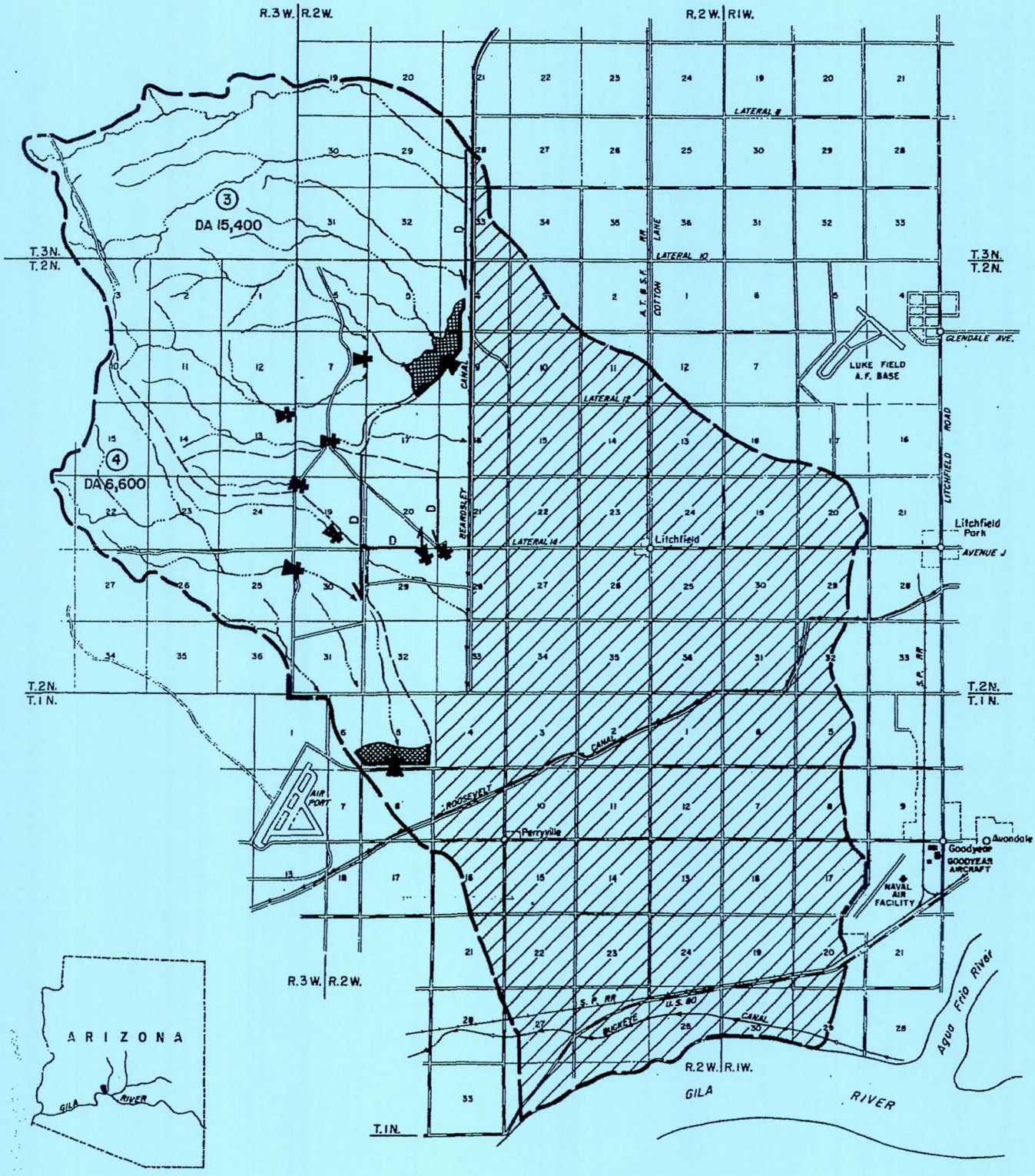
WORK PLAN
WHITE TANKS WATERSHED
ARIZONA



PREPARED BY
SOIL CONSERVATION SERVICE
UNITED STATES DEPARTMENT OF AGRICULTURE
APRIL, 1954

M-514

AGUA FRIA SOIL CONSERVATION DISTRICT

P. O. BOX 578, WE 5-9251
PEORIA • ARIZONA

June 3, 1954

Mr. Lucien Hill,
Area Soil Conservationist,
Soil Conservation Service,
United States Department of Agriculture,
39 N. 6th Ave.
Phoenix, Arizona.

Dear Mr. Hill;

The Supervisors of the Agua Fria Soil Conservation District have reviewed the Work Plan for the White Tanks Watershed as prepared by the Soil Conservation Service.

We whole heartedly subscribe to the plan and will do our part in effecting its completion and successful operation.

Very truly yours,

H. S. Raymond, Secretary

MARICOPA COUNTY MUNICIPAL WATER CONSERVATION
DISTRICT NUMBER ONE

P. O. BOX 807
PEORIA, ARIZONA

June 3, 1954

Mr. Lucien Hill,
Area Soil Conservationist,
Soil Conservation Service,
United States Department of Agriculture,
39 N. 6th Ave.
Phoenix, Arizona.

Dear Mr. Hill;

We have reviewed the Work Plan for the White Tanks Watershed as prepared and presented by the Soil Conservation Service. We are in agreement with the plan and pledge our continued participation in the construction, maintenance, and operation of the project.

Very truly yours,

H. S. Raymond, District Engineer.

WORK PLAN

WHITE TANK WATERSHED PROTECTION PROJECT
Agua Fria River Watershed
Maricopa County, Arizona

Participating Agencies

Agua Fria Soil Conservation District
Maricopa County Municipal Water Conservation District
Soil Conservation Service, USDA

Prepared by
Soil Conservation Service
United States Department of Agriculture
April 1954

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WORK PLAN
WHITE TANK WATERSHED PROTECTION PROJECT
AGUA FRIA RIVER WATERSHED
MARICOPA COUNTY, ARIZONA.

INTRODUCTION

Authority - The Federal participation outlined in this work plan is expected to be performed under the authority of the Soil Conservation Act of 1935 (Public Law No. 46 74th Congress) and other authorities of the national programs of concerned agencies.

Purpose and Scope of the Plan - The purpose of this plan is to state specifically the practices and measures required and feasible and how they will be carried out to achieve the maximum practicable reduction of erosion, floodwater and sediment damages. Application of this mutually developed plan will provide protection and improvement of land and water resources which it has been agreed can be undertaken at this time with the combined facilities of local interests, State and Federal agencies. Upon completion and continued maintenance of the measures set forth in this plan, agricultural production will be sustained at a level corresponding to the capability of the land, and the welfare of the landowners and operators, the community, and State and the Nation will be promoted thereby. The area in the subwatershed is entirely in Maricopa County and contains 59,136 acres, or 92.4 square miles.

SUMMARY OF PLAN

This plan is a combination of land treatment practices and measures used for the conservation of water and watershed lands which contribute directly to flood prevention, and of measures primarily for flood prevention. The works of improvement as listed in combined Tables 1 and 2 are planned to be completed entirely during calendar year 1954, at an estimated total cost of $417,375, said cost to be shared $218,287, by the non-Federal interests and $199,088 by the Federal Government. These estimates include the current costs of local interests and Federal agencies under the going national programs pertaining to the objectives of this plan.

The Agua Fria Soil Conservation District hereafter referred to as the "District" will assume overall responsibility for future operation and maintenance of this project. This District has arranged with the Maricopa County Municipal Water Conservation District #1 (Locally known and hereinafter referred to as the Beardsley Project) an irrigation district organized under laws of Arizona to assume specific responsibility for overall periodic inspection of the measures primarily for flood prevention and for maintenance of the floodwater retarding structures and directly associated measures at an estimated annual cost of $3,750.

Comparison of Benefit and Cost - When the works of improvement are applied and operating at full effectiveness, the ratio of the estimated average annual benefit ($35,350) to the estimated average annual value of the cost $20,860 is 1.7 to 1 based on current price levels for costs and long term prices for benefits.

DESCRIPTION OF THE WATERSHED PROTECTION PROJECT AREA

The White Tank Mountains generally form the western edge of the Agua Fria River Watershed near its confluence with the Gila River. Drainage from the eastern face of the White Tank Mountains is divided between Trilby Wash on the north, tributary to the Agua Fria River, and an intermittent stream locally known as Avondale Wash, tributary to the Gila River on the south. It is this southern portion of the White Tank Mountain drainage area that comprises the subwatershed area covered by this plan. The watershed has a gross area of 59,136 acres, of which 25,024 acres are mountain and foothill slopes comprising the drainage area and flood source. The remaining 34,112 acres are intensively irrigated land lying on a broad, gently sloping alluvial fan and terrace which have an average slope to the southeast of about 0.4 percent. Channels are very poorly defined or even non-existent through the cultivated areas, making the construction of floodways through the farmland to the Gila River impractical.

Following the disastrous floods of 1951, the Agua Fria Soil Conservation District with the technical assistance of the Soil Conservation Service prepared plans designed to reduce the damages caused by flash runoffs from the White Tank - Trilby Wash watersheds. Construction of a series of four primary detention structures numbered (1) to (4) respectively were planned, near the mouths of Trilby and Avondale Washes. Damage to military and national defense installations in the area, however, led to the initiation by the Corps of Engineers of plans for the protection of these installations from water originating in the Trilby Wash drainage. These plans of the Corps of Engineers also protect the irrigated lands from floods from Trilby Wash so no further

consideration was given by the Soil Conservation Service for structures (1) and (2) of their original plan.

The Avondale Wash watershed has no protection and therefore active interest in watershed protection has been maintained in this area. The necessity for structures 3 and 4 remains, if adequate protection to farm lands is to be obtained. Since the numerical designation has become recognized through usage, it has been retained throughout this report. Costs of original planning on these four structures have been prorated and those applying to structures 3 and 4 are charged as a portion of the engineering costs incident to this plan.

The soils of the area comprise recent alluvial soils along the Gila River, the moderately developed fan soils of the intermediate slopes and the shallow soil materials and rocks in the White Tank Mountains. The soils of the intermediate slopes, including the bulk of the cultivated lands, are moderately deep, deep or very deep, calcareous, moderately developed fan soils. They are derived principally from granites and schists.

Soils derived from these parent materials compact badly as a rule and as a result water penetrates slowly and they are highly susceptible to erosion. The organic matter content is low but the general fertility level is good with the possible exception of nitrogen.

The soils of the area have been classified according to their permanent limitations and hazards into five capability classes. The non-arable lands fall into classes VI, VII and VIII, whereas the cultivated lands fall into classes I and II. See Map 2. Irrigation is required for successful crop production. Water for irrigation is available and exceptionally high crop yields are obtained.

Class I lands are productive farm lands with very few or no permanent hazards or limitations. These lands are subject to a moderate overflow hazard at the present time. The proposed program will greatly reduce this hazard. Class II lands have a few recognized limitations and under the conservation farming being practiced in this area safe and continuing production is assured. The limitation which places these lands in Class II is the greater slope which creates an erosion hazard. Land leveling and adjustment of length of irrigation runs keep erosion at a minimum. Class II lands are also subject to a moderate overflow hazard which will be greatly reduced by this project works. Good land management, including the use of fertilizers and crop rotations to improve soil structure, is essential to keep the soils of both classes I and II productive.

Class VI lands consist of desert bottom intermingled with rolling desert plain. The soils are medium textured and subject to gullying when the vegetative cover is depleted. The dominant climax vegetation is sacaton and big galleta. Class VI lands have moderate rates of runoff.

Class VII lands consist of medium textured soils of varying depth with plane to slightly rolling topography. The climax vegetation is mixed desert grass and shrub. Class VII lands have high rates of runoff

The upper portion of the watershed is mapped as desert mountains and includes capability classes VII and VIII. These lands consist of bare rock or rough, stony, mostly shallow soils. Vegetation consists of desert shrubs such as encelia, bursage, cactus cholla, lycium, mariola and grasses such as bush muhly, tobosa, Arizona Cotton grass and black grama. Runoff rates are very high. Infiltration rates for

classes VI, VII and VIII vary from .10 inches per hour on the less permeable shallow soils to .60 inches per hour for the desert bottoms. Sediment production rates are relatively low in this area.

The elevation of the watershed varies from about 950 feet above sea level at its confluence with the Gila River to 3,500 feet at the crest of the White Tank Mountains. Mean temperatures range from 50 degrees Fahrenheit in winter to 91 degrees in summer, with recorded extreme temperatures ranging from a low of 17 degrees to a high of 117 degrees. The average date of the last killing frost is March 3 and that of the first killing frost is November 22, or a normal frost free period of 264 days. The mean annual precipitation is 8.04 inches, which generally occurs in two well defined rainy seasons. The winter rainy season usually extends through December, January and February, while the summer season includes July and August and early September. During the summer flood season the damage potential is very high due to the fact that crops, especially cotton which is the staple crop in the area, are very susceptible to damage. In contrast, during the winter flood season the value of crops is much lower. Most of the cotton has been harvested at this time and the growing crops consist of alfalfa, small grain and a small acreage of winter vegetables. Offsetting the lower crop values during the winter rainy season, to some extent, is the higher damage that land sustains due to the fact that it is not so well protected. Other direct flood damages are not usually affected by the season in which the flood occurs.

The range land in the upper, mountainous part of this watershed has sparse vegetation of the desert grassland type. Forage production is low and generally grazing occurs only after periods of unusually high precipitation. Because of the low precipitation, difficulty of

access, and scarce watering facilities, grazing use has not significantly affected the vegetative cover in the upper portion of this watershed.

The cultivated land is highly productive under irrigation and is intensively farmed with cotton being the principal cash crop. Alfalfa barley and various varieties of sorghums are the principal feed crops. Some winter vegetables are grown on the less calcareous soils. Double cropping is practiced to some extent, but not to the degree found in the Salt River Valley to the east. Farm units vary from small family-size farms of forty to eighty acres to large commercial farms covering several thousand acres. The value of crop production in the watershed is estimated at seven million dollars annually.

The White Tank Watershed includes parts of three soil conservation districts, the Agua Fria, Roosevelt and Buckeye. Because of the nature of the enabling legislation prior to an amendment adopted by the legislature in 1954 soil conservation districts in Arizona are limited to areas used primarily for crop production. The non-arable flood producing portion of the watershed is, therefore, not included within the boundaries of any district. The Agua Fria Soil Conservation district sponsored this project as major structures and principal damage areas are in this district.

Approximately 53 percent of the land in the watershed is privately owned. Ownership of the remainder is about equally divided between the State of Arizona and the Federal Government. The Federal land is all included in Arizona Grazing District Number 3 and is administered by the Bureau of Land Management. Most of the high runoff producing portion of the watershed is publicly owned, whereas the flood plain is

privately owned. See map 3.

The watershed is adequately served by a network of county roads aggregating 62 miles. U. S. Highway No. 80 crosses the lower portion of the flood plain for a distance of four miles. Drainage ways are poorly defined or non-existent in the flood plain, so destruction of bridges does not constitute an important part of highway damage. The Southern Pacific railroad crosses the lower portion of the flood plain, generally paralleling U. S. Highway No. 80. In addition, the Santa Fe Railway has a branch line from Ennis extending about 2½ miles into the flood plain from the north. Portions of the supply canals of the Beardsley, Roosevelt, Goodyear and Buckeye Irrigation Districts lie within the flood plain. All are subject to damage by floods. Many miles of farm laterals serve the farm land in the watershed.

There are no incorporated towns within the watershed. Phoenix, within 20 miles of the watershed, is the trade center for this part of Arizona. The small unincorporated villages of Liberty and Perryville are in the lower end of the watershed. Cotton gins are located at various places throughout the farming area. The Caterpillar Tractor Company has a proving ground for testing various types of earth moving equipment near the central part of the watershed.

FLOOD AND EROSION PROBLEMS AND DAMAGES

Storm runoff from the White Tank Mountains and intervening foothill areas strike the Beardsley Canal at the western edge of the flood plain. Siphons have been installed along this canal at natural drainageways so that floodwater may pass over without damage. However, past experience has shown that these siphons are inadequate both as to capacity or number

to handle anything but small flows. Occasionally even small flows damage the canal because aggradation causes shifts in the channels above the canal and floodwater may strike a section of the canal where there is no siphon. After the water passes over the Beardsley Canal it tends to spread out because of the flat terrain and absence of defined channels. This sheet flow is, however, modified by roads and irrigation ditches which tend to concentrate the water until sufficient volume is attained to cause it to break over into adjoining fields. Improved roads have eroded in some cases to depths of 3 to 4 feet. Ponding usually occurs in the lower ends of flooded fields until water over-tops and breaches the irrigation lateral that has caused the ponding. Other obstructions such as railroad grades or flood dikes may shift the area of overflow but seldom reduce it. Attempts to control floodwater, once it has crossed the Beardsley Canal, have not been successful. Farm property incurs the greatest damage of any type of property within the flood plain. Crop yields are reduced by scouring of soil from the plant roots, ponding and scalding due to high temperatures. Irrigation furrows and field laterals may be so badly damaged late in the irrigation season that it is not possible to make the final irrigation needed to develop a profitable yield. In many cases where land damage is severe the land cannot be cultivated until it has been releveled. Growing alfalfa usually is not seriously damaged, but hay that has been cut is a complete loss. Land damage is greatest where water concentrates and flows with considerable velocity as it does below breaks in irrigation laterals, road fills, or other obstructions and where there is no protective cover from growing crops or crop stubble.

Farm irrigation systems are damaged by even relatively small floods. Earthen ditches generally require rebuilding after a flood, and the case of ditches formed above the ground surface considerable dirt has to be hauled in to build a new ditch. Concrete lined ditches generally withstand small floods, but scouring of the soil away from the lining causes structural failures that are expensive to repair. Occasionally pump motors are fouled by sediment and have to be repaired before they can be used. In a few cases, irrigation wells have caved in and have been abandoned. Farm improvements are frequently damaged, though not seriously because water does not attain great depths. Farm machinery is damaged if the water reached sufficient depth to deposit mud on moving parts. Stored crops and supplies sustain damages. The lower tiers of stacked baled hay that are flooded usually rot and this also requires the rebuilding of the stack.

Flood flows from the upper watershed first strike the Beardsley Canal with sufficient force to breach it in many places. Larger floods also damage other canals. Siphons and unloaders to spill floodwater that gets into canals have been installed, but these measures have been of only minor benefit. The floods of 1951 breached canals in many places and tore out many sections of canal lining, ruined two irrigation wells and washed out training dikes. In some places the canal embankments have been washed out so many times that it is becoming increasingly difficult to secure earth within reasonable distances to patch them. The Beardsley District has been forced to defer replacing some canal lining until the flood hazard is reduced except where the canal gradient is so steep that lining is necessary to prevent damaging erosion. As a result, water losses from seepage have increased. County roads are

very susceptible to damage by floodwater. This is due primarily to two reasons: first, road beds have eroded below ground level and now serve as channelways, and second, the location of irrigation laterals on the downstream side of east and west roads provide a natural barrier to prevent water from draining off the road. As a result, most roads are sub-standard and until such time as the flood hazard is reduced, permanent road improvements are not practicable.

Railroads in the flood plain experience some damage in each flood. The principal damage is loss of ballast where floodwaters over-top the roadbed. Occasionally, the roadbed is washed out and requires major repair work before trains can again move over the line.

Damage to power and telephone lines is usually limited to undermining a few poles, thereby necessitating resetting or straightening. The cost associated with this type of damage in this area is comparatively small.

The true value of property subject to damage in the flood plain is estimated at $23,900,000, distributed as follows (1951 prices):

Agricultural	$22,110,000.00
Irrigation Works	1,320,000.00
Transportation Facilities . . .	370,000.00
Rural Non-Farm	100,000.00

Flood records of the past 25 years indicate that damaging floods occur once in two years on the average. Analysis of high intensity storms and examination of past flood records show that fully 85 percent of the floods can be expected during the summer months when crops are most susceptible to damage. The most damaging recent flood year was 1951 when floods in January, July and two in August occurred. The flood of August 28, 1951, caused direct damage of more than $200,000.

The total primary direct floodwater damage is estimated to average $28,220 annually, of which 47 percent is crop damage. About 23 percent is irrigation system damage including farm laterals, 15 percent is land damage and the remainder consists of damage to transportation facilities and farm improvements. None of this floodwater damage occurs in the area which will be inundated by proposed detention structures. These figures are based on all floods up to and including those of 100-year frequency. In addition, there are important indirect primary damages such as the reduction in crop yields arising from interruption of irrigation schedules, travel interruptions or detouring costs, losses of income to cotton gins and reduction of income to cotton workers. The estimated annual value of these indirect primary damages is $7,000. See Table 4.

Erosion Damage - Soil erosion, exclusive of flood plain scour, is a factor only on the upper desert portion of the watershed. In this part of the watershed sheet erosion has progressed to the point where the soil surface consists principally of desert pavement. Gully erosion is confined chiefly to the rough mountainous part of the watershed and the alluvial outwash at the base of the mountains. Because of watershed characteristics, it is not considered feasible to apply a program designed primarily to reduce the present rate of erosion. There is little likelihood that the present rate of erosion will change under existing use and management practices. Erosion damage of watershed land has not been evaluated for the reason that erosion has not seriously impaired the productivity of these lands, and it is apparent that a program which would significantly reduce the rate of erosion is not practical.

Sedimentation Damage - Deposition of sediment has caused considerable channel changes above works that have been installed to protect irrigation canals. As a result, each successive flow may strike canals or other property at unprotected places. Sediment deposition on farm land makes more frequent leveling necessary to maintain the precise grade of irrigated land. Both of these types of sediment damage are closely associated with floodwater damage and have been evaluated as floodwater damage. None of the sediment from this watershed reaches irrigation reservoirs.

EXISTING OR PROPOSED WATER MANAGEMENT PROJECTS

Efforts to control high runoff in the White Tank-Trilby Wash watersheds date back at least to 1939. At that time efforts were made by local interested groups to establish a soil erosion demonstration project. In 1945 the Agua Fria Soil Conservation District was organized for the express purpose of unifying flood control efforts. At various times plans to alleviate the flood problem have been prepared, but inability to finance delayed construction. For practical purposes work being done by local interests is continuous. Some structures have been completed recently and others are being built concurrently with work being done by the Federal Government (See combined Table 1 and 2 attached).

Measures Primarily for Flood Prevention - Engineering and hydrologic studies show that the most effective method of controlling surface runoff from the watershed of Avondale Wash above the Beardsley Canal is by the construction of two retarding structures and 11 miles of diversions. The diversions will divert runoff from small subwatersheds into retarding structures numbers 3 and 4, located in the larger drainage channels. Eight small stabilizing and sediment control structures

in the upper watershed will provide sediment storage and desilting basins and thereby lengthen the effective life of the retarding structures. The total cost of these measures is shown in combined Table 1 and 2 attached. The location of these structures is shown on map 2. These measures are located on nonarable land.

For design purposes, the area-depth-duration relationship for storm rainfall was developed from a number of high intensity storms which have occurred in central and southern Arizona. For reservoir design a storm of four-inch center was used. This is estimated to have a recurrence interval of more than 100 years. Retarding structure Number 3 will discharge into the Beardsley Canal. Retarding Structure Number 4 will discharge into existing waterways at a safe rate. Maximum evacuation time for the detention reservoirs will not exceed five days. The spillway design storm selected was one of six-inch rainfall center. The frequency of such a storm is estimated to substantially exceed the 100-year expectancy. Reservoir and spillway designs are based on the occurrence of design storms centered over each watershed so that the maximum runoff would occur at the structure. Because adequate detention storage is developed at each structure paved emergency spillways are unnecessary. Sediment capacity has been provided in the design of the retarding structures for 50 years of sedimentation without encroachment on the effective detention capacity.

Measures for Conservation of Water and Watershed Lands Which Contribute Directly to Flood Prevention - Sixty-four hundred acres of private and state range land are being retired permanently from grazing. The lands retired from grazing include those areas immediately above the retarding structures and any improvement in cover will reduce reservoir sedimentation.

Measures for Evaluating the Effects of the Program - The hydrologic, economic and other effects of this watershed program will be measured in the future. A plan for the installations and procedures required to evaluate these results is now being developed in cooperation with other interested fact-finding agencies. This plan will be distributed later as a supplement to this work plan.

Effect of These Measures on Damages and Benefits - The measures described above will prevent damage from all floods of the size used in the damage evaluation series. Hence, the floodwater damage reduction benefit is equal to the average annual damage under present conditions or $35,220 in Table 4.

Approximately 79 percent of the flood damage reduction benefit is credited to the two retarding structures and 18 percent is credited to the diversions. The remainder is credited to the stabilization and sediment control structures and the range improvement program. The flood prevention benefit is distributed by measures in Table 5.

It is not believed that any significant land use changes will occur from the measures described above. An examination of land use in the flood plain indicates that the presence of a flood hazard is not a primary determinant of land use. This conclusion is confirmed by local people. Hence, no land enhancement benefit is expected to accrue from these measures.

Range forage production on the watershed is extremely limited. Hence, the conservation benefit is insignificant and only $130.00 per year is credited to range improvement in Table 5. As previously mentioned, about one-third of the total watershed above the structures has been retired from grazing use. The remaining area consisting of steep rocky desert mountains is under adequate management by the Bureau of Land

Management. The program is not expected to improve ground or surface water supply significantly and no water conservation benefit is credited to it.

Comparison of Costs and Benefits - The ratio of the average annual benefit from measures primarily for flood prevention ($35,100) to the average annual cost of the measures ($20,730) is 1.7 to 1. The ratio of the average annual benefit ($250) from the range improvement measure to the average annual cost ($130) is about 1.9 to 1. The ratio of total average annual benefits ($35,350) to total average annual value of costs ($20,860) is 1.7 to 1. See Table 5.

ACCOMPLISHING THE PLAN

The sponsoring agency, the Agua Fria Soil Conservation District, and the Soil Conservation Service have mutually agreed to the sharing of costs set forth in combined Table 1 and 2. Specifically, the Soil Conservation District (or the Beardsley Irrigation District or others in behalf of the Agua Fria Soil Conservation District) will:

1. Acquire all lands, easements and rights of way needed for the floodwater retarding structures. This has been done.
2. Purchase and install all outlet pipes in the retarding structures together with gates and appurtenant works. The pipe and gates have been ordered.
3. Clear, strip and excavate the sites for the retarding structures. This has been done.
4. Excavate 300 feet of the spillway on Structure Number 3. Arrangements for accomplishing this are now being negotiated.
5. Arrange to complete the installation of all stabilization and sediment control structures and diversions by December 31, 1954.

6. Provide for periodic inspection of the measures to insure that they are maintained in a satisfactory manner.

7. Bring about the retirement from grazing use of 6,400 acres (about one-third) of watershed above the Structures 3 and 4.

The above items of local contribution are valued at $218,287.

The sponsoring agency has sufficient funds or commitments to meet its obligations within the specified time.

The Soil Conservation Service will:

1. Contract for the earth work for Structures 3 and 4, except for Item 4 above.

2. Design Structures 3 and 4 with appurtenances and will provide engineering supervision and inspection during construction.

3. Transfer to the Agua Fria District the sum of $14,000 to help defray costs of the Districts' portion of the work.

The above items of Federal contribution, plus Program evaluation and development of the work plan are valued at $199,088.

PROVISIONS FOR MAINTENANCE

Executed agreements provide for adequate future maintenance by assuring that periodic inspections, at least annually, will be made by a responsible local agency with representatives of the Soil Conservation Service, annual levies will be made for maintenance purposes and repairs will be made promptly when needed.

COMBINED TABLE 1 & TABLE 2 *

ESTIMATED INSTALLATION COST ** - TOTAL NEEDED PROGRAM

MEASURES	UNIT	NO. TO BE APPLIED	ESTIMATED TOTAL COSTS		
			Federal	Private ***	Total
A-Measures Primarily for Flood Protection					
Floodwater Retarding Structures	No.	2	192,088	119,664	311,752
Stabilization and Sediment Control Measures					
Diversion Dykes & Ditches	Mile	11		77,805	77,805
Debris & Desilting Basins	No.	8		18,068	18,068
SUB TOTAL			192,088	215,537	407,625
B-Measures					
Range Improvement	Ac.	6400		2,750	2,750
TOTAL A & B MEASURES			192,088	218,287	410,375
Facilitating Measures					
SCS					
Program Evaluation			2,000		2,000
Work Plan Development			5,000		5,000
TOTAL SOIL CONSERVATION SERVICE			7,000		7,000
GRAND TOTAL			199,088	218,287	417,375

* For practical purposes, the work being done by local interests is a continuous job. Some items have been completed recently and others are now being constructed concurrently with the work being done by the Federal Government. For convenience, all parts of the program are shown in combined Table 1 and 2.

** All items to be installed during calendar year 1954.

*** It is impractical to distinguish between contributions from Maricopa County and the Beardsley project, which are local units of government, and from strictly private sources. Hence, no separate column has been shown for Non-Federal Gov't costs and these items are included in Private costs.

TABLE 3

ANNUAL COSTS

MEASURES	AMORTIZATION OF INSTALLATION COSTS			OPERATION AND MAINTENANCE			OTHER ECONOMIC COSTS	GRAND TOTAL
	FEDERAL	PRIVATE	TOTAL	FEDERAL	PRIVATE	TOTAL		
A MEASURES								
	(1)	(2)						
Floodwater Retarding Structures	$6,950	$5,570	$12,520	--	$2,950	$2,950	--	$15,470
Stabilization and Sediment Control Measures								
Debris & Desilting Basins	--	840	840	--	150	150	--	990
Diversion Dikes & Ditches	--	3,620	3,620	--	650	650	--	4,270
SUB TOTAL	$6,950	$10,030	$16,980	--	$3,750	$3,750	--	$20,730
B MEASURES								
Range Improvement	--	$ 130	$ 130	--	--	--	--	$ 130
TOTAL A & B	$6,950	$10,160	$17,110	--	$3,750	$3,750	--	$20,860

(1) Amortization factor .035258 (50 yrs. @ 2½% interest).
(2) Amortization factor .04655 (50 yrs. @ 4% interest).

TABLE 4

SUMMARY OF AVERAGE ANNUAL MONETARY FLOODWATER AND SEDIMENT DAMAGE AND FLOOD PREVENTION BENEFIT FROM THE PLAN
(LONG TERM PRICES)

DAMAGES	AVERAGE ANNUAL DAMAGE			AVERAGE ANNUAL BENEFIT		
	PRESENT CONDITION	B-MEASURES ONLY	A and B MEASURES	B-MEASURES ONLY	A-MEASURES ONLY	TOTAL FLOOD BENEFIT FROM A & B MEASURES
	DOLLARS	DOLLARS	DOLLARS	DOLLARS	DOLLARS	DOLLARS
FLOODWATER & SEDIMENT DAMAGE						
CROP	$13,260	$13,140	0	$ 120	$13,140	$13,260
LAND	4,380	4,380	0	0	4,380	4,380
IMPROVEMENTS	1,310	1,310	0	0	1,310	1,310
TRANSPORTATION FACILITIES	2,790	2,790	0	0	2,790	2,790
DITCH SYSTEMS	6,480	6,480	0	0	6,480	6,480
POWER & PHONE ETC.	--	--	--	--	--	--
INDIRECT DAMAGE	7,000	7,000	0	0	7,000	7,000
TOTAL DAMAGE	$35,220	$35,100	0	XXX	XXXXX	XXXXX
BENEFIT FROM REDUCTION OF DAMAGE	XXXXX	XXXXX	XXXXX	$ 120	$35,100	$35,220
BENEFIT FROM MORE INTENSIVE USE OF FLOOD PLAIN	XXXXX	XXXXX	XXXXX	0	0	0
TOTAL FLOOD PREVENTION BENEFIT	XX	XXXXX	XXXXX	$ 120	$35,100	$35,220

TABLE 5

DISTRIBUTION OF COSTS AND BENEFITS BY MEASURES AND GROUPS OF MEASURES

ITEM	TOTAL COST	AVERAGE ANNUAL COST	FLOODWATER & SEDIMENT BENEFIT	MORE INTENSIVE USE OF LAND	CONSERVATION BENEFIT	TOTAL	BENEFIT COST RATIO
A MEASURES							
Floodwater Retarding Structures	$316,752	$15,470	$27,970	-	-	$27,970	1.8 to 1
Stabilization and Sediment Control Measures							
Debris & Desilting Basins	18,068	990	990	-	-	990	1.0 to 1
Diversion Dikes & Ditches	77,805	4,270	6,140			6,140	1.4 to 1
TOTAL A MEASURES	$412,625	$20,730	$35,100			$35,100	1.7 to 1
B MEASURES							
Range Improvement	2,750	130	120		$130	250	1.9 to 1
TOTAL	$415,375/1	$20,860	$35,220		$130	$35,350	1.7 to 1

/1 Does not include the cost of program evaluation ($2,000).

TABLE 6

FLOODWATER RETARDING STRUCTURE DATA

SITE NO.	DRAINAGE AREA SQ. MI.	STORAGE CAPACITY: SEDIMENT POOL	DETENTION POOL	TOTAL	SURFACE AREA: SEDIMENT POOL	DETENTION POOL	TOTAL	TOP OF SED. POOL	TOP OF DET. POOL	MAXIMUM HT. OF DAM	FLOOD PLAIN AREA INUNDATED: UNDER SED. POOL	UNDER DET. POOL	TOTAL	VOL. OF FILL	DRAW DOWN RATE	TYPE OF SPILLWAY	EST. TOTAL COST
		AC.FT.	AC.FT.	AC.FT.	INCHES OF RUNOFF			ACRES		FEET	ACRES			C.Y.	CFS		
3*	24.1	193	2,462	2,655	.14	1.92	2.06	30	384	30	---	---	---	375,000	375	Earth	$229,500
4*	10.3	72	964	1,036	.13	1.76	1.89	14	221	20	---	---	---	175,000	100	Earth	$124,159

Sediment Storage based on 50 Year estimated accumulation (including structures on Drainage Area).

*Note discussion of numerical designations in narrative portion of report.

TABLE 7

SUMMARY OF PROGRAM DATA

ITEM	UNIT	QUANTITY
YEARS TO COMPLETE PROGRAM	YEAR	1
TOTAL INSTALLATION COST		
FEDERAL	DOLLARS	199,088
NON-FEDERAL	DOLLARS	218,287
ANNUAL O & M COST		
FEDERAL	DOLLARS	---
NON-FEDERAL	DOLLARS	3,750
ANNUAL BENEFITS	DOLLARS	35,350
FLOODWATER RETARDING STRUCTURES	EACH	2
AREA INUNDATED BY STRUCTURES		
FLOODPLAIN	ACRES	0
UPLAND	ACRES	605
WATERSHED AREA ABOVE STRUCTURES	ACRES	22,000
REDUCTION IN FLOODWATER AND SEDIMENT DAMAGE		
A MEASURES	PERCENT	99.7
B MEASURES	PERCENT	0.3
REDUCTION OF EROSION DAMAGE		
A MEASURES	PERCENT	---
B MEASURES	PERCENT	---
OTHER BENEFITS		
A MEASURES	DOLLARS	---
B MEASURES	DOLLARS	130

TABLE 8

SUMMARY OF PHYSICAL DATA

ITEM	UNIT	QUANTITY WITHOUT PROGRAM	QUANTITY WITH PROGRAM
WATERSHED AREA	SQ. MI.	92.4	92.4
WATERSHED AREA	ACRES	59,136	59,136
AREA OF CROPLAND	ACRES	34,112	34,112
AREA OF GRASSLAND	ACRES	25,024	25,024
AREA OF WOODLAND	ACRES	---	---
FLOODPLAIN SUBJECT TO DAMAGE BY DESIGNATED STORM	ACRES	4,800	0
ANNUAL RATE OF EROSION (FLOOD PRODUCING PORTION)			
SHEET	TONS/YR)	33,900	31,900
GULLY	TONS/YR)		
STREAMBANK	TONS/YR)		
SCOUR	TONS/YR)		
AREA DAMAGED ANNUALLY BY:			
SEDIMENT	ACRES)	660	0
FLOODPLAIN SCOUR	ACRES)		
SWAMPING	ACRES	---	---
STREAMBANK EROSION	ACRES	---	---
SHEET EROSION	ACRES	Not determined	
SEDIMENT PRODUCTION (FLOOD PRODUCING PORTION)	TONS/AC/YR	.77	1/
SEDIMENT ACCUMULATION IN RESERVOIRS	AC/FT/YR	---	---
FREQUENCY OF FLOODING	EVENTS/YR	.5	0
AVERAGE ANNUAL RAINFALL	INCHES	8	8
AVERAGE ANNUAL RUNOFF	INCHES	.3	.3

1/ Amount depends on trap efficiency of retarding structures. No basis for accurate estimate at this time.