope and Axis deer. There is no significant trapping of fur animals for their pelts or carcasses, nor is there any sport hunting for them."

WATERSHED PROBLEMS

Floodwater Damages

An estimated 17,098 acres of the watershed, excluding stream channels, is flood plain. This is the area that would be inundated by a 100-year frequency flood.

Present flood plain land use is as follows: rangeland, 67 percent; cropland, 27 percent; pasture and hayland, 3 percent; and miscellaneous uses including urban areas, public roads, and railroads, 3 percent. Current trends are toward improvement of native rangeland.

Some landowners, on an individual basis, have attempted to enlarge, straighten, and levee some streams. This has resulted in very little reduction of flood damage. In 1964 the D'Hanis Lions Club, at an estimated cost of $5,000, constructed a relief channel from Seco Creek into Live Oak Creek. This was an attempt to control some of the urban flooding in D'Hanis.

The adverse economic and physical effect of flooding has been felt throughout the entire watershed and will prompt local participation in the alleviation of the flood problem.

Flooding occurs frequently in portions of the watershed causing damages to agricultural and nonagricultural properties. Major floods, inundating more than half the flood plain, occur on the average of once every 3 to 4 years. Minor floods, inundating less than half the flood plain, occur on the average of two or three times a year.

Cumulative totals of recurrent flooding show an average of 9,320 acres flooded annually during the evaluation period. Damage to flood plain lands from deposition of sediment and flood plain erosion has resulted in reductions in crop yields.

The most disastrous flood in recent years occurred on June 17, 1958. The total storm rainfall occurred over a 24-hour period and varied from approximately 12 inches in the upper portion of the watershed to 2 inches in the lower portion. Approximately 4 inches was recorded at D'Hanis.

The recurrence interval of the resulting flood peak was estimated to be between 25 years and 40 years. The resulting flood inundated approximately 14,432 acres of flood plain in the watershed, of which 300 acres are located inside the urban area of D'Hanis.

Currents of rushing water from Seco and Parker Creeks caused evacuation of about 75 families as water crept into their homes. Numerous low water crossings were closed. The Salvation Army and the American Red Cross provided food, medical care, lodging, and other necessities for vicitims of the flood. Volunteers from surrounding towns pitched in to help victims clean up and reorganize businesses and homes.

Under the present level of development, the direct monetary floodwater, sediment, and erosion damage from such a flood is estimated to be in excess of $574,000 of which over $324,000 would be to urban properties.

Other large floods that caused severe floodwater damages occurred in 1935, 1932, and 1919.

A flood resulting from a 100-year frequency event would cause direct floodwater damages in excess of $1,425,000.

For the floods expected to occur during the evaluation period, which includes floods up to the 100-year frequency, the total direct floodwater damage is estimated to average $164,617 annually at adjusted normalized prices (table 5). Of this amount, $31,045 is crop and pasture damage, $57,943 is other agricultural damage, $2,257 is road and bridge damage, and $73,372 is damage to urban and other nonagricultural development.

Indirect damages such as interruption of travel, losses sustained by businesses, evacuation of premises when floods threaten, and similar losses are estimated to average $34,251 annually.

Sediment Damage

The estimated average annual sediment production rate is 0.68 tons per acre. This amounts to an average annual sediment yield of 65 acre-feet at the lower limit of the watershed. The estimated suspended sediment concentration at the lower end of the watershed is 9,350 parts per million. Sediment derived from the watershed is a source of pollution in Hondo Creek and in the Frio and Nueces Rivers lowering the quality of water for all present and probable future uses. Sediment necessitates expensive additional treatment of water supplies and reduces the oxygen content of water needed to assimilate wastes. No estimate of the monetary value of this type of sediment damage has been made.

Low inherent erosion rates of most of the watershed soils, the fine texture of sediment, fair to good hydrologic cover on most of the grassland, and the large Seco Creek channel are primarily responsible for a low rate of sediment damage on the flood plain. An estimated 536 acres of flood plain land within the project area are damaged by overbank deposits of clay, silt, sand, gravel, and cobbles. This damage is estimated to be 10 percent on 362 acres and 80 percent on 174 acres in terms of reduced productive capacity. The 80 percent damage is continued to reach 5 (figure 1). The average annual monetary value of the damage is estimated to be $ at adjusted normalized price levels (table 5).

Erosion Damage

The estimated average annual rate of gross erosion is 2.41 tons per acre. Of this, sheet erosion accounts for 45 percent and flood plain scour 55 percent. Streambank and gully erosion are insignificant. The most severe flood plain scour is occurring in evaluation reach 1 (figure 1) where the stream assumes a prominant meandering course. Deep scour channels, originating at sharp bends in the stream channel and cutting across soils of high productive potential are common in this reach. Upland erosion rates are low, primarily because the soils on steeper slopes are either stony or gravelly and are used as rangeland.

An estimated 3,923 acres are damaged by flood plain scour. The damaged areas range from 0.5 to 14.0 feet in depth and from 40 to 1,500 feet in width. It is estimated that scour causes a 10 percent loss of productive capacity on 1,161 acres, 20 percent on 1,890 acres, 30 percent on 767 acres, 40 percent on 55 acres, and 50 percent on 50 acres. The average annual value of this damage is estimated to be $ at adjusted normalized price levels (table 5).

Problems Relating to Water Management

There is no local interest in providing additional storage in any planned floodwater retarding structure for agricultural or nonagricultural water management purposes.

There is no activity relative to drainage in the watershed.

At present, about 2,000 acres within the watershed are irrigated. Irrigation water within the watershed is obtained largely from wells in the Leona Formation. Immediately to the east of the watershed, considerable supplies of irrigation water are pumped from the Edwards and associated limestones. The water in both aquifers is generally of good quality for irrigation and public supply. Water in the Edwards in the southern part of the watershed is too saline for irrigation and most other uses. Also, according to the Geological Survey, water in the Leona Formation has a high nitrate content in some places.

Problems in management exist on about 90 percent of the irrigated land. The major problems encountered involve steep slopes, length of irrigation runs, frequency of water application, maintenance of irrigation ditches, and the need for lined or underground delivery systems and land leveling. However, farmers are currently improving their irrigation systems to provide for more efficient utilization of irrigation water.

Irrigated crops consist mainly of grain sorghums, forage crops, and some vegetables.. These crops are all well adapted to the soils on which they are grown.

A sufficient supply of municipal and industrial water for D'Hanis is obtained from wells in the Leona Formation.

The Edwards Underground Reservoir has a notable capacity for being recharged rapidly. According to the Geological Survey Water-Supply Paper 1422, much more water probably enters and leaves Medina County underground through channels in the Edwards Limestone than is withdrawn by wells in the county.

There is no immediate threat to the quality or quantity of water supply for D'Hanis. It is anticipated that D'Hanis's population will increase slightly from its present population of approximately 500. A limestone reservoir such as the Edwards is highly susceptable to contamination. With future agricultural and associated industrial expansion and the related increase in pollution sources, extreme caution and proper watershed management will be necessary in order to maintain the good quality of ground water in the Edwards Underground Reservoir.

The Medina Lake on the Medina River is located approximately 30 miles northeast of D'Hanis. This reservoir offers an abundance of opportunities for year-round water based recreation.

Rural domestic and livestock water is furnished adequately from wells and/or farm ponds.

PROJECTS OF OTHER AGENCIES

There are no existing or proposed water resource development projects of any other agencies within the watershed.

The works of improvement included in this plan will have no known detrimental effects on any existing or proposed downstream works of improvement of other agencies.

PROJECT FORMULATION

There is a history of extensive flood damage to business, residential, and railroad properties; city streets; and utilities in D'Hanis and to agricultural properties along Seco and Parker Creeks. In addition, the Seco Creek watershed lies within the vast area depending on the Edwards Underground Reservoir for water supply. The increased use of ground water due to expanding industry, irrigation farming, military installations, and cities coupled with periods of drought has intensified water problems of the watershed and the surrounding area. Realizing the social and economic impact of these problems, foresighted sponsoring local organizations sought assistance. Representatives of the Commissioners Courts of Medina, Bandera, and Uvalde Counties, the Edwards Underground Water District, the Medina Valley and the Nueces-Frio-Sabinal Soil and Water Conservation Districts, and the Soil Conservation Service initially made studies to identify existing problems. Meetings were held to reach agreement on water and land resource development needs. Desires of sponsoring local organizations were discussed, and project objectives were formulated. Watershed protection and flood prevention were the primary objectives expressed by the sponsors.

The following specific objectives were agreed to:

1. Reduce erosion and increase rainfall infiltration by establishing land treatment measures which would contribute directly to watershed protection and flood prevention. The

goal is to increase the establishment of needed land treatment measures from the present 68 percent to 90 percent during the ten-year installation period. At least 75 percent of the land above floodwater retarding structures would be adequately protected from erosion before construction would begin on any structural measure.

2. Attain a 70 to 75 percent reduction in average annual flood damages in the agricultural reaches of the flood plain.

3. Attain a 90 percent reduction in average annual flood damages in D'Hanis with consideration given to the 100-year frequency storm.

In addition, the Edwards Underground Water District is vitally interested in increased ground water recharge to the Edwards Ground Water Reservoir which would occur incidental to the installation of floodwater retarding structures.

Possible sites for ten floodwater retarding structures were investigated in order to select the least costly system needed to provide the agreed upon level of protection. In selecting sites for structural measures, consideration was given to locations which would provide maximum protection to areas most subject to damage. Topographic, geologic, hydrologic, and other physical features had considerable influence upon the size, number, design, and cost of structures included in the plan.

One possible floodwater retarding structure site was investigated but not included in the final project.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Farmers and ranchers, controlling 87 percent of the agricultural land in the watershed, are applying and maintaining soil and water conservation plans on their land with assistance from the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts. These plans, which are essential to a sound program for watershed protection and flood prevention, are based on the use of each acre within its capabilities and its treatment in accordance with its needs. Needed land treatment measures have been applied to date at an estimated expenditure of $ by landowners and operators (table 1A).

Increased application and maintenance of land treatment measures is particularly important for protection of the 152.39 square miles which comprise the drainage areas of planned floodwater retarding structures. This treatment will reduce the capacities required for sediment accumulation and will retard runoff into the structures.

There are 115.61 square miles downstream from floodwater retarding structures that will continue to contribute sediment and runoff to flood plain areas. Land treatment on these lands will further reduce floodwater and sediment damages.

The acreage in each major land use, on which land treatment measures will be established during the ten-year project installation period, is included in table 1. These measures will be established and maintained by landowners and operators in cooperation with the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts.

PICTURE

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Cultivated land will be treated with a combination of measures in keeping with a conservation cropping system for soil conditioning and protection from erosion. Conservation cropping systems in this watershed include crop residue management and contour farming. Terraces, provided with grassed waterways or outlets, will be installed to control erosion and retard runoff from the more rolling areas.

A good base cover of desirable forage plants will be attained by pasture and/or hayland planting and pasture and/or hayland management.

Proper grazing use, range seeding, and deferred grazing will be practiced to improve the quality of range vegetation and maintain adequate cover for soil protection. Rangeland with infestations of woody plants will be either bulldozed, root plowed, chained, or sprayed to control brush. Destruction of cover caused by over-use around present watering places will be reduced by establishing ponds.

Damage to land caused by rapid runoff from steeper areas will be reduced by construction of diversions.

In addition, irrigated cropland will receive irrigation land leveling, irrigation ditch and canal lining, irrigation pipeline, and irrigation water management. The combined effects of these measures will be reduced erosion, more efficient use of water, and increased net income to farm operators.

Retention, establishment, and management of wildlife habitat will result from the practice of wildlife habitat management on wildlife-recreation land.

Local people will continue to install and maintain measures needed in the watershed following the project installation period.

The application of land treatment planned for the installation period will reduce average annual gross erosion by about 12 percent and increase infiltration of rainfall as a result of improved ground cover in cultivated areas and increased vigor, forbs, and other desirable vegetation on pasture, rangeland, and wildlife-recreation land.

Structural Measures

A system of nine floodwater retarding structures will be installed to provide the needed protection to agricultural and urban properties which can not be provided by land treatment alone.

The locations of the floodwater retarding structure sites are shown on the Project Map (figure __). Figure 2 shows a typical section of a floodwater retarding structure. Figures 3 and 3A include a general plan of dam, spillway, and reservoir; embankment plan and profile; and cross-section of a zoned embankment typical of the type of floodwater retarding structure included in this work plan.

The nine floodwater retarding structures will have a total floodwater detention capacity of 27,431 acre-feet and will temporarily detain 3.37 inches of runoff from the watershed area above them. The structures are designed with sufficient capacity to provide 100-year project life without sediment encroachment upon the planned floodwater detention capacity.

Major factors which will affect construction will be rock excavation in the emergency spillways of all sites except Site No. 1; zoning of available borrow material within the embankments, the absences of sufficient on-site borrow materials; permeable gravel deposits within the foundations at Sites Nos. 1 and 6, and porous or fractured limestone within foundations at structure Sites Nos. 2 through 9.

Emergency spillways at all sites except Site No. 1 will have erosion resistant rock crests and forebays, and exit channels will be mostly underlain at shallow depths by rock. The emergency spillway at Site No. 1 will be vegetated earth.

Structural details will be treated in the final design phase. Preliminary and present indicators are that the principal spillways will be on compressible foundations and will have monolitic rectangular reinforced concrete inlets. Floodwater retarding structure Site No. 3 lends itself to a monolithic rectangular reinforced concrete barrel, and all other sites to prestressed concrete-lined, stell cylinder pipe outlet barrels. Rock lined plunge pools for Sites Nos. 1, 2, 4, 5, 6, 7, 8, and 9 and reinforced concrete de-energizing basin for Site No. 3 are included in the preliminary details.

Principal spillway capacities and floodwater detention storage in all planned floodwater retarding structures except Site No. 1 will provide a two percent chance of emergency spillway use. Site No. 1 will provide a one percent chance of emergency spillway use.

There are sufficient volumes of clay, silty clay, sandy clay, and gravelly clay for construction of very slowly permeable central embankment sections. The remainder of the embankments will be comprised primarily of clayey sand, silty sand, clayey gravel, silty gravel, and limestone. It is anticipated that limestone blankets will cover the embankments of floodwater retarding structures Nos. 2, 3, 4, 5, 6, 8, and 9. The upper limit of limestone blankets on Sites Nos. 1 and 7 shall be determined by the yield of durable rock from emergency spillway excavation and durable gravel and cobble content in common excavation. Vegetation will be required to supplement the blankets on these two sites.

Foundations are characterized by alluvial deposits of silty clay, gravelly clay, sandy clay, and clayey gravel containing rapidly permeable horizons. These materials have good bearing and shear strength. The alluvium is underlain at relatively shallow depth by hard, medium bedded to massive limestone at Sites Nos. 2 through 9. The alluvium is relatively thick at Site No. 1, and the underlying bedrock is composed of alternating beds of hard limestone and soft clay and shale. Foundation drains will be needed at all floodwater retarding structures because of expected high rates of seepage from pools.

Tables 1, 2, and 3 show details on quantities, costs, and design for each floodwater retarding structure.

Installation of floodwater retarding structures will require relocation or modifications of known existing improvements as follows: utility lines, county road, fencing at Site No. 1; private road and fencing at Site No. 2; utility lines, private roads, corrals, livestock well, storage and livestock drinking facilities, livestock pipleine, fencing, and county road at Site No. 3; utility line, private road, and fencing at Site No. 4; private road and fencing at Sites Nos. 5 and 9; and fencing at Sites Nos. 6, 7, and 8. There are numerous private and public road crossings below the planned floodwater retarding structures which will be made impassable by release flows. The public crossings will be improved to make them passable during prolonged release flows or alternate routes will be provided for use during periods of inundation. Private road crossings can be handled the same as public crossings or a permit to inundate the crossing will be required.

All applicable State laws will be complied with in the storage and use of water and in the design and construction of all structural measures.

EXPLANATION OF INSTALLATION COSTS

Land treatment measures listed in table 1 will be applied by local interests at an estimated cost of $______________. This includes $____________ of Public Law 46 funds to be provided by the Soil Conservation Service under the going program for technical assistance during the ten year installation period and cost sharing in the establishment of approved conservation measures under the Agricultural Conservation Program as administered by the Agricultural Stabilization and Conservation Service. The costs of application of the various measures are based on present prices being paid by landowners and operators in the area.

The total installation cost of structural measues is estimated to be $3,165,658 of which $2,894,153 will be borne by Public Law 566 funds and $271,505 by local interests.

The Public Law 566 costs for installation of structural measures include $2,409,808 for construction, $124,550 for engineering services, and $359,759 for project administration.

The local costs for installation of structural measures include $213,100 for the value of land, $48,905 for the relocation or modification of power lines, telephone lines, private roads, stock pens, water wells and storage tanks, livestock watering devices, county roads, and low water crossings; $4,200 for legal fees; and $5,300 for project administration.

Construction costs include the engineer's estimates and contingencies. The engineers estimates were based on unit costs of structural measures in similar areas modified by special conditions inherent to each individual site location. Included are such items as permeable foundations, special placement of embankment materials, and rock excavation in emergency spillways. Ten percent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction costs.

Engineering services and project administration costs were based on analysis of previous work in similar areas. Engineering services costs consist of, but are not limited to, detailed surveys, geologic investigations, laboratory analyses, reports, designs, and cartographic services.

Public Law 566 project administration costs consist of construction inspection and supervision, contract administration, maintenance of Soil Conservation Service State Office records and accounts, and Washington Office and E&WP Unit costs.

The local costs for project administration include sponsor's costs related to contract administration , overhead and organizational administrative costs, and whatever construction inspection they desire to make at their own expense.

The cost of land rights was determined by appraisal cooperation with representatives of the local sponsoring organizations.

The following is the estimated schedule of obligations for the ten-year installation period.

Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
First	Land Treatment	-		
Second	Land Treatment	-		
	Structure No. 6	158,741	19,218	177,959
Third	Land Treatment	-		
	Structure No. 7	100,679	13,876	114,555
Fourth	Land Treatment	-		
	Structure No. 2	652,868	32,074	684,942
Fifth	Land Treatment	-		
	Structure No. 1	383,564	30,724	414,288
Sixth	Land Treatment	-		
	Structure No. 3	473,492	77,220	550,712
Seventh	Land Treatment	-		
	Structure No. 4	459,655	24,913	484,568
Eighth	Land Treatment	-		
	Structure No. 5	315,358	32,603	347,961
Ninth	Land Treatment	-		
	Structure No. 8	208,207	22,363	230,570
Tenth	Land Treatment	-		
	Structure No. 9	141,589	18,514	160,103
	Total	2,894,153		

This schedule may be changed from year to year to conform with appropriations, accomplishments, and any mutually desirable changes.

EFFECTS OF WORKS OF IMPROVEMENT

This project will benefit directly the owners and operators of approximately 40 farms and ranches in the agricultural land of the flood plain and the owners and operators of about 125 residential and business units in D'Hanis through reduction of floodwater damage.

After installation of the combined program of land treatment and structural measures described above, average annual flooding will be reduced from 9,320 acres to 3,499 acres, a reduction of 62 percent.

Reduction in area inundated varies with respect to location within the watershed. The general locations of the areas to be benefited as a result of reduced flooding, caused by the combined program of land treatment and structural measures are presented in the following tabulations:

Average Annual Area Inundated

Evaluation Reach (figure 1)		Without Project (acres)	With Project (acres)	Reduction (percent)
1	Seco Creek - V.S. S-1 to V.S. S-7	5,121	2,182	57
2	Seco Creek - V.S. S-8 to V.S. S-13	1,651	697	58
3	Parker Creek	1,358	195	86
4	Urban Area - D'Hanis	60	3	95
5	Seco Creek - V.S. S-16 to V.S. S-26	634	50	92
6	Seco Creek - V.S. S-27 to Site No. 1	496	372	25
	Total	9,320	3,499	62

Area Inundated

Evaluation Reach (figure 1)	2-Year Without Project (acres)	2-Year With Project (acres)	5-Year Without Project (acres)	5-Year With Project (acres)	25-Year Without Project (acres)	25-Year With Project (acres)	100-Year Without Project (acres)	100-Year With Project (acres)
1	3,697	1,375	4,374	2,728	5,008	3,667	5,553	3,970
2	1,028	411	1,763	742	2,746	1,260	3,367	1,770
3	1,060	2	1,845	413	2,760	976	3,345	1,446
4	20	0	100	8	300	18	435	35
5	380	31	910	61	2,054	231	3,522	384
6	306	263	434	340	537	398	876	678
Total	6,491	2,082	9,426	4,292	13,405	6,550	17,098	8,283

Figure __ shows the urban area of D'Hanis that would be inundated by a 100-year frequency flood without and with project conditions. The proposed project will provide flood-free protection from the 100-year event to all existing urban properties. With the project installed,direct damages of $1,122,160 to urban properties will be eliminated. The actions of people during times of floods, whether major or minor, cannot be predicted. However, with any reasonable precautions, the hazard to life from flood waters will be eliminated.

The direct monetary floodwater damage resulting from a recurrence of a flood similar to the one that occurred in 1958 would be reduced 85 percent with installation of the planned program of land treatment and structural measures.

Application of the planned land treatment program is expected to reduce annual gross erosion from about _____ tons to ____ tons, a reduction of _____percent. The average annual sediment yield from the watershed will be reduced from an estimated _____ acre-feet to ______ acre-feet as a result of the combined program of land treatment and floodwater retarding structures.

Sediment transported in suspension is the major pollutant in the Nation's streams. It is estimated that the concentration of suspended sediment leaving the watershed will be reduced from _______ to _______ parts per million as a result of the combined program of land treatment and floodwater retarding structures.

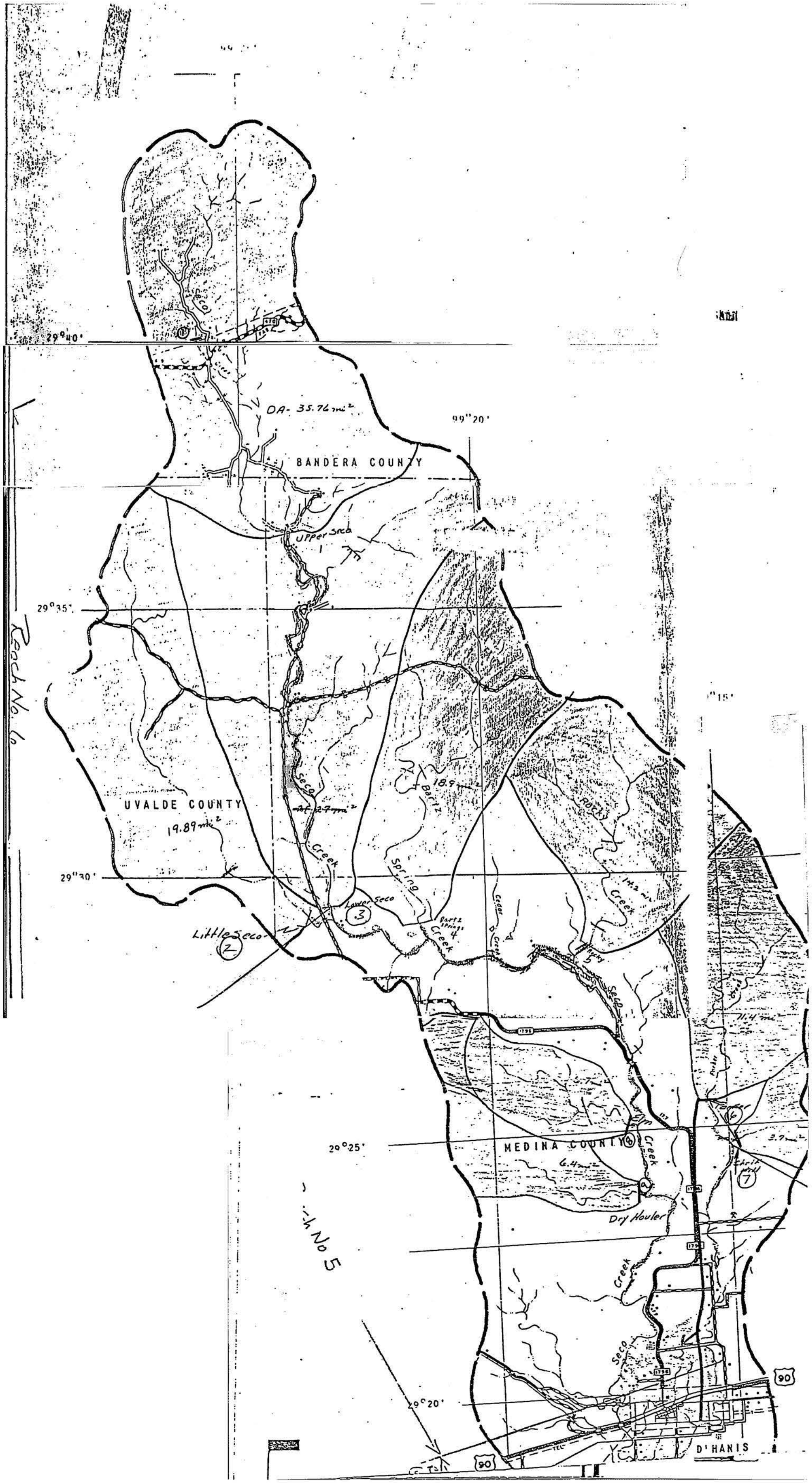
Annual flood plain scour damage on 3,923 acres is expected to be reduced about 77 percent.

After the completed program is installed, a 61 percent reduction in overbank sediment deposition damages on 536 acres will be effected.

Average annual ground water will be increased from an estimated _____ acre-feet to about _____ acre-feet, an incidental effect resulting from the installation of floodwater retarding structures.

The effects of the works of improvement on fish and wildlife habitat are described by the Bureau of Sport Fisheries and Wildlife as follows:

> "Future wildlife populations would be expected to remain at about their present levels. Hunting would be expected to increase as a result of better wildlife management, more use of wildlife resources, and increasing human populations.
>
> With the project, land treatment measures such as conservation cropping systems, cover and green manure crops, grassed waterways, proper grazing use, and deferred grazing would benefit some species



29°40'
DA- 35.76 mi²
99°20'
BANDERA COUNTY
Upper Seco
29°35'
Reach No. 6
UVALDE COUNTY
19.89 mi²
Seco
Creek
Bartz
18.9 mi²
Spring
Rocky
29°30'
Lower Seco
3
Little Seco
2
Creek
14.2 mi²
Creek
11.4 mi²
MEDINA COUNTY
6.4 mi²
3.9 mi²
7
Dry Hollow
Creek
Seco
29°25'
29°20'
90
D'HANIS

of big game and upland game. However, doves and bobwhites would not be favored by increasing the density of grass cover."

The project will create additional employment opportunities for local residents. The firms contracting for installation of the structures will employ some of their employees locally. The operation and maintenance of project measures over the life of the project will also provide employment opportunities for the local residents.

Analysis of information collected indicated that no significant changes would be made in the use of agricultural land within the flood plain, either in the form of restoration of former productivity or in more intensive use. Allotted crops are minor and no significant changes are expected.

A total of ______ acres of land in sediment pools, dams, and emergency spillways will be retired from agricultural production. Only _____ acres of this is presently in cultivation.

Secondary benefits, including improved economic conditions in the area, will result from the installation of complete project for flood prevention. The operation and maintenance of the project measures will provide some employment opportunities for local residents. Significant intangible benefits from enhancement of environmental quality will accrue in the town of D'Hanis including reduced hazards of loss of life and injury, elimination of health hazards associated with damage to water supply and waste disposal systems, improved vector control, and the prevention of other factors accompanying floods which tend to disrupt the maintenance of public health.

PROJECT BENEFITS

The estimated average annual monetary floodwater, sediment, erosion, and indirect damages (table 5) within the watershed will be reduced from $222,688 to $30,611 by the proposed project. This is a reduction of 86 percent.

Benefits to landowners and operators from the planned land treatment measures were not evaluated in monetary terms since experience has shown that conservation practices produce benefits in excess of their costs.

Reduction in monetary flood damages vary with respect to locations within the watershed. The following tabulations show the general locations of damage reduction benefits attributed to the combined program of land treatment and structural measures.

Average Annual Damage

Evaluation Reach (figure 1)	Location	Without Project (dollars)	With Project (dollars)	Reduction (percent)
1	Seco Creek - V.S. S-1 to V.S. S-7	25,886	9,134	65
2	Seco Creek - V.S. S-8 to V.S. S-13	26,903	9,569	64
3	Parker Creek	57,888	7,373	87
4	Urban Area-D'Hanis	73,372	0	100
5	Seco Creek - V.S. S-16 to V.S. S-26	21,767	2,905	87
6	Seco Creek - V.S. S-27 to Site No. 1	2,198	1,630	26
	Total	222,688	30,611	86

Direct Monetary Floodwater Damage

Evaluation Reach (figure 1)	Average Recurrence Interval: 2-Year: Without Project (dollars)	2-Year: With Project (dollars)	5-Year: Without Project (dollars)	5-Year: With Project (dollars)	25-Year: Without Project (dollars)	25-Year: With Project (dollars)	100-Year: Without Project (dollars)	100-Year: With Project (dollars)
1	14,054	3,905	19,832	8,494	25,141	15,347	28,923	18,119
2	13,230	4,203	28,465	9,463	48,122	19,855	63,877	27,546
3	32,951	7	61,466	6,262	106,770	31,438	147,286	47,147
4	0	0	59,345	0	700,815	0	1,122,160	0
5	4,533	111	11,382	769	35,279	2,696	47,370	5,516
6	1,681	1,166	2,371	1,904	3,738	2,628	5,197	3,482
Total	66,449	9,392	182,861	26,892	920,051	71,964	1,425,343	101,810

The monetary value of the incidental ground water recharge is estimated to be ~~$91,200~~ annually.

Redevelopment benefits stemming from employment of local labor during project installation and from operation and maintenance will amount to an amortized value of $7,624 annually.

It is estimated that the project will produce local secondary benefits, which exclude indirect benefits in any form, averaging $24,768 annually. Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures (amortized total installation and project administration cost, plus operation and maintenance) is $157,956. These measures are expected to produce average annual benefits excluding secondary benefits, of $278,287 resulting in a benefit-cost ratio of 1.8:1.0.

The ratio of total average annual project benefits, including secondary benefits, accruing to structural measures ($303,055) to the average annual cost of structural measures ($157,956) is 1.9:1.0 (table 6).

PROJECT INSTALLATION

Landowners and operators will establish planned land treatment (table 1) in cooperation with the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts during a ten-year period. Technical assistance in planning and application of land treatment is provided under the going program of the districts. Soil surveys have been completed on about 107,400 acres in the watershed.

An estimated 68 percent of needed soil and water conservation practices has been applied. The goal is to increase the level of land treatment application to at least 90 percent of total needs during the installation period.

In reaching this goal, it is expected that accomplishments of additional treatment will progress as shown in the following tabulation:

Land Use	Fiscal Year 1st	2nd	3rd	4th	5th
Cropland	145	290	290	290	435
Pasture	135	270	270	270	405
Wildlife-Recreation	65	130	130	130	195
Rangeland	1,800	3,600	3,600	3,600	5,400
Total	2,145	4,290	4,290	4,290	6,435

Land Use	Fiscal Year (Continued) 6th	7th	8th	9th	10th	Total
Cropland	435	290	290	290	145	2,900
Pasture	405	270	270	270	135	2,700
Wildlife-Recreation	195	130	130	130	65	1,300
Rangeland	5,400	3,600	3,600	3,600	1,800	36,000
Total	6,435	4,290	4,290	4,290	2,145	42,900

The governing bodies of the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts will assume aggressive leadership in getting the land treatment program underway. Landowners and operators will be encouraged to apply and maintain soil and water conservation measures on their farms and ranches. In addition, landowners and operators where floodwater retarding structures will be located will be encouraged to apply and maintain measures for the enhancement of wildlife. The Soil Conservation Service will provide technical assistance in the planning and application of soil, plant, and water conservation measures.

Special emphasis will first be placed on getting a higher degree of land treatment in the drainage areas of floodwater retarding structures. Then the emphasis will be on land outside drainage areas of structures.

The Extension Service will assist with the educational phase of the program by providing information to landowners and operators in the watershed.

The Commissioners Courts of Medina, Bandera, and Uvalde Counties have rights of eminent domain under applicable State law and have the financial resources to fulfill their responsibilities.

The Soil Conservation Service, in compliance with a request from the sponsors, will provide the necessary administrative and clerical personnel; facilities, supplies, and equipment to advertise, award, and administer contracts; and will be the contracting agency to let and service contracts. The Medina County Commissioners Court will represent sponsoring local organizations in coordination with the Soil Conservation Service on matters concerning construction.

The Medina County Commissioners Court will have the following responsibilities pertaining to floodwater retarding structures Nos. 2 through 9:

1. Obtain the necessary land rights;

2. Provide for the relocation or modification of utility lines and systems, roads, and privately owned improvements necessary for installation of floodwater retarding structures;

3. Provide for the necessary improvements to low water crossings on public and private roads in Medina County to make them

passable during prolonged release flows from floodwater retarding structures or provide equal alternate routes for use during periods of inundation; and

4. Determine and certify legal adequacy of easements and permits for construction of the floodwater retarding structures.

The Bandera County Commissioners Court will have the following responsibilities pertaining to floodwater retarding structure No. 1:

1. Obtain the necessary land rights;

2. Provide for the relocation or modification of utility lines and systems, roads, and privately owned improvements necessary for installation of the floodwater retarding structure;

3. Provide for the necessary improvements to low water crossings on public and private roads in Bandera County affected by the release flow from floodwater retarding structure No. 1 to make them passable during prolonged release flows from the structure or provide equal alternate routes for use during periods of inundation; and

4. Determine and certify legal adequacy of easements and permits for construction of the floodwater retarding structure.

The Uvalde County Commissioners Court will be responsible for providing for the necessary improvements to low water crossings on public and private roads in Uvalde County affected by release flow from floodwater retarding structure No. 1 to make them passable during prolonged release flows from the structure or provide equal alternate routes for use during periods of inundation.

The sponsoring local organizations recognize the importance of limestone, gravel, and clay and the possible future importance of other rocks and minerals in the watershed vicinity. There is no intention by the sponsors to prevent the extraction of such resources as long as the operations can be performed without detrimental affects upon the structural measures included in this project.

Technical assistance will be provided by the Soil Conservation Service in preparation of plans and specifications, construction inspection, preparation of contract payment estimates, final inspection, execution of certificate of completion, and related tasks necessary to install planned structural measures.

The structural measures will be constructed during the ten-year project installation period in the general sequence as follows:

First Year - None

Second Year - Floodwater Retarding Structure No. 6

Third Year - Floodwater Retarding Structure No. 7

Fourth Year - Floodwater Retarding Structure No. 2

Fifth Year - Floodwater Retarding Structure No. 1

Sixth Year - Floodwater Retarding Structure No. 3

Seventh Year- Floodwater Retarding Structure No. 4

Eighth Year - Floodwater Retarding Structure No. 5

Ninth Year - Floodwater Retarding Structure No. 8

Tenth Year - Floodwater Retarding Structure No. 9

In order for construction to proceed according to schedule, land rights for each floodwater retarding structure are scheduled by the Commissioners Courts of Medina and Bandera Counties to be secured not later than six months before construction of each measure is scheduled to begin.

FINANCING PROJECT INSTALLATION

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

The cost of applying land treatment measures will be borne by landowners and operators.

Funds for the local share of the cost of this project relative to installation of floodwater retarding structures Nos. 2 through 9 will be provided by Medina County. Bandera County will provide funds for the local share of floodwater retarding structure No. 1 installation cost. The Commissioners Courts of Medina and Bandera Counties will set aside revenue funds to finance the local share of installation costs.

The sponsors will carry out all phases of project installation, operation, and maintenance and have the financial ability to make adequate arrangements for carrying out their responsibilities.

It is anticipated that approximately ___ percent of the easements for structural measures will be donated. Out-of-pocket costs for land rights, legal expenses, and project administration are estimated to be $________.

Structural measures will be constructed during the ten-year project installation period pursuant to the following conditions:

1. Requirements for land treatment in drainage areas of floodwater retarding structures have been satisfied.

2. All land rights have been obtained for all structural measures, or a written statement is furnished by the Medina and Bandera County Commissioners Courts that their rights of eminent domain will be used, if needed, to secure any remaining land rights within the project installation period and that sufficient funds are available for purchasing them.

3. Provisions have been made, at no cost to the Federal Government, for improving low water crossings or bridges and/or culverts on public roads making them passable during periods of prolonged release flow from structures or provisions have been made for equal alternate routes for use during periods of inundation.

4. Utilities, such as power lines, telephone lines, and pipelines, have been relocated or permission has been obtained to inundate the properties involved.

5. Project agreements have been executed.

6. Operation and maintenance agreements have been executed.

7. Public Law 566 funds are available.

Various features of cooperation between the cooperating parties have been covered in appropriate memorandums of understanding and working agreements.

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

The County Agricultural Stabilization and Conservation committees will cooperate with the governing bodies of the soil and water conservation districts by continuing to provide financial assistance for selected conservation practices.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Planned land treatment measures will be maintained by landowners and operators of farms and ranches on which measures are applied under agreement with the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts. Representatives of the districts will make periodic inspections of land treatment measures to determine maintenance needs and encourage landowners and operators to perform maintenance.

Structural Measures

The Commissioners Court of Medina County will be responsible for operation and maintenance of floodwater retarding structures Nos. 2 through 9. The Commissioners Court of Bandera County will be responsible for operation and maintenance of floodwater retarding structure No. 1.

The estimated annual operation and maintenance cost for floodwater retarding structures is $___________. Monies for operation and maintenance of the floodwater retarding structures will be supplied from the General Funds of Medina and Bandera Counties. These funds are supported by revenue from existing taxes. Each year the Medina and Bandera County Commissioners Courts will budget sufficient funds for operation and maintenance.

Specific operation and maintenance agreements will be executed prior to the issuance of invitation to bid on construction of any of the floodwater retarding structures.

Floodwater retarding structures will be inspected at least annually and after each heavy rain by representatives of the Commissioners Courts of Medina and Bandera Counties, and the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts. The Soil Conservation Service will participate in these inspections for a period of at least three years following construction and will participate in inspections as often as it elects to do so after the third year. Items of inspection will include, but will not be limited to, conditions of principal spillways and their appurtenances, emergency spillways, and earth fills.

Upon acceptance of the completed works of improvements from the contractors, the Medina County Commissioners Court will be totally responsible for operation and maintenance of floodwater retarding structures Nos. 2 through 9 and the Bandera County Commissioners Court will be totally responsible for operation and maintenance of floodwater retarding structure No. 1. Maintenance will be performed promptly as the need arises.

The Soil Conservation Service will assist in operation and maintenance only to the extent of furnishing technical guidance.

Provisions will be made for unrestricted access by representatives of sponsoring local organizations and the Federal Government to inspect all structural measures and their appurtenances at any time and for sponsoring local organizations to operate and maintain them.

The Medina and Bandera County Commissioners Courts will maintain a record of all maintenance inspections made and maintenance performed and have it available for inspection by Soil Conservation Service personnel.

The necessary maintenance work will be accomplished either by contract, force account, or equipment owned by sponsoring local organizations.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Seco Creek Watershed, Texas

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/		
			Public Law 566 Funds	Other	
		Non-Federal Land	Non-Federal Land	Non-Federal Land	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	2,900	-	59,600	59,600
Pasture and Hayland	Acre	2,740	-	55,000	55,000
Rangeland	Acre	35,980	-	256,300	256,300
Wildlife-Recreation Land	Acre	1,290	-	12,900	12,900
Technical Assistance			-	47,600	47,600
TOTAL LAND TREATMENT					
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Floodwater Retarding Structures	No.				
Subtotal - Construction					
Engineering Services					
Soil Conservation Service					
Floodwater Retarding Structures	No.				
Subtotal - Engineering Services					
Project Administration					
Soil Conservation Service					
Construction Inspection					
Other					
Subtotal - Administration					
Other Costs					
Land Rights					
Subtotal - Other					
TOTAL STRUCTURAL MEASURES					
TOTAL PROJECT					

1/ Price Base: 1970

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(at time of work plan preparation)

Seco Creek Watershed, Texas

Measures	Unit	Number Applied To Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Conservation Cropping System	Acre	9,163	9,200
Crop Residue Management	Acre	10,844	21,700
Diversion	Foot	33,127	3,300
Terraces	Foot	97,976	9,800
Grassed Waterway or Outlet	Acre	14	1,800
Irrigation Land Leveling	Acre	749	59,900
Irrigation Water Management	Acre	23	100
Irrigation Ditch and Canal Lining	Foot	40,543	56,800
Brush Control	Acre	20,262	283,700
Deferred Grazing	Acre	103,524	51,800
Proper Grazing Use	Acre	118,457	59,200
Range Seeding	Acre	3,665	18,300
Pond	No.	72	72,000
Wildife Habitat Management	Acre	3,156	31,600
Pasture and Hayland Planting	Acre	1,061	21,200
Pasture and Hayland Management	Acre	257	1,000
TOTAL			701,400

1/ Price Base: 1970

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Seco Creek Watershed, Texas

(Dollars) 1/

Item	Installation Cost P. L. 566 Funds: Construction	Installation Cost P. L. 566 Funds: Engineering	Installation Cost P. L. 566 Funds: Total P.L. 566	Installation Cost Other Funds: Land Rights	Installation Cost Other Funds: Total Other	Total Installation Cost
Floodwater Retarding Structures						
1	320,937	16,047	336,984	30,124	30,124	367,108
2	546,270	27,314	573,584	31,374	31,374	604,958
3	396,182	19,809	415,991	76,470	76,470	492,461
4	384,605	19,230	403,835	24,313	24,313	428,148
5	263,868	13,193	277,061	31,903	31,903	308,964
6	129,327	7,760	137,087	18,718	18,718	155,805
7	80,609	5,643	86,252	13,426	13,426	99,678
8	172,656	8,633	181,289	21,863	21,863	203,152
9	115,354	6,921	122,275	18,014	18,014	140,289
Subtotal	2,409,808	124,550	2,534,358	266,205	266,205	2,800,563
Project Administration			359,795 2/		5,300	365,095
GRAND TOTAL	2,409,808	124,550	2,894,153	266,205 3/	271,505	3,165,658

1/ Price Base: 1969

2/ Includes $153,626 for construction inspection.

3/ Includes $4,200 for legal fees and $48,905 for relocation or modification of other fixed improvements and utilities.

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Seco Creek Watershed, Texas

Item	Unit	Structure Number 1	Structure Number 2
Class of Structure		B	B
Drainage Area	Sq.Mi.	11.67	21.22
Controlled	Sq.Mi.	-	-
Curve No.(1-day)(AMC II)		75	75
T_c	Hrs.	0.93	1.81
Elevation Top of Dam	Ft.	1596.1	1240.4
Elevation Crest Emergency Spillway	Ft.	1586.0	1231.0
Elevation Crest Lowest Ungated Outlet	Ft.	1556.7	1199.6
Maximum Height of Dam	Ft.	52	53
Volume of Fill	Cu.Yd.	354,600	524,300
Total Capacity	Ac.Ft.	2,266	3,690
Sediment Pool(Lowest Ungated Outlet)1/	Ac.Ft.	56	91
Sediment Aerated 1st 50 years	Ac.Ft.	56	91
Sediment Aerated 2nd 50 years	Ac.Ft.	50	79
Sediment in Detention Pool-Aerated	Ac.Ft.	6	11
Retarding Pool	Ac.Ft.	2,154	3,509
Surface Area			
Sediment Pool (Lowest Ungated Outlet)	Acres	15	17
Sediment Pool-Principal Spillway Crest	Acres	15	17
Retarding Pool	Acres	146	260
Principal Spillway			
Rainfall Volume(areal)(1-day)	In.	8.24	8.12
Rainfall Volume(areal)(10-day)	In.	13.36	13.30
Runoff Volume (10-day)	In.	5.48	5.07
Capacity (Maximum)	cfs	178	350
Frequency Operation-Emergency Spillway	% chance	2	2
Size of Conduit	In.	36	48
Emergency Spillway			
Rainfall Volume (ESH)(areal)	In.	9.65	9.17
Runoff Volume (ESH)	In.	6.55	6.10
Type		Veg.	Rock
Bottom Width	Ft.	500	750
Velocity of Flow (Ve)	Ft./Sec.	8.6	8.4
Slope of Exit Channel	Ft./Ft.	0.023	0.024
Maximum Water Surface Elevation	Ft.	1589.3	1234.9
Freeboard			
Rainfall Volume (FH)(areal)	In.	20.50	19.56
Runoff Volume (FH)	In.	16.98	17.17
Maximum Water Surface Elevation	Ft.	1596.1	1240.4
Capacity Equivalents			
Sediment Volume	In.	0.18	0.16
Retarding Volume	In.	3.46	3.10

~~1/ Volume included in sediment aerated 1st 50 years~~

(Footnote on last page of Table 3.) March 1970

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES (Continued)

Seco Creek Watershed, Texas

Item	Unit	Structure Number 3	Structure Number 4	Structure Number 5
Class of Structure		B	B	B
Drainage Area	Sq.Mi.	52.36	19.74	15.41
Controlled	Sq.Mi.	11.67	-	-
Curve No.(1-day)(AMC II)		75	77	79
Tc	Hrs.	2.12	1.78	1.66
Elevation Top of Dam	Ft.	1240.1	1217.4	1099.9
Elevation Crest Emergency Spillway	Ft.	1228.2	1206.9	1091.9
Elevation Crest Lowest Ungated Outlet	Ft.	1189.0	1166.5	1067.8
Maximum Height of Dam	Ft.	74	64	52
Volume of Fill	Cu.Yd.	364,700	403,000	368,000
Total Capacity	Ac.Ft.	8,212	3,643	3,197
Sediment Pool(Lowest Ungated Outlet) 1/	Ac.Ft.	195	84	66
Sediment Aerated 1st 50 years	Ac.Ft.	195	84	66
Sediment Aerated 2nd 50 years	Ac.Ft.	196	74	66
Sediment in Detention Pool-Aerated	Ac.Ft.	28	10	8
Retarding Pool	Ac.Ft.	7,793	3,475	3,057
Surface Area				
Sediment Pool(Lowest Ungated Outlet)	Acres	28	14	12
Sediment Pool-Principal Spillway Crest	Acres	28	14	12
Retarding Pool	Acres	600	216	290
Principal Spillway				
Rainfall Volume (areal)(1-day)	In.	7.91	8.14	8.20
Rainfall Volume(areal)(10-day)	In.	13.10	13.31	13.38
Runoff Volume (10-day)	In.	4.39	5.42	6.07
Capacity (Maximum)	cfs	680	296	268
Frequency Operation-Emergency Spillway	% chance	2	2	2
Size of Conduit	In.	54x54	42	42
Emergency Spillway				
Rainfall Volume (ESH)(areal)	In.	8.29	9.22	9.41
Runoff Volume (ESH)	In.	5.30	6.40	6.83
Type		Rock	Rock	Rock
Bottom Width	Ft.	800	550	600
Velocity of Flow (Ve)	Ft./Sec.	9.9	9.5	8.1
Slope of Exit Channel	Ft./Ft.	0.025	0.026	0.037
Maximum Water Surface Elevation	Ft.	1232.9	1211.3	1095.1
Freeboard				
Rainfall Volume (FH)(areal)	In.	17.70	19.67	20.08
Runoff Volume (FH)	In.	14.24	16.49	17.20
Maximum Water Surface Elevation	Ft.	1240.1	1217.4	1099.9
Capacity Equivalents				
Sediment Volume	In.	0.15	0.16	0.17
Retarding Volume	In.	2.79	3.30	3.72

(Footnote on last page of table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES (Continued)

Seco Creek Watershed, Texas

Item	Unit	Structure Number 6	7	8
Class of Structure		C	B	B
Drainage Area	Sq.Mi.	9.73	4.78	9.35
Controlled	Sq.Mi.	-	-	-
Curve No.(1-day)(AMC II)		79	79	79
T_c	Hrs.	1.23	1.90	3.00
Elevation Top of Dam	Ft.	1038.9	999.6	1019.6
Elevation Crest Emergency Spillway	Ft.	1027.5	992.6	1013.9
Elevation Crest Lowest Ungated Outlet	Ft.	1000.7	974.6	989.7
Maximum Height of Dam	Ft.	48	33	45
Volume of Fill	Cu.Yd.	137,400	115,900	190,400
Total Capacity	Ac.Ft.	2,500	1,216	2,194
Sediment Pool(Lowest Ungated Outlet)1/	Ac.Ft.	47	36	65
Sediment Aerated 1st 50 years	Ac.Ft.	47	36	65
Sediment Aerated 2nd 50 years	Ac.Ft.	41	30	55
Sediment in Detention Pool-Aerated	Ac.Ft.	5	3	5
Retarding Pool	Ac.Ft.	2,407	1,147	2,069
Surface Area				
Sediment Pool (Lowest Ungated Outlet)	Acres	14	13	14
Sediment Pool-Principal Spillway Crest	Acres	14	13	14
Retarding Pool	Acres	220	138	200
Principal Spillway				
Rainfall Volume (areal)(1-day)	In.	9.40	8.40	8.40
Rainfall Volume (areal)(10-day)	In.	15.0	13.5	13.5
Runoff Volume (10-day)	In.	7.50	6.97	6.55
Capacity (Maximum)	cfs	242	100	176
Frequency Operation-Emergency Spillway	%chance	1	2	2
Size of Conduit	In.	42	30	36
Emergency Spillway				
Rainfall Volume (ESH)(areal)	In.	13.00	9.70	9.70
Runoff Volume (ESH)	In.	10.28	7.11	7.11
Type		Rock	Rock	Rock
Bottom Width	Ft.	300	160	575
Velocity of Flow (V_e)	Ft./Sec.	10.2	7.6	6.9
Slope of Exit Channel	Ft./Ft.	0.034	0.035	0.140
Maximum Water Surface Elevation	Ft.	1032.1	995.3	1016.4
Freeboard				
Rainfall Volume (FH)(areal)	In.	30.80	20.70	20.70
Runoff Volume (FH)	In.	27.82	17.82	17.82
Maximum Water Surface Elevation	Ft.	1038.9	999.6	1019.6
Capacity Equivalents				
Sediment Volume	In.	0.18	0.27	0.25
Retarding Volume	In.	4.64	4.50	4.15

(Footnote on last page of table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES (continued)

Seco Creek Watershed, Texas

Item	Unit	Str. No. 9	Total
Class of Structure		B	xxx
Drainage Area	Sq.Mi.	8.13	152.39
Controlled	Sq.Mi.	-	xxx
Curve No.(1-day)(AMC II)		79	xxx
T_c	Hrs.	3.08	xxx
Elevation Top of Dam	Ft.	983.5	xxx
Elevation Crest Emergency Spillway	Ft.	977.6	xxx
Elevation Crest Lowest Ungated Outlet	Ft.	954.4	xxx
Maximum Height of Dam	Ft.	46	xxx
Volume of Fill	Cu.Yd.	120,400	2,578,700
Total Capacity	Ac.Ft.	1,924	28,842
Sediment Pool(Lowest Ungated Outlet)1/	Ac.Ft.	52	692
Sediment Aerated 1st 50 years	Ac.Ft.	52	692
Sediment Aerated 2nd 50 years	Ac.Ft.	48	639
Sediment in Detention Pool-Aerated	Ac.Ft.	4	80
Retarding Pool	Ac.Ft.	1,820	27,431
Surface Area			
Sediment Pool(Lowest Ungated Outlet)	Acres	9	136
Sediment Pool-Principal Spillway Crest	Acres	9	136
Retarding Pool	Acres	208	2,278
Principal Spillway			
Rainfall Volume (areal)(1-day)	In.	8.40	xxx
Rainfall Volume (areal)(10-day)	In.	13.5	xxx
Runoff Volume (10-day)	In.	6.63	xxx
Capacity (Maximum)	cfs	178	xxx
Frequency Operation-Emergency Spillway	% chance	2	xxx
Size of Conduit	In.	36	xxx
Emergency Spillway			
Rainfall Volume (ESH)(areal)	In.	9.70	xxx
Runoff Volume (ESH)	In.	7.11	xxx
Type		Rock	xxx
Bottom Width	Ft.	400	xxx
Velocity of Flow (Ve)	Ft./Sec.	6.3	xxx
Slope of Exit Channel	Ft./Ft.	0.500	xxx
Maximum Water Surface Elevation	Ft.	979.9	xxx
Freeboard			
Rainfall Volume (FH)(areal)	In.	20.70	xxx
Runoff Volume (FH)	In.	17.82	xxx
Maximum Water Surface Elevation	Ft.	983.5	xxx
Capacity Equivalents			
Sediment Volume	In.	0.24	xxx
Retarding Volume	In.	4.20	xxx

1/ Volume included in sediment aerated 1st 50 years.

TABLE 4 - ANNUAL COST

Seco Creek Watershed, Texas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Floodwater Retarding Structures Numbers 1 through 9	137,704	2,300	140,004
Project Administration	17,952		17,952
GRAND TOTAL	155,656	2,300	157,956

1/ Price Base: Installation - 1969, O&M - Adjusted normalized prices.

2/ 100-years at 4.875 percent interest.

March 1970

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Seco Creek Watershed, Texas

(Dollars) 1/

Item	Estimated Average Annual Damage: Without Project	Estimated Average Annual Damage: With Project	Damage Reduction Benefits
Floodwater			
Crop and Pasture	31,045	8,591	22,454
Other Agricultural	57,943	11,298	46,645
Nonagricultural			
Road and Bridge	2,257	762	1,505
Urban	73,372	0	73,372
Subtotal	164,617	20,651	143,976
Sediment			
Overbank Deposition	926	365	561
Erosion			
Flood Plain Scour	30,230	6,813	23,417
Indirect	26,915	2,782	24,133
TOTAL	222,688	30,611	192,087

1/ Price Base: Adjusted normalized prices, April 1966.

March 1970

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Seco Creek Watershed, Texas
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/ Damage Reduction	Incidental: Ground Water Recharge	Redevelopment	Secondary	Total	Average Annual Cost 2/	Benefit Cost Ratio
Floodwater Retarding Structures Numbers 1 through 9	179,460	~~91,200~~ 114,000	7,620	~~24,780~~ 26,860	~~303,050~~ 327,940	140,000	2.2:1.0
Project Administration						17,950	
GRAND TOTAL	179,460 3/	~~91,200~~ 114,000	7,620	24,780	303,050 327,940	157,950	1.9:1.0 1.5

1/ Price Base: Adjusted normalized prices, April 1966.

2/ From Table 4.

3/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $12,620 annually.

March 1970

INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment for the watershed was developed by the Medina Valley, Bandera, and Nueces-Frio-Sabinal Soil and Water Conservation Districts assisted by personnel from the Soil Conservation Service work units at Hondo, Bandera, and Uvalde, Texas. Conservation needs data were compiled from existing conservation plans within the watershed and expanded to represent conservation needs of the entire watershed. The quantity of each land treatment practice, or combination of practices, necessary for essential conservation treatment was estimated for each land use by capability class. The estimated number of acres, by land use, to be treated during the project installation period are shown on table 1. Hydraulic, hydrologic, sedimentation, and economic investigations provided data as to the effects of land treatment measures in terms of reduction of flood damage. Although measurable benefits would result from application of planned land treatment measures, it was apparent that other flood prevention measures would be required to attain the degree of flood damage reduction desired by local people.

Hydrologic soil and cover conditions were determined by detailed mapping of a 22 percent sample of the watershed.

Present hydrologic cover conditions were determined on the basis of the percentage of vegetative ground cover and litter. Future hydrologic cover conditions were estimated on the basis of the expected percentage of needed land treatment to be applied during the installation period and the probable effectiveness of the application.

Engineering

Studies were made on both the agricultural flood plain and the urban flood plain in D'Hanis to locate those areas subject to flood damage. High water marks of previous floods were obtained from local people who were eye-witnesses to past floods. The areas subject to flood damage were separated into evaluation reaches in order to formulate the most feasible system of structural measures to meet project objectives (figure ___).

No floodwater retarding structure sites were given consideration as possible multiple-purpose structures. The soils and geologic strata of abutments and beneath the sediment and detention pools of all sites except Site No. 1 do not exhibit favorable water holding characteristics.

Comprehensive surveys and investigations were made on ten possible floodwater retarding structure sites.

Nine floodwater retarding structures were selected for inclusion in the final work plan. Structure locations are shown on figure 1. The site surveyed but was not included in the plan was located approximately ___ miles below Site No. 1. Numerous involvements made floodwater retarding structure control infeasible.

Sediment and floodwater storage, structure classification, and emergency spillway layout and design meet or exceed criteria outlined in Engineering Memorandum SCS-27.

Multiple routings of both principal and emergency spillways were made to determine principal spillway sizings, height of embankment, detention storage requirements, and to analyze the effects of release flows on downstream improvements such as highway and low water crossings. Least cost studies were made on planned floodwater retarding structure sites because of extensive rock excavation in the emergency spillways on all except Sites Nos. 1 and 7.

Hydraulics and Hydrology

A stereoscopic study was made using the most recent aerial photographs to delineate the flood plain area. This study was field checked and corrections made after talking to local residents and consultation with the economist.

Valley cross sections were marked on the aerial photographs and concurred in by the economist and geologist. Valley cross sections were then surveyed and plotted.

Water surface profile computations were made to develop rating curves by using the electronic computer at the SRTSC, Fort Worth, Texas. Discharge-velocity curves were plotted to select a typical valley section to represent a routing reach. Project formuation, hydrology, routing reaches were selected and routings were made for present and with project conditions. Three alternate programs were tested for with project conditions. Project formulation hydrology routings were made by using the electronics computer at the SRTSC, Fort Worth, Texas.

Stage-area inundation computations were made for present and with project conditions by the ECON II program on the electronic computer at SRTSC, Fort Worth, Texas. Working jointly with the economist, corrections were made to output data from the ECON II program to conform to changes of structures and flood plain.

Urban depths of flooding to D'Hanis for present and with project conditions were computed for various frequency events.

Stage-area inundation computations for the agricultural reaches were also computed using the frequency method.

Stream gauged data, published by the U.S.Geological Survey, was used to determine recharge benefits and input data for log pearson frequencies computations made using the electronic computer at the SRTSC, Fort Worth, Texas.

U.S. Weather Bureau T.P. 40 was used to select rainfall volumes for various frequency events.

Geology

Soils and Foundations

Preliminary geologic investigations were made at each of the nine floodwater retarding structure sites (figure__) to obtain information on the nature and extent of embankment and foundation materials, types of materials in emergency spillway excavation, emergency spillway stability, and other problems that might be encountered during construction. These investigations were made in accordance with Technical Release No. 17, "Geologic Investigations for Watershed Planning", March 1966 and NEH, Section 8, Chapter 6. These investigations included core drill and power auger borings, hand portable seismograph tests, and surface observations of valley slopes, alluvium, channel banks, and exposed geologic strata. Geologic maps and reports concerning the watershed and vicinity were studied.

Findings of these investigations were used in making cost estimates of structures and to assure that sites selected are feasible for construction.

All nine planned floodwater retarding structures will be located within the Balcones fault zone. In general the faults are the normal type, trend toward the east-northeast, and are upthrown on the north-northwest. The regional dip is toward the south-southeast, but local dips in almost any direction can be found. The dip angles are generally less than two degrees.

Site No. 1 is located in an area of strong relief on the outcrop of alternating beds of calcareous clay and shale and hard limestone belonging to the Glen Rose Limestone Formation. Pliestocene and Recent alluvial deposits, consisting mainly of silty clay, sandy clay, and gravelly clay, overlie the Glen Rose Formation on the flood plain and stream terraces. The thickness of the alluvium ranges to greater than 15 feet beneath the major portion of the dam and pool areas.

Sites Nos. 2,3, 4, 5, and 6 lie on the Lower Cretaceous outcrop of the Edwards Limestone. The topographic relief is moderate to strong. The aboutments are composed of hard, massive to medium bedded, somewhat vugular limestone. Recent Alluvium, consisting of silty clay, gravelly clay, sandy clay and clayey gravel, occupy the valley floors. The alluvium is generally thin, but ranges up to 13 feet in thickness at Sites Nos. 3 and 6. Indurated caliche is common at the base of the alluvium and rests upon limestone bedrock.

Sites Nos. 7, 8, and 9 are by the Austin Chalk Formation of the Upper Cretaceous series. The formation consists of brittle, thin bedded to massive chalky limestone and calcareous clay and shale. The topography is mostly moderate, but each site has one steep abutment. Recent alluvium, consisting of silty clay and gravelly clay and ranging up to 8 feet in thickness, overlies the Austin Chalk on the flood plains.

Foundation materials at the nine sites exhibit evidence of sufficient bearing and shear strength. However, the need for foundation drainage measures is anticipated at all floodwater retarding structure sites because of the common occurrence of rapidly permeable horizons in both the alluvium and bedrock.

Sufficient volumes of alluvial clay, silty clay, sandy clay, gravelly clay, clayey sand, silty sand, and clayey gravel are available for embankment construction within short haul distances. Durable limestone from emergency spillway excavation will be available at Sites Nos. 2,3, 4, 5, 6, 8, and 9 for use as rock blankets on the embankments.

Preliminary estimates of rock excavation in emergency spillways are ______ cubic yards at Site No. 2; ________ cubic yards at Site No. 3;__________ cubic yards at Site No. 4; ________ cubic yards at Site No. 5;__________ cubic yards at Site No. 6; ________ cubic yards at Site No. 8; and ________ cubic yards at Site No. 9.

Detailed investigations, including exploration with core drilling equipment, will be made at all sites prior to final design. Laboratory tests will be made to determine suitability and methods of handling foundation and embankment materials.

Ground Water

An investigation was made in accordance with NEH, Section 18, and Technical Release No. 17, "Geologic Investigation for Watershed Planning", March 1966, to determine the effect the project would have on ground water resources of the area.

Pertinent information was gathered from recent publications of the Geological Survey, United States Department of the Interior, concerning ground water in the vicinity of the watershed. Field studies included inspecting and mapping exposed geologic strata, borings with power drilling equipment, and observations of water losses during bore hole advancement.

The Leona River watershed is underlain by two important aquifers, the Edwards and associated limestones of Cretaceous age and the Leona Formation of Pleistocene age. Other less important aquifers will not be discussed in the work plan.

The principal aquifer is the Edwards and associated limestones, consisting of the Georgetown Limestone, Edwards Limestone, and the Comanche Peak Limestone. These formations behave as a single hydrologic unit beneath an extensive portion of south-central Texas and comprise a vast ground water reservoir. The reservoir lies within the Balcones fault zone, where numerous joints, fractures, sinkholes, and solutional channels in the limestones permit rapid infiltration and movement of water. The size of openings ranges from caverns, through which water moves freely, to minute solutional cavities and cracks where large head losses occur.

The aquifer is recharged primarily by streams which originate upstream from the Balcones fault zone, flow across the fault zone, and lose large volumes of water to the limestones. The greater volume of ground water in the reservoir moves from Kinney County eastward through Uvalde and Medina Counties and into Bexar County to the San Antonio vicinity. The direction of flow then turns toward the northeast, crosses Comal County, and extends to San Marcos in Hays County.

Much of the natural discharge from the aquifer occurs at the eastern end of the reservoir in Bexar, Comal, and Hays Counties. Artificial discharge is increasing rapidly. This is primarily due to increasing irrigation and expanding cities and military bases.

Pronounced and rapid water level fluctuations occur in response to droughts, pumping, and rainfall. Since about 1934, the estimated average annual recharge has been less than average annual discharge.

The Leona Formation, composed of alluvial clay, silt, sand, gravel, and cobbles, is also an important aquifer occupying the valley of Seco Creek and other streams in the vicinity. A small spring south of D'Hanis on the Seco Creek flows from gravel beds of the Leona Formation. The primary source of recharge to the Leona Formation is direct stream flow seepage from Seco Creek and other streams of the area.

In the Seco Creek watershed, the Edwards and associated limestones are recharged primarily by runoff from streams which cross the Balcones fault zone to the west. Seco Creek heads north of the recharge zone. It has a base flow, in its upper reaches, sustained largely by small springs issuing from porous beds in the Glen Rose Limestone, This flow ~~in its~~ upper reaches ~~which~~ is absorbed by porous limestones in its mid reaches where the rocks are highly fractured and faulted.

A study was made to estimate the significance of ground water recharge within the Seco Creek watershed under existing conditions. The estimate was based on average annual runoff above the recharge zone compared with average annual runoff below the recharge zone. The difference between the two is considered to be the amount of recharge. Since the gages on Seco Creek have been in operation only a short period, other streams in the vicinity where records of longer duration were available were used as a basis for the estimate. The estimated average annual recharge under present conditions is 15,400 acre-feet (62 percent of the average annual water resources available).

The pools of ~~all~~ eight of the nine nine structures will lie within the recharge zone. Site No. 1 lies north of the recharge zone. The estimated increase in average annual ground water recharge, resulting incidentally from installation of floodwater retarding structures, is 7,600 acre-feet. In addition, there are excellent opportunities for local interests to install other works such as recharge wells and improved openings for maximum injection of impounded water and release flows from floodwater retarding structures.

Sedimentation

Sedimentation investigations were made in accordance with procedures as outlined in NEH, Section 3, Technical Release No. 17, "Geologic Investigations for Watershed Planning", March 1966, and Technical Release No. 12, "Procedure-Sediment Storage Requirements for Reservoirs", January 1968.

Sediment Storage

Determinations for 100-year sediment storage requirements for the nine planned floodwater retarding structures (figure __) were made according to the following procedure:

Detailed studies of soils, slopes, and cover were made within sample areas covering 22 percent of the watershed. The sample areas were selected to be representative of the watershed in respect to sediment producing characteristics. Average annual sheet erosion rates, for both present and future conditions, were computed. The soil loss equation by Musgrave was used. Estimates of average annual sheet erosion within drainage areas of structure sites were based on the computed erosion rates.

Computations of gully and streambank erosion were based on estimated lateral bank erosion rates, bank heights, and channel lenghts affected by erosion.

Sediment delivery ratios and trap efficiency adjustments were applied to computed average annual erosion to arrive at estimates of sediment volumes to be deposited in reservoirs.

Allowances were made for differences in density between soil in place and sediment. These densities were based on estimated volume weights of 60 pounds per cubic foot for submerged sediment and 82 pounds per cubic foot for soil in place.

Allocation of sediment to the pools of floodwater retarding structures was based on sediment texture and reservoir topography. The allocation was approximately 95 percent in sediment and sediment reserve pools and 5 percent in detention pools.

A sedimentation survey was made at Davenport Lake, located about 30 miles west of Seco Creek within the drainage area of Site No. 2 Leona River watershed. After computing the actual rate of sediment deposition in the

106 acre reservoir, the procedure described above was followed in order to determine its applicability in estimating sediment storage requirements for planned floodwater retarding structures in the vicinity. The accuracy of the procedure was approximately 90 percent.

Flood Plain Sediment and Scour Damages

The following investigations and computations were made to determine the nature and extent of physical damage to flood plain lands and the effect of the project on these damages:

Borings were made along valley cross sections (figure 1). Factors such as depth and texture of sediment deposits, soil condition, depth and width of scoured areas, channel degradation or aggradation, and channel bank erosion were recorded. The elevation of the original flood plain before modern deposition began was estimated for each valley section. Estimates of past physical flood plain damage were obtained through interviews with landowners and operators.

A damage table was developed to show percent loss of productive capacity by texture and depth increment for sediment and by depth and width for scour. Due consideration was given to agronomic and land treatment practices, soils, crop yields, and land capabilities in assigning damages. Adjustments for recoverability of productive capacity were made on the basis of field studies and interviews with farmers.

Each valley cross section represents a segment of flood plain within an evaluation reach. The area of each damage category was computed by segments and summariezed by evaluation reaches.

Estimated reductions of damaging sediment yield were based on detailed sediment source studies. Sediment yields to evaluation reaches were computed for without project conditions, with land treatment measures applied, and with the combined program of land treatment and structural measures installed. The reductions in sediment yields were adjusted to reflect the relative importance of each sediment source as a contributor of damage. The estimated reduction of monetary damage from overbank deposition was based on reduction of area inundated by floodwater and reduction in damaging sediment yield. The estimated reduction of scour damage due to installation of the project was based on reduction of depth and area inundated by floodwater.

Economics

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guide for Watershed Protection and Flood Prevention", U.S. Department of Agriculture, Soil Conservation Service, March 1964.

Because of the diversity of damageable values and flood plain characteristics, the flood plain was divided into six evaluation reaches (figure 1). Of these, one was in the urban area of D'Hanis.

Determination of Nonagricultural Damages

The ~~synthetic~~ frequency method of analysis was used. Information was collected in the field on damages experienced from the flood of June 1958 and from several other floods. At the same time an evaluation was made of the damages that would occur from a flood which could be expected on an average of once in 100 years. Under without project conditions, a flood of this magnitude would result in high water elevations in D'Hanis of approximately 2.0 feet higher than the high water elevations recorded in 1958. High water marks from the experienced floods were used to determine peak stages which in turn were related to stages calculated for the synthetic series. Stage damage curves were developed to cover the range of damage producing floods. Average annual damages under present state of development were calculated for each evaluation reach.

An analysis was made of existing data pertaining to the economic development of the D'Hanis area. In addition, data developed by the Office of Business Economics (OBE), U.S. Department of Commerce, for Area 09135, which includes the town of D'Hanis, was analyzed to determine the factors which have contributed to the overall economic growth of the area. Bank deposits were also considered.

From these indicators, it was assumed that per capita income and resulting total personal income for D'Hanis will increase at about the same ~~total~~ rate as for the ~~entire~~ OBE Area.

The urban flood plain of Seco and Parker Creeks is subject to infrequent flooding. Most of the property in the flood plain is composed of moderate to low value residential units. Few business properties exist or are expected to be developed in the area. The population of D'Hanis has remained relatively stable for the past 20 years. Property subject to flooding will continue to increase in value because of progressively higher per capita incomes. Because of the low starting base, low per capita income, and resulting increases in damageable values, developments may increase at above average rates for the OBE Area. For these reasons, it is believed that projections of per capita income best reflect the value of properties that would be subject to flood damage even in the absence of a project. Therefore, damage to the existing development was increased by 115.8 percent to reflect the gradual accrual of these values discounted to present worth.

It is conservatively estimated that this type of development would cause the existing urban values to increase during the first 50-years of the project life and to remain at this level for the remainder of the 100-year project life.

Indirect damages associated with urban flooding will bear a higher than normal relationship to the direct damage. Expenses associated with dislocation of residents and rehabilitation of businesses will be high. For this reason, it is estimated that indirect damages to urban property would approximate 20 percent of the direct damage.

Estimates of damages to railroads, roads, highways, and bridges in the flood plain were obtained from railroad officials, county officials, State highway officials, and supplemented by information from local residents.

Determination of Agricultural Damages

Agricultural damage calculations were based on information obtained in interviews with owners and operators of approximately 40 percent of the acreage of the flood plain. Schedules covered flooding and flood damage; past, present, and intended future use; and yield data. Verification of information gained by interviews in the field was obtained from local agricultural technicians.

The synthetic frequency method of analysis of damages was used, and the occurrence of more than one flood in a growing season was considered in determining crop and pasture damage. The computed damages were discounted for the recurrence with allowance for partial recovery between floods.

Other agricultural damages to irrigation facilities, fences, farm roads, livestock losses, and the cost of removing debris from fields were estimated from information collected in the field and correlated with area and depth of flooding.

Monetary damages to the flood plain from scour and overbank deposition were based on the value of production losses. Scour damage reductions were related to the area of flooding, and influenced by the increased scouring effect from deeper flows. Reduction in monetary damages from sediment deposition was based on the effectiveness of land treatment measures, trap efficiency of planned floodwater retarding structures, and the average annual area flooded under each progressive phase of the project.

Incidental Benefits from Ground Water Recharge

Ground water recharge will occur incidental to the installation of the floodwater retarding structures. Flood prevention was the only purpose considered in the location and design of these structures. No additional costs are involved in obtaining recharge as it takes place naturally as seepage. When the structures are installed, it is estimated that an additional 7,600 acre-feet will be recharged annually.

Investigations were made in an attempt to determine the areas of recovery and probable use of the additional water made available by recharge. These investigations indicated that because of the vastness of the Edwards aquifer and its hydraulic gradient, generally to the east, areas of recovery and purposes of use could not be predicted with any degree of certainty. Undoubtedly some of the recharge will be recovered in the immediate area, but most of it will probably be recovered from that portion of the Edwards underground reservoir between Medina County and the springs at San Marcos.

Water recovered from this area is used largely for agriculture, recreation at Comal and San Marcos springs, municipal and industrial use, and abatement of stream flow pollution. Based on studies made by the U.S. Army Corps of Engineers and the Edwards Underground Water District, the value of an acre-foot of water to increase the pumping potential of the underground aquifer varies from about $15 to $38. In view of uncertainties regarding the efficiency of recovery, the value of ground water recharge was appraised at the lowest estimated value of $15 ~~$12~~ per acre-foot. Total annual benefits from this source were estimated to average ~~$91,400~~.

Redevelopment Benefits

Redevelopment benefits which would accrue during project installation and from operation and maintenance were calculated by applying prevailing wage rates to the amount of local labor by classes and types that will be used by contractors. This estimate was converted to an average annual equivalent value by the application of appropriate amortization factors. The estimate of the amount of local labor which will be used was based on an analysis of recent contracts. Medina County has been designated as a county eligible for assistance under provisions of the Economic Development Act.

Negative Project Benefits

Areas that will be used for project construction and areas to be inundated by pools of reservoirs were excluded from damage calculations. Net income from production to be lost in these areas after installation of the project was compared with the appraised value of the land amortized over the period of project life. No production in sediment pools was considered and the land covered by detention pools was assumed to be rangeland under project conditions. The annual value of the loss of net income from these areas was less than the amortized value of the land; therefore, the easement value was used in economic justification.

Secondary Benefits

The value of local secondary benefits stemming from the project were estimated to be equal to 10 percent of direct primary benefits, including those from reduction of damages and incidental ground water recharge. This excludes all indirect benefits from the computation of secondary benefits.

Fish and Wildlife

The Bureau of Sport Fisheries and Wildlife, in cooperation with the Texas Parks and Wildlife Department, has completed a reconnaissance study of Seco Creek watershed. This report was valuable in work plan development pertaining to fish and wildlife. In addition to data presented in other parts of the work plan, the following is reproduced from the Bureau of Sport Fisheries and Wildlife reconnaissance survey report:

> "If any of the floodwater retarding structures hold water, they could present attractive opportunities for sport fishing in an area where there is considerable demand and few places

for people to fish. The structures would be expected to provide habitat for species such as largemouth bass, bluegill, and channel catfish. There still would be no commericial fishing.

To increase fertility and reduce turbidity in floodwater retarding structures that hold water, the reservoir basins and barren areas draining into them should be planted to grasses or other suitable vegetation prior to impoundment. The exclusion of livestock from the reservoir detention pools would prevent fouling of the water and permit the growth of native food and cover plants of value to wildlife. Where practical, the dams should be fenced to prevent damage by livestock. If practicable, the detention pools should be fenced and water requirements for livestock be met by piping water to tanks below the dams and outside the enclosures or by providing water lanes to detention pools.

Indiscriminate fish stocking often results in unbalanced fish populations. The Texas Parks and Wildlife Department should be consulted regarding reservoir stocking requirements in order to avoid the introduction of undesirable fish species in the watershed, or stocking at undesirable rates.

As much brush and timber as possible should be retained in the watershed for wildlife. Losses of brush and timber resulting from the installation of project measures could be offset by planting trees and shrubs at appropriate locations such as on idle lands, eroded areas, banks, gullies, along fencerows and hedgerows, and around the reservoirs.

In view of the above, it is recommended that:

1. Basins of the floodwater reservoirs and barren areas draining into them be planted to grasses or other suitable vegetation upon completion of construction and prior to detention of water.

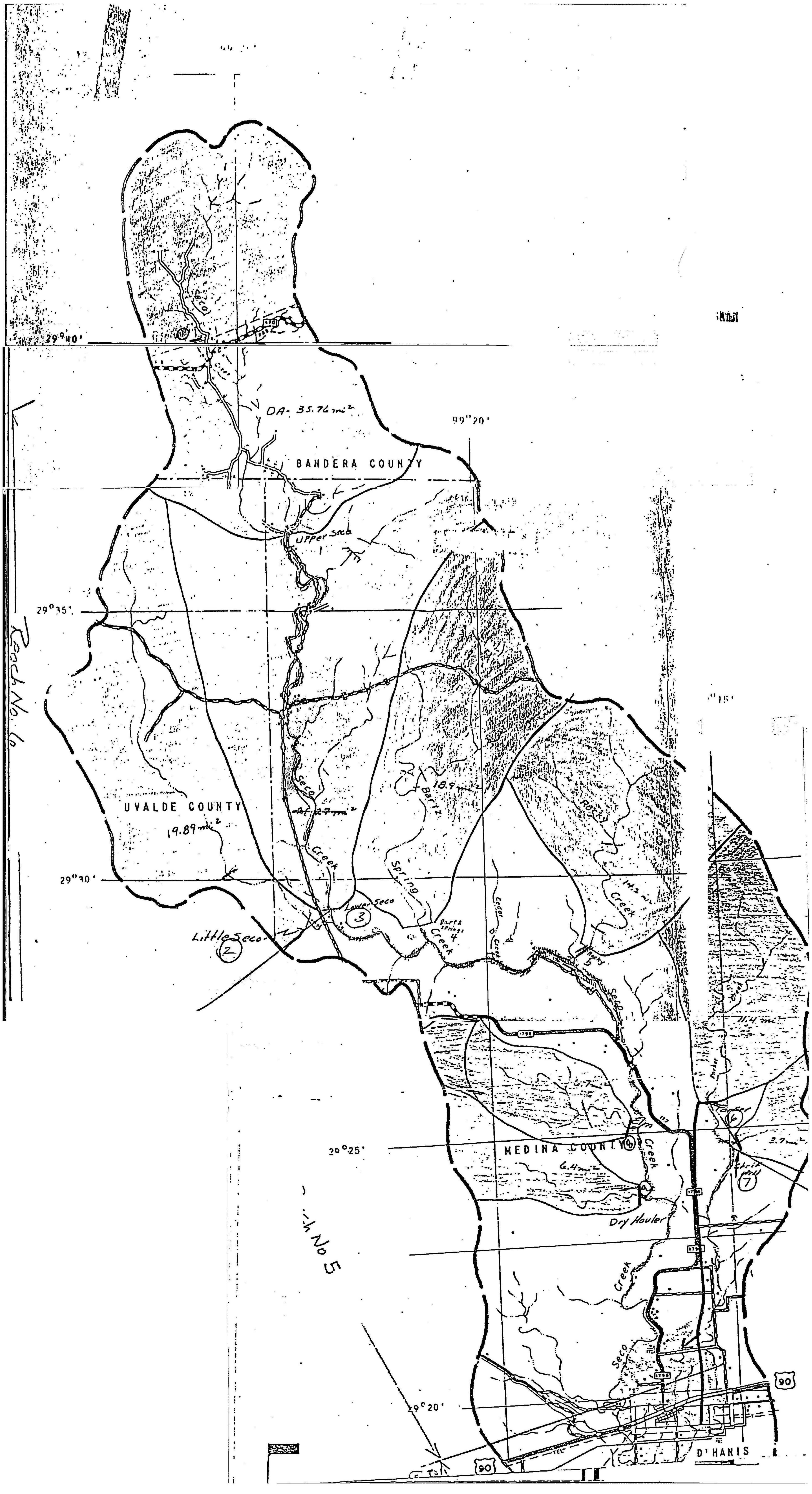
2. Floodwater retarding reservoirs be fenced, watering devices be installed below the drains outside the fenced enclosures, or water lanes for cattle be provided to the detention pool.

3. Floodwater retarding reservoirs be stocked with fish species and at rates recommended by the Texas Parks and Wildlife Department.

4. Clearing of timber and brush in the watershed be kept to a minimum during and following project construction.

5. Losses of brush and timber be compensated for by planting trees and shrubs suitable for wildlife at appropriate locations such as idle lands, eroded areas, streambanks, and along fencerows.

The above recommendations are in conformance with the USDA Soil Conservation Service's Biology Memorandum-7(Rev. 1), National Standards for Biology Practices. If adopted as a part of the plan of development, losses of wildlife habitat would be mitigated and, additionally, fish and wildlife benefits would accrue to the project.


29°40'
DA- 35.76 mi²
99°20'
BANDERA COUNTY
Upper Seco
29°35'
Reach No. 6
UVALDE COUNTY
19.89 mi²
18.9 mi²
Seco
Creek
Spring
Creek
Rock
Creek
14.2 mi²
29°30'
Little Seco
Lower Seco
11.4 mi²
MEDINA COUNTY
6.4 mi²
29°25'
Dry Hollow
Reach No 5
Creek
Seco
29°20'
D'HANIS
90