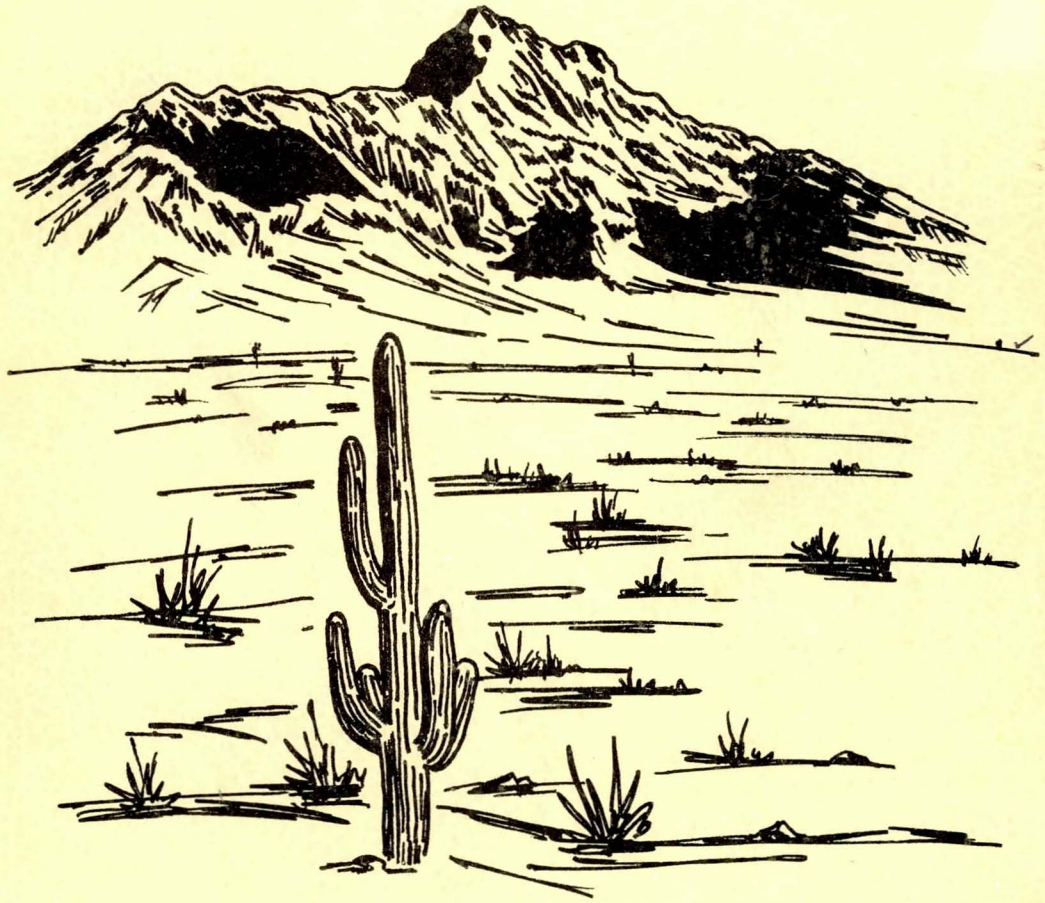
FINAL
Environmental Impact Statement

Harquahala Valley Watershed

Maricopa and Yuma Counties, Arizona

March, 1977



U. S. Department of Agriculture
Soil Conservation Service

USDA-SCS-EIS-WS-(ADM)-76-2-(F)-AZ

HARQUAHALA VALLEY WATERSHED
Maricopa and Yuma Counties,
Arizona

Final
Environmental Impact Statement

Responsible Federal Official

Thomas G. Rockenbaugh, State Conservationist
UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
3008 Federal Building
230 N. First Avenue
Phoenix, Arizona 85025

Sponsoring Local Organizations

Flood Control District of Maricopa County
3335 W. Durango, Phoenix, Arizona 85009

Buckeye-Roosevelt Natural Resource Conservation District
Rt. 2, Box 199, Buckeye, Arizona 85326

Wickenburg Natural Resource Conservation District
Box 146, Salome, Arizona 85348

March 1977

Prepared By

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
3008 Federal Building
230 N. First Avenue
Phoenix, Arizona 85025

Assisted By

STATE OF ARIZONA
Arizona Water Commission
222 N. Central, Ste. 800
Phoenix, Arizona 85004

USDA ENVIRONMENTAL IMPACT STATEMENT

Harquahala Valley Watershed Project

Maricopa and Yuma Counties

Arizona

Prepared in Accordance with
Sec. 102(2)(C) of P.L. 91-190

Summary

I. Final

II. Soil Conservation Service

III. Type of Action: Administrative

IV. Brief Description of Project

This statement involves a project for watershed protection and flood prevention in Maricopa and Yuma Counties, Arizona, to be implemented under authority of the Watershed Protection and Flood Prevention Act (P.L. 566 83rd Congress, 68 Stat. 666), as amended.

Proposed works of improvement include both conservation land treatment and structural measures.

Conservation land treatment program is proposed for 13,000 acres of irrigated cropland and about 200,000 acres of rangeland.

The proposed structural program includes two floodwater retarding structures with a total length of 16.77 miles and total floodwater retarding storage of 14,624 acre-feet, 1.58 miles of new channel work, 4.64 miles of new diversion, and 9.45 miles of levee.

V. Summary of Environmental Impacts Including Favorable and Adverse Environmental Effects

Floodwater, sediment and erosion damages will be reduced on existing agricultural and other improvements in Harquahala Valley, Arizona.

1. Conservation land treatment will decrease sheet erosion from .08 tons/acre/year to .06 tons/acre/year on 13,000 acres of irrigated cropland.

2. Structural measures will decrease the area inundated by the 100-year flood from 16,000 acres to 6,850 acres.

3. Structural measures will decrease the 100-year peak discharge from the Harquahala Valley Watershed into Centennial Wash from 38,200 cfs to 6,000 cfs and reduce the 50-year peak from 28,600 cfs to 5,300 cfs.

4. Structural measures will decrease the sediment delivered by the watershed to Centennial Wash from 30,000 tons/year to 10,000 tons/year.

The project will provide protection to a proposed irrigation distribution system, a 10.5 mile reach of the proposed Granite Reef Aqueduct and reduce damages to a 9 mile length of Interstate 10. The project will improve the quality of surface water runoff, create approximately 550 acre-feet of surface water storage, improve yield potential to downstream impoundments, contribute about 350 acre-feet per year to the groundwater basin, create new vegetation for wildlife use and retain approximately 9,060 acres as open space.

About 10,472 acres of land supporting mostly desert shrub vegetation will be needed for land easements and rights-of-way. Vegetation will be removed and wildlife lost from about 780 acres of land needed for construction. The aesthetic values of the immediate area will be altered during and following construction. The project structures will limit accessibility to some sectors of the watershed.

VI. Alternatives Considered

A. Alternative of accelerated land treatment only.
B. Alternative of nonstructural measures.
C. Alternative of installing the approved 1967 plan with revisions.
D. Major Alternatives in the selection and design of components of the recommended plan.
   1. Alternative of dam across main watercourse of Centennial Wash.
   2. Alternative of channelization of Centennial Wash.
   3. Alternative of installing a channel system in place of Saddleback F.R.S.
   4. Alternative of multi-purpose storage in the proposed dams.
   5. Alternative of substituting a floodwater retarding dam for Reach 1 of Centennial Levee.
   6. Alternative of extending Centennial Levee.
E. Alternative of no project.

VII. List of Entities from Which Written Comments Have Been Received

Federal Government

Department of Agriculture, Office of Equal Opportunity
Department of the Army
Department of Health, Education, and Welfare
Department of the Interior
Department of Transportation
Environmental Protection Agency

State and Local Agencies

Governor of Arizona
Arizona Department of Transportation
Arizona Game and Fish Department
Arizona State Land Department
Arizona State Museum
Mineral Resources Department
Arizona Water Commission
Maricopa County Board of Supervisors (includes comments from Maricopa County Parks and Recreation Department)
Maricopa County Highway Department

Other Groups

Buckeye-Roosevelt Natural Resource Conservation District
El Paso Natural Gas Company
Sierra Club

Individuals

E. Billie Bennett
Barto B. Price

VIII. Draft Statement transmitted to CEQ on April 9, 1976

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PROJECT IDENTIFICATION AND ENVIRONMENTAL SETTING

III. PROJECT IDENTIFICATION AND ENVIRONMENTAL SETTING

USDA SOIL CONSERVATION SERVICE
FINAL ENVIRONMENTAL IMPACT STATEMENT*

for

A. Harquahala Valley Watershed, Arizona

Installation of this project constitutes an administrative action. Federal assistance will be provided under authority of Public Law 83-566 83rd Congress, 68 Sta. 666, as amended.

B. Sponsoring Local Organizations

Flood Control District of Maricopa County
Buckeye Roosevelt Natural Resource Conservation District
Wickenburg Natural Resource Conservation District
Endorsing Organization: Harquahala Valley Association

C. Project History, Purpose and Goals

1. Introduction [1]

This statement for proposed works of improvement in Harquahala Valley Watershed is submitted in compliance with Section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969 (Pub. L. 91-190, 83 Stat. 852 (42 U.S.C. 4321 et seq.), the Council on Environmental Quality Guidelines for Environmental Impact Statements, August 1, 1973 (38 FR 20550-20562), and Secretary of Agriculture Memorandum 1695, Supplement 4, as revised (Environmental Impact Statements). It covers a planned program of conservation land treatment and flood prevention for the Harquahala Valley Watershed area located primarily in western Maricopa County, Arizona. (See Project Map - Appendix B.)

2. History of Project [2,3]

On August 17, 1961, the Sponsoring Local Organizations submitted an application to the Secretary of Agriculture requesting assistance in preparing a plan for works of improvement for the Harquahala Valley Watershed under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666). The Secretary of Agriculture accepted this application as valid under the authorities of Public Law 566 and authorized the USDA-Soil Conservation Service to assist the watershed sponsors in preparing a plan for works of improvement.

During the period 1963-1968, the watershed sponsors and the Soil Conservation Service conducted detailed studies and

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* All information and data, except as otherwise noted, were collected by the Arizona Water Commission, SCS, and Forest Service.

completed a final plan titled, "Watershed Work Plan, Harquahala Valley Watershed, USDA-SCS, January 1967." On April 1, 1969, the Congress authorized the Soil Conservation Service to prepare detailed design plans and proceed with construction of the recommended structural measures. The watershed sponsors, because of financial constraints, failed to secure necessary land rights and to date none of the structural measures recommended in the 1967 plan have been constructed.

Between 1967 and 1973, there were several developments which have a significant impact on the Harquahala Valley area. The construction of Interstate Highway 10 was completed. The highway modified drainage patterns and created conflicts with several of the structures proposed in the 1967 Work Plan. Also of major significance was the authorization of the Central Arizona Project which will be constructed through upper Harquahala Valley. The Harquahala Valley Irrigation District has made a commitment to contract for water from the project and has developed preliminary plans for an extensive water distribution system in Harquahala Valley.

In view of these changes in watershed conditions, the watershed sponsors recognized that the 1967 Work Plan should be revised. Early in 1973, the sponsors requested that the Soil Conservation Service restudy the Harquahala Valley Watershed and prepare a supplement to the approved 1967 Work Plan if changes in the works of improvement were feasible. Due to restrictions in funding and personnel, the Soil Conservation Service could not complete the necessary investigations within the desired time without detracting from other ongoing projects. Therefore, the restudy of the project was conducted by the Arizona Water Commission with the assistance of SCS. Several important changes in the original works of improvement are recommended. This Statement is for the proposed works of improvement as presented in Supplement No. 1 Watershed Work Plan Harquahala Valley Watershed March 1977.

3. Project Purpose and Goals

The sponsors of the Harquahala Valley Watershed project have as their objectives a watershed protection and conservation land treatment program to prevent and reduce floodwater, sediment, and erosion damages to productive agricultural lands, existing irrigation facilities, Interstate Highway 10, county and farm roads, commercial establishments, residences and public facilities. It is also desired that project measures provide maximum protection and benefit for the proposed Granite Reef Aqueduct of the Central Arizona Project and the proposed system of canals, laterals, and other improvements that will be installed in Harquahala Valley to distribute Central Arizona Project water in the valley.

The sponsors propose to provide a level of protection consistent with current and expected agricultural use and the highest level of economic return.

The sponsors' goals for installing land treatment measures include the reduction of erosion rates on cropland and other lands, increased infiltration rates and water holding capacities of the soils, and improved agricultural water management.

Due to the need for supplemental water in the watershed, the sponsors desire that all proposed dams be designed, wherever possible, to retain floodwater runoff for controlled release into irrigation canals and as additional water sources for wildlife.

The planned project will meet all of the sponsors objectives with the possible exception of retainment of floodwater runoff. At present, the program includes limited provisions for floodwater storage, however, downstream water rights may preclude this possibility. Possible program restrictions due to water rights are discussed in Section V.

D. Planned Project

1. General

To meet the sponsors' objectives in the watershed, the planned project measures will employ a combination of conservation land treatment and structural measures.

2. Land Treatment Measures [2,4]

Land treatment measures to be installed are an integral part of the overall watershed protection and flood prevention objective. The measures reduce erosion and sediment, increase infiltration and water holding capacity of the soil, and contribute to better agriculture water management. Measures are to be installed on private lands and land leased from the State of Arizona.

Land treatment is installed, operated, and maintained voluntarily by individuals or groups of farmers and ranchers. There are no specific state or local regulations that will insure its implementation. The treatment results from technical assistance provided by the Soil Conservation Service to the private landusers who enter into cooperative agreements with the Buckeye-Roosevelt or Wickenburg Natural Resource Conservation Districts to use the land within its capabilities and treat it according to its needs for protection and sustained production.

Land treatment measures to be installed on the irrigated

cropland include conservation cropping systems and crop residue use, irrigation ditch and canal lining, irrigation field ditches, irrigation land leveling, irrigation pipelines, irrigation tail-water recovery systems, irrigation water management, pumping plants for water control and structures for water control. Approximately 13,000 acres (67%) of the cropland will be adequately treated at the end of the installation period. The installation cost of the land treatment program is estimated at $1,936,000.

On public lands the Bureau of Land Management will continue its existing multiple use conservation program, including Proper Grazing Use. This program is primarily the control of grazing by adjusting the number of livestock and time of use to maintain vegetative cover on the land and protect the multiple use values of the resources. The program is applied to 163,887 acres of public rangeland in the watershed.

3. Structural Measures for Flood Prevention

a. General

The structural measures to be installed in the watershed under the authorities of Public Law 566 consist of two floodwater retarding structures (Harquahala F.R.S. and Saddleback F.R.S.), one floodway (Harquahala Floodway), one floodwater diversion (Saddleback Diversion), and one levee to limit the floodplain area of Centennial Wash (Centennial Levee). The locations of these measures are as shown on the Project Map in Appendix B.

In addition to the above mentioned structures, the U.S. Bureau of Reclamation is constructing a floodwater retarding structure immediately upstream of the proposed Granite Reef Aqueduct extending from the Buckeye-Salome Road westward to Centennial Wash. The structure will be approximately 6 miles long of which 4½ miles will be within the boundaries of the Harquahala Valley Watershed. This structure is not a part of the planned project under the authorities of Public Law 566, and therefore, is not considered as a "project structural measure" for the purposes of the Environmental Impact Statement. Further details concerning the proposed Bureau of Reclamation structure are presented in the section of this statement titled, "Projects of Other Agencies."

The combined Harquahala F.R.S., Harquahala Floodway, Saddleback F.R.S., and Saddleback Diversion will control 140.6 square miles or 39.8 percent of the watershed area. These structures are designed to function as a system in operational series rather than as individual units. Each upstream structure is dependent upon the lower structures for proper operation and drainage. Harquahala F.R.S. will drain through Harquahala Floodway, Saddleback F.R.S., and Saddleback Diversion.

Located on the western side of Harquahala Valley, Centennial Levee will control 21 square miles of the residual drainage area below Harquahala F.R.S. and the Bureau of Reclamation structure. The levee will also limit the area in Harquahala Valley that will be subject to inundation from Centennial Wash.

The current design criteria and policy for dams require that both Saddleback F.R.S. and Harquahala F.R.S. be designed to control the 100-year flood event. Saddleback Diversion will provide a 50-year level of protection and Centennial Levee a 100-year level of protection. The design frequency of these two structures was determined based on optimization of benefits.

Special consideration has been given in the location and design of all of the proposed structures to minimize wildlife losses and maintain aesthetic values.

The planned structural program presented in this statement is considered the best means to meet the objectives of the sponsors. It is recognized that some changes in the program could be necessitated following detailed design investigations and as improved data from continuing environmental studies and evaluations becomes available.

b. Floodwater Retarding Structures

(1) Saddleback F.R.S.

Plate 1 shows the location and structural details of Saddleback F.R.S. and Table I is a summary of data of the structure. See Figures P1, P2, and P3 for photographs of the alignment.

Design floodrouting computations, and consequently the sizing of the structure, were based on the assumption that the upstream Harquahala F.R.S. would be releasing its maximum discharge of 485 cubic feet per second as a base flow through Saddleback F.R.S. at the same time that the peak discharge from the 29.6 sq. mi. uncontrolled drainage area above Saddleback F.R.S. would occur. This design assumption would be an extreme condition and is equivalent to a simultaneous occurrence of storms over the Harquahala F.R.S. and Saddleback F.R.S. drainage areas. Although not evaluated, the probabilities of simultaneous peak discharges is considered extremely remote.

The Bureau of Reclamation is currently conducting studies in the Tonopah Watershed area immediately adjacent and east of Harquahala Valley. One tentative proposal is for the construction of a dike above the Granite Reef Aqueduct. If

constructed, this proposed dike could extend into Harquahala Valley Watershed and intercept approximately 6.26 sq. mi. of drainage area presently contributing to Saddleback F.R.S. Since the possible construction of this dike is uncertain, the current hydrologic design and sizing of Saddleback F.R.S. was made with the assumption that the drainage area above the structure will not be modified. If construction becomes definite, then any change in drainage area will be accounted for in the final design of Saddleback F.R.S.

Floodwater runoff will be temporarily impounded behind the dam and released into Saddleback Diversion through a 10 foot by 4 foot reinforced concrete box culvert principal spillway. The spillway will be ungated, with a straight drop inlet. A steel trash rack on the inlet will prevent debris clogging of the box culvert.

This structure will not employ the normal excavated earth or concrete open chute type of emergency spillway system that is usually associated with an earth dam. The principal spillway will therefore also serve as the emergency spillway for the structure. Saddleback F.R.S. was located to allow adequate floodwater impoundments without inundating Interstate Highway 10. For that reach of Interstate 10 which could possibly be influenced by backwater from the dam, the low point in the eastbound roadbed is at elevation 1195.5. This elevation compares with an elevation of 1178.0 for the crest of the principal spillway of Saddleback F.R.S., an elevation of 1190.5 for the maximum water surface attained during passage of the 100-year 10-day storm, and a top of dam elevation of 1194.2. The top of the dam is 1.3 feet lower than the low point of the Interstate 10 roadbeds. The final design of the structure will be fully coordinated with the Arizona Department of Transportation.

The Saddleback F.R.S. embankment will be located essentially along a contour, however, at two locations, the embankment will be located downslope from the contour and create basins which will retain floodwater. These basins are shown as Basin Nos. 1 and 2 on Plate 1. Both basins have been located at points where the dike embankment intersects a major drainageway and where concentrated sediment deposition is anticipated. The basins are sized so that the pool volume of storage above natural ground is equal to the anticipated sediment accumulation for a 50-year period. Basin No. 1 will have an above natural ground storage of 80 acre-feet, with a surface area of 42.7 acres and maximum depth above natural ground of 5.3 feet. Basin No. 2 will have an above natural ground storage of 21 acre-feet, with a surface area of 12.3 acres and maximum depth above natural ground of 4.7 feet. The estimated average annual yield from the 132 square mile contributing drainage area (includes area above Harquahala F.R.S. which is diverted through Saddleback F.R.S.) is about 540 acre-feet. This water could provide at lease some semipermanent storage pools behind the dam. Water rights will be required.

Two gated and two ungated vegetative maintenance conduits will be strategically located to maintain a continued water supply for downstream pseudoriparian vegetation. (See Plate 1.)

Foundation treatment for the site will consist of stripping and recompaction of the loose surface soils to the width of the embankment for the total length of the structure. Depth of stripping will vary from 2 to 5 feet. For the two reaches that will have nondraining sediment pools, a cutoff trench will be installed to insure against excessive seepage and the possibility of piping. The depth of the trench will be approximately 7 feet for Basin No. 1 and 6 feet for Basin No. 2.

The main part of the embankment will be constructed as a compacted homogeneous fill of approximately 584,050 cubic yards. The estimated amount of material to be taken from borrow to provide this fill is 698,000 cubic yards. Borrow areas will be located upstream from the dam within the flood pool. The results of geologic investigations that will be conducted prior to final design, and soil conditions as encountered during construction, will determine the final location, size and depth of the borrow areas. Influencing factors include suitability of material as embankment, physical limitations on depth of cut because of underlying caliche, economical haul distances, aesthetic values, and the need to minimize vegetative disturbances.

One location of concentrated borrow excavation is in an area of high ground in the northwest 1/4 section 21, and the southwest 1/4 section 16, T2N, R8W. This high ground was encountered along the alignment because the embankment was located upslope off the contour in order to clear a telephone cable booster station located in the southeast 1/4 section 17, T2N, R8W, and a proposed subdivision in section 20, T2N, R8W. Excavation through the high ground will be required to drain the northern sections of the flood pool area through the principal spillway. Approximately 150,000 cubic yards of material will come from this area. The cut will be approximately 200 feet wide for a distance of 6,000 feet. This borrow area will free drain.

The dike embankment will cross four roads, one underground telephone cable, one abandoned concrete irrigation ditch and one abandoned unlined irrigation ditch.

Two of the roads are unimproved farm roads that provide access to an abandoned farmstead located near the east 1/4 corner of section 17. The irrigation ditches are immediately adjacent to and parallel the farm roads. These ditches were originally used to convey water to the south and west from an irrigation well located at the farmstead. The farmstead consists of a

small frame house, which has been badly vandalized, and the abandoned irrigation well. The well pump and motor have been removed. The elevations of the pump base and of the house floor are both approximately one foot higher than the top of dam elevation. (See Figure P4.)

It is highly improbable that the abandoned farmhouse will be repaired for future use, with or without the construction of Saddleback F.R.S. After construction, access to the abandoned farmstead will be from the Buckeye-Salome Road.

The dam will cross two county roads, Courthouse Road and Buckeye-Salome Road. Courthouse Road is paved and well traveled. Buckeye-Salome Road is unpaved and carries minimal traffic.

The top elevation of the dam at the Courthouse Road crossing will be approximately two feet higher than the present roadbed elevation. Courthouse Road will be raised to cross over the embankment. This will require the raising and repaving of approximately 260 feet of road. After construction, approximately 440 feet of Courthouse Road on the eastern side of the embankment will be within the maximum design flood pool area of the dam, however, the reservoir elevation of the 100-year event is 1.5 feet lower than the low point of the roadbed. The planned program includes the placing of warning signs on Courthouse Road advising that a portion of the road is located within a flood pool area. However, if a storm condition of such severity did occur that would cause backwater over Courthouse Road, in all probability traffic would already be stopped at other points along the road due to flow in the numerous washes that cross the road by dip section.

The Buckeye-Salome Road crossing will be accomplished by ramping over the dike embankment. The dike will be approximately 5 feet high at the point of crossing. Approximately 900 feet of the road will be within the flood pool area of the dam. Warning signs will also be placed along this road advising that the road is impassable under flood condition.

Before installing the structure, a written right or permission to flood both Courthouse Road and Buckeye-Salome Road will be obtained from Maricopa County which has jurisdiction over both roads.

The dike will cross an underground telephone cable in the southwest 1/4 section 16, T2N, R8W. Construction of the dike embankment and upstream borrow channel will necessitate the lowering of this cable.

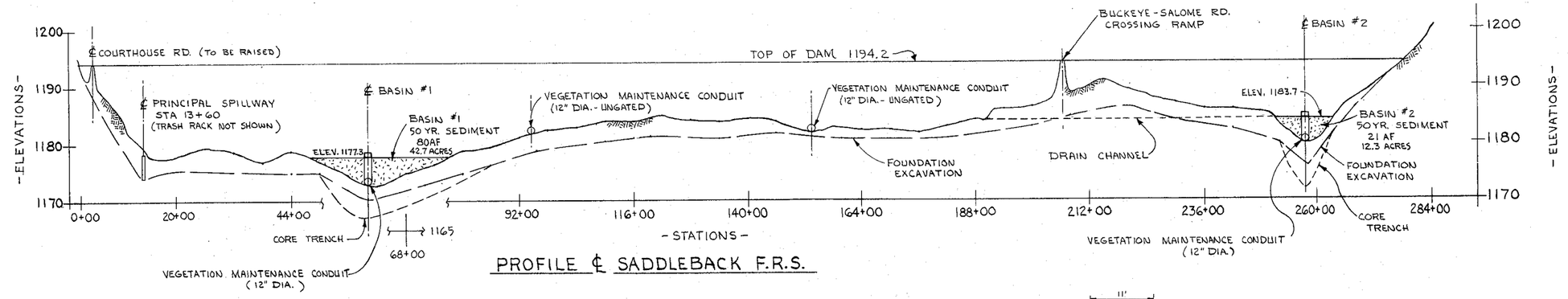
TABLE I

STRUCTURAL DATA

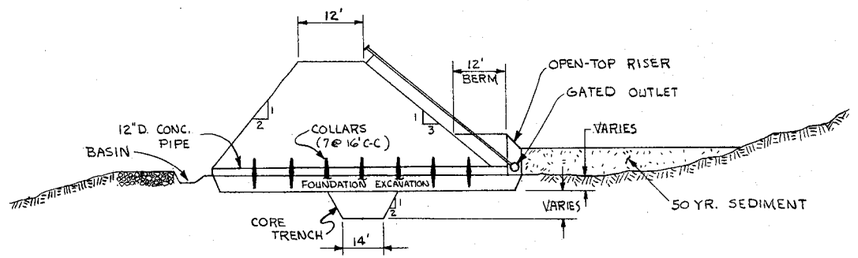
SADDLEBACK FLOODWATER RETARDING STRUCTURE

Item	Unit	Data
Drainage Area	Sq.Mi.	29.6
Storm Protection Frequency	Yr.	100
Total Length	Mi.	5.27
Maximum Height	Ft.	22
Average Height	Ft.	15
Top Width	Ft.	11
Maximum Bottom Width	Ft.	133
Average Bottom Width	Ft.	86
Side Slopes	Ft./Ft.	
Upstream		3
Downstream		2
Storage Capacity	Ac.-Ft.	
Floodwater Retarding		4,127
Sediment (50 yr)		120
Total		4,247
Principal Spillway 1/		
Reservoir Drawdown Time	Days	8.5
Maximum Release Rate	C.F.S.	800

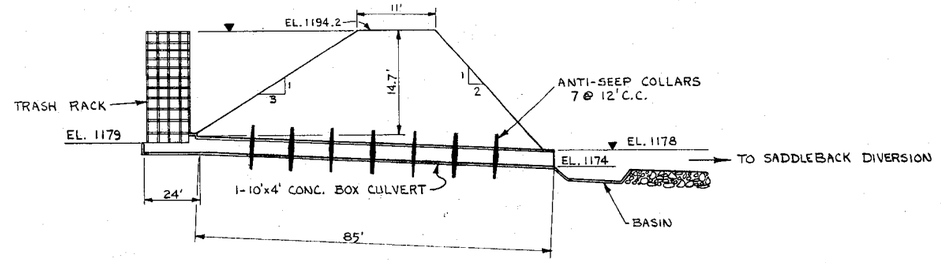
1/ For 100-year storm protection frequency.



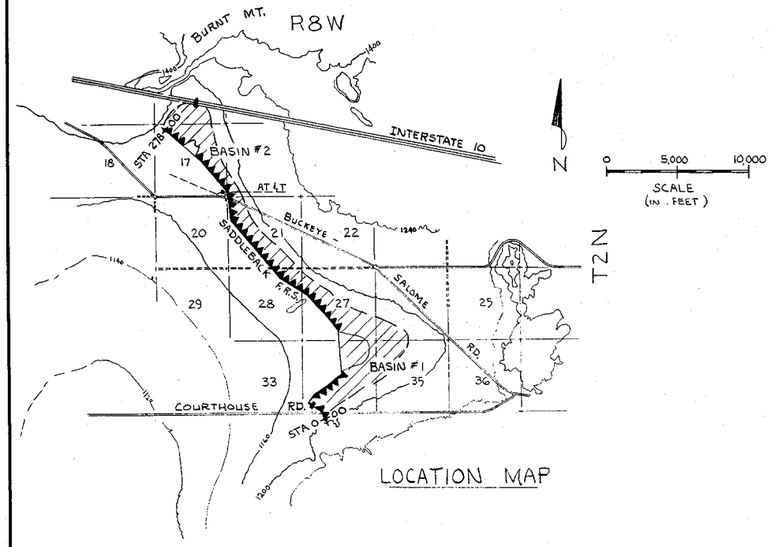
PROFILE ℄ SADDLEBACK F.R.S.



CROSS - SECTIONS
VEGETATION MAINTENANCE CONDUITS AT BASINS #1 & #2



CROSS - SECTION
PRINCIPAL SPILLWAY AT STA. 13+60
(FOUNDATION NOT SHOWN)



LOCATION MAP

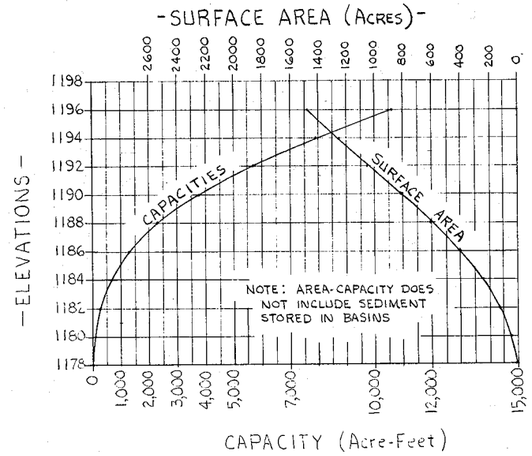


PLATE 1
SADDLEBACK FLOODWATER RETARDING STRUCTURE
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA
PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION
STATE OF ARIZONA

	Date		
Designed B.J.F.	2/10/76	Approved by	
Drawn C. Mezzo	2/12/76	Title	
Traced		Title	
Checked		Sheet No	Drawing No.
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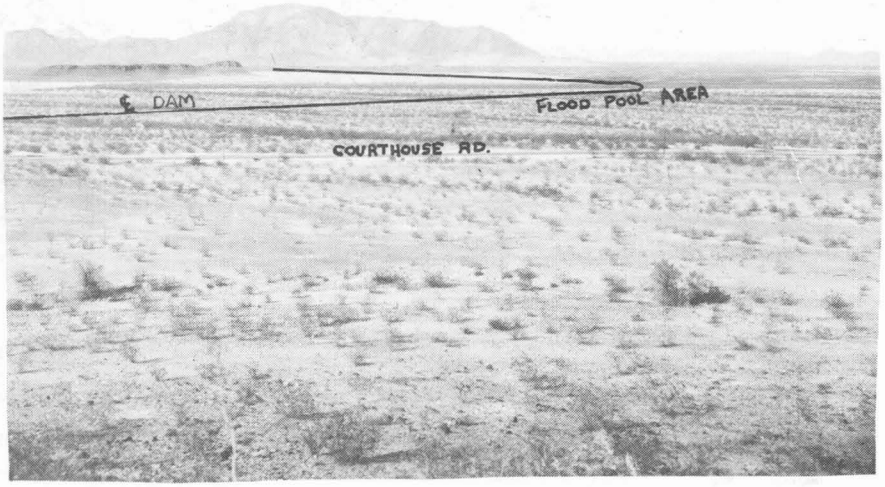


Figure P1. Looking north toward Burnt Mountain showing alignment of Saddleback F.R.S.

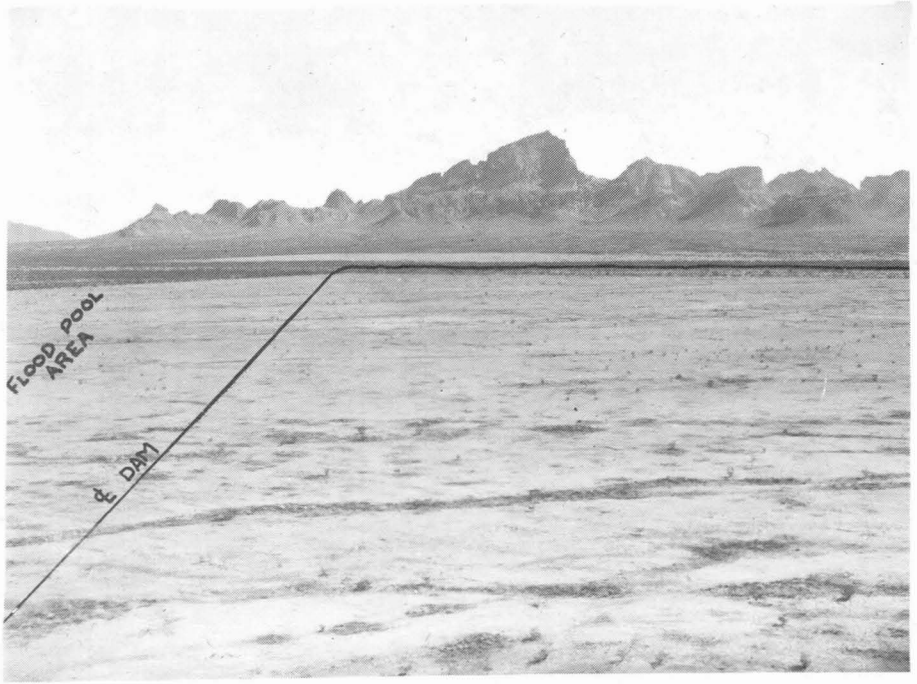


Figure P2. Alignment of Saddleback F.R.S. looking southeast from andesite knoll, Section 27,T2N,R8W. Saddleback Mountain in background.

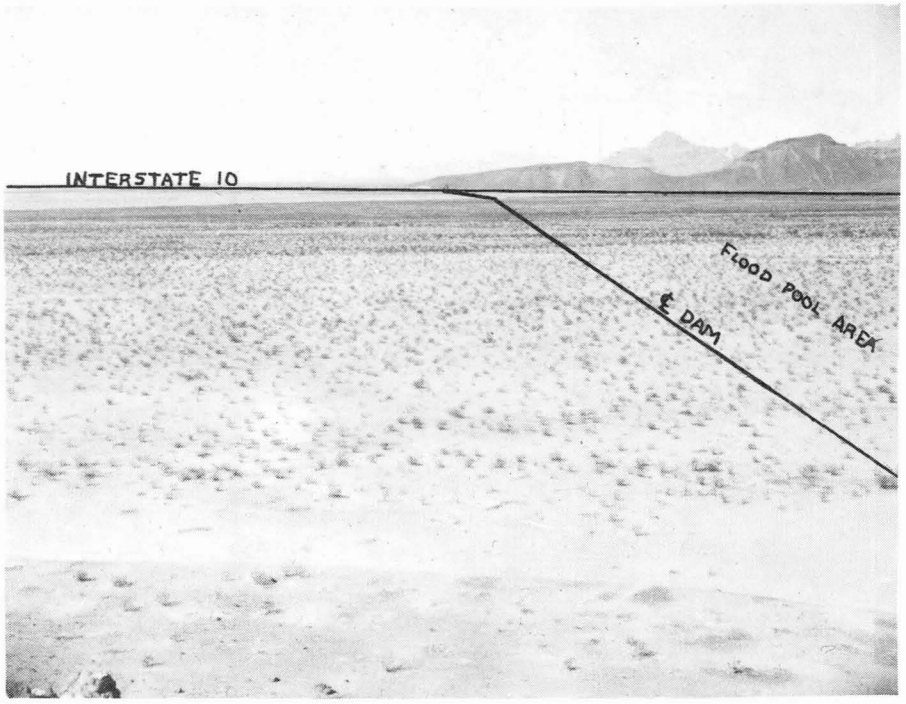


Figure P3. Burnt Mountain, Interstate 10 and alignment of Saddleback F.R.S. Looking northwest from andesite knoll, Section 27,T2N,R8W.

Figure P4. Abandoned farmhouse located in Section 17,T2N,R8W, immediately above the floodpool of Saddleback F.R.S.

An electric power line runs east-west on the south section line of Section 17, T2N, R8W. Construction of the dike will necessitate the relocation of one pole and raising of approximately 500 feet of line.

The construction of Saddleback F.R.S. will require land rights acquisition of 1,266.2 acres encompassed by the dam, borrow areas, and flood pool. Of the 1,266.2 acre total, approximately 515 acres are in private ownership, 281 acres are State Trust lands administered by the Arizona State Land Department, 464 acres of public land administered by the U.S. Bureau of Land Management, 5 acres of State land within the Interstate 10 right-of-way administered by the Arizona Department of Transportation, and an estimated 1.2 acres are under the jurisdiction of Maricopa County for Courthouse and Buckeye-Salome Roads rights-of-way.

All of the land required is unimproved desert except 85 acres of previously irrigated land located in the south 1/2 Section 17, T2N, R8W.

No relocation of people, businesses, or farm operations will result from the construction of the dam.

(2) Harquahala F.R.S.

Harquahala F.R.S. will be located immediately above and parallel to the proposed Central Arizona Project Granite Reef Aqueduct. About 6.1 miles of the alignment lies across mountain foot slope terrain of the Big Horn Mountains and 5.4 miles across valley soils of the Harquahala Plains. (See Project Map, Plates 2 and 2a, and Figures P5, P6, and P7. Structural Data is shown in Table II.)

The average natural ground elevation at the base of the dam drops about 4.0 feet from west to east in the entire length between Buckeye-Salome Road and Burnt Mountain. This elevation drop results in the parallel alignment with the Granite Reef Aqueduct, which has a slope of about 0.0008 ft. per ft. (0.4 ft. per mile). Floodwater runoff from intercepted drainages will be temporarily impounded and rerouted eastward along the dam alignment for controlled release through the principal spillway.

The principal spillway will be located just west of Burnt Mountain. It will consist of a 4 foot by 4 foot reinforced concrete box culvert constructed as a continuous closed conduit through the dam foundation and underneath the aqueduct. The spillway will be ungated, with a reinforced concrete standard covered top riser at the inlet and a S.A.F. (Saint Anthony Falls) Basin outlet. There will be an 83 foot long transition between the box culvert conduit and the S.A.F. Basin.

Floodwater releases through the principal spillway will enter an existing unnamed wash (designated as Harquahala Floodway) to be conveyed via this wash through existing box culverts under Interstate 10, diverted eastward into Saddleback F.R.S. and then southward through Saddleback Diversion to an outlet in Centennial Wash.

The emergency spillway for the dam will be located in the east abutment. The spillway will be a straight inlet rectangular concrete chute with a 100-foot bottom width, outletting into the Granite Reef Aqueduct. Flows greater than those expected on the average of once in 100 years will pass through the spillway. This is equivalent to a runoff of 2.61 inches from the total 102.3 square mile drainage area in a six hour period. Maximum discharge through the spillway with reservoir stage to top of dam elevation will be 9,650 cfs.

Geologic investigations were conducted along the alignment at intervals ranging from 1,000 to 1,500 feet, alternating between centerline of the dam and centerline of the aqueduct. Results showed a distinct difference occurs in the soils and foundation conditions where the dike alignment leaves the mountain foot slope terrain and proceeds across alluvial fan deposits of the Harquahala Plains. This change in soil effectively divides the dam into two separate reaches, requiring separate methods of foundation treatment and embankment design. The two reaches will be discussed separately.

Reach 1 constitutes the eastern 6.1 miles of the dam. Soils consist of shallow to moderately deep alluvial fan deposits generally having a well developed erosion pavement. Based on soil conditions as evaluated to date, the embankment for Reach 1 will consist of a homogeneous fill. Oversized cobbles unsuitable for fill will be raked out. Selective placement of material will be utilized with the coarser material placed on the outside and toes of the embankment grading inward to finer material. A core trench of 15 foot bottom width and 2:1 side slopes will key the embankment to the foundation. Depth of the core trench will average about 5 feet.

Reach 2 constitutes the western 5.4 mile length of the dam across the flat alluvium of the Harquahala Plains. Soils consist of fine grained alluvial fan deposits.

Present design of the embankment for Reach 2 also calls for a homogeneous fill, however, foundation conditions in this area are inferior to those encountered along Reach 1. Foundation treatment will consist of complete removal of weak or questionable material for the entire base width of the dam. Depth of foundation excavation will average 6 feet. (See Plate 2.)

At the west end, the dam alignment will depart from the aqueduct and parallel Buckeye-Salome Road.

The western end of the dam will be extended to direct flow from a series of washes into the dam proper. This extension to the dam will consist of a diversion type embankment.

The embankment section for Reaches 1 and 2 will require 4,530,558 cubic yards of compacted fill. This material will be obtained as excavation from the Granite Reef Aqueduct section.

There are three proposed outlets through the embankment. The principal spillway will be located on the east end at Burnt Mountain. A small low flow channel will be constructed upstream of the embankment draining from west to east to the principal spillway.

Harquahala F.R.S. is a very long structure (11.5 miles). Two 24-inch diameter gated drain outlets will be spaced along the dam alignment. These will serve as emergency drains in the extremely unlikely event that a debris plug should separate parts of the reservoir. One of the outlets will also serve to drain the pool area described in the Environmental Features Section.

The alignment of the dam is over terrain that provides relatively east movement by four-wheel drive and other off-road type vehicles. There are several faint vehicular roads or trails along the alignment that will be intersected by the dam and aqueduct. These roads were created by off-road vehicle use on State and public lands. The planned program does not include any crossings over the dam embankment for roads of this type. However, the dam embankment will lie across three unimproved roads that are used on an infrequent basis. They are unsuited for passenger type automobile use.

Of these three roads, only one is considered to have significant use and purpose to warrant a crossing over the embankment and aqueduct. This crossing will be to provide access to an abandoned mine located in Section 15, T3N, R9W, and ranching operations north of Harquahala F.R.S. Access to this mine is currently provided by an unimproved road passable only under favorable weather conditions. This road is actually a fork off another unimproved road located to the west. The fork occurs approximately 3/4 mile south of Harquahala F.R.S. The two roads proceed north independently and essentially parallel of each other. At the point of intersection with the dam, the roads are approximately 1/2 mile apart. The dam and Granite Reef Aqueduct will intersect both roads. A crossing over the dam will be provided for the west fork in Section 21, T3N, R9W, to match a bridge over the aqueduct. The east road will be severed. An approximately 1/2 mile long detour road, to be located through the flood pool area or other suitable location, will connect the two roads. Due to the infrequent use of this road, the planned program does not include any

TABLE II

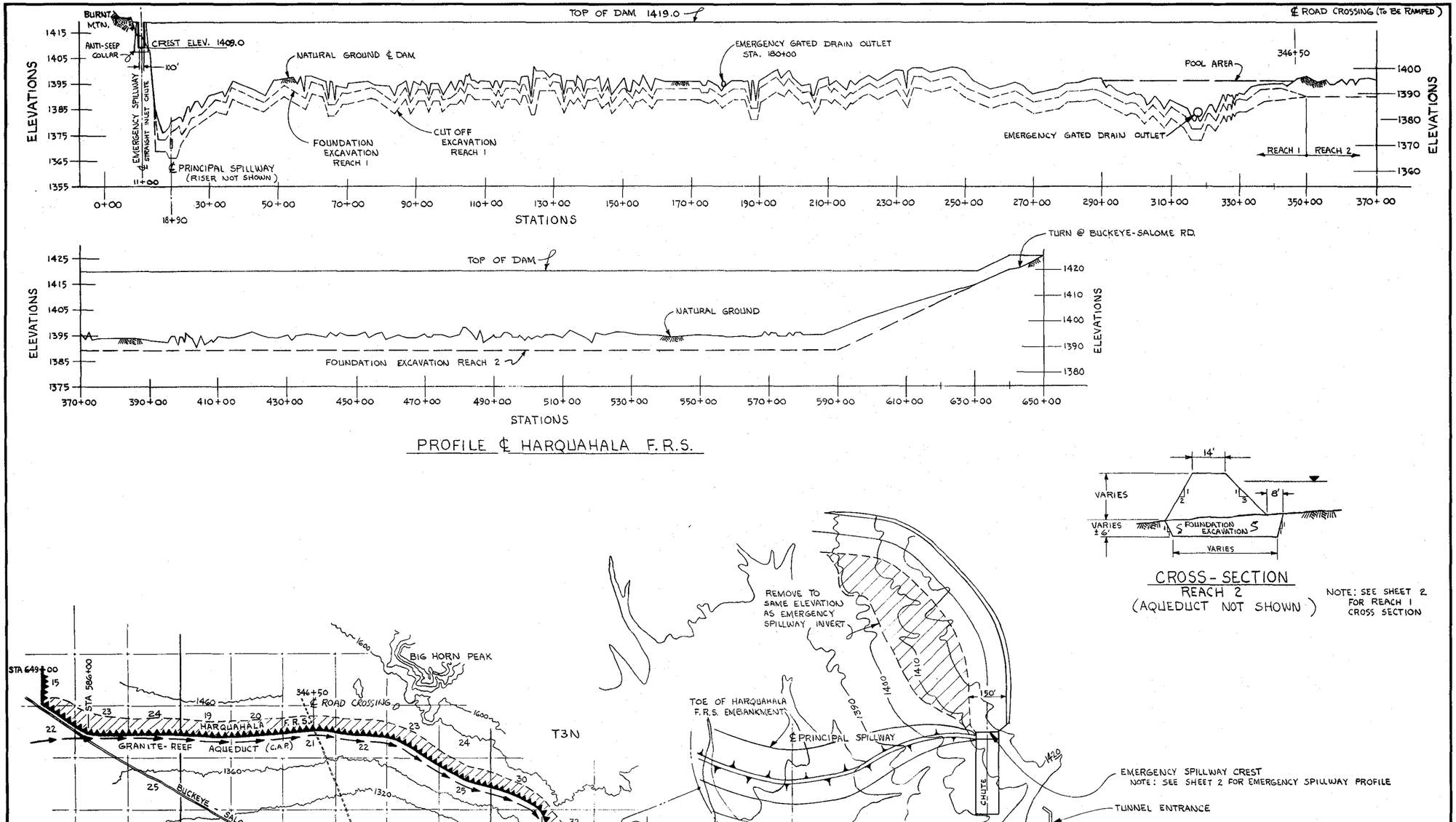
STRUCTURAL DATA

HARQUAHALA FLOODWATER RETARDING STRUCTURE

Item	Unit	Data
Drainage Area	Sq.Mi.	102.3
Storm Protection Frequency	Yr.	100
Total Length	Mi.	11.5
Maximum Height	Ft.	43
Average Height	Ft.	25
Top Width	Ft.	14
Maximum Bottom Width	Ft.	234
Average Bottom Width	Ft.	140
Side Slopes	Ft./Ft.	
Upstream		3
Downstream		2
Storage Capacity 1/	Ac.-Ft.	
Floodwater Retarding		10,497
Sediment (50yr)		414
Total		10,911
Principal Spillway 2/		
Reservoir Drawdown Time	Days	9.08
Maximum Release Rate	C.F.S.	485

1/ At emergency spillway crest elevation.

2/ For 100-year storm protection frequency.



PROFILE ℄ HARQUAHALA F.R.S.

PLAN VIEW
EMERGENCY SPILLWAY

CROSS-SECTION
REACH 2
(AQUEDUCT NOT SHOWN)

NOTE: SEE SHEET 2 FOR REACH 1 CROSS SECTION

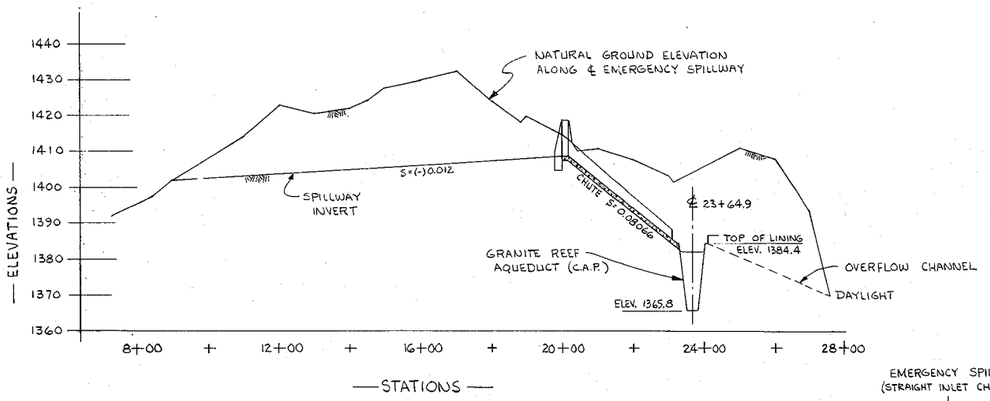
PLATE 2
HARQUAHALA FLOODWATER RETARDING STRUCTURE
HARQUAHALA VALLEY, WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976

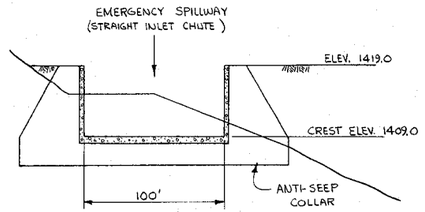
ARIZONA WATER COMMISSION — STATE OF ARIZONA

	Date		
Designed	2/10/76	Approved by	
Drawn	2/12/76	Title	
Traced		Title	
Checked		Sheet No. 1 of 2	Drawing No.

SCS-ENG-313-B Rev. 7-69



℄ PROFILE
EMERGENCY SPILLWAY



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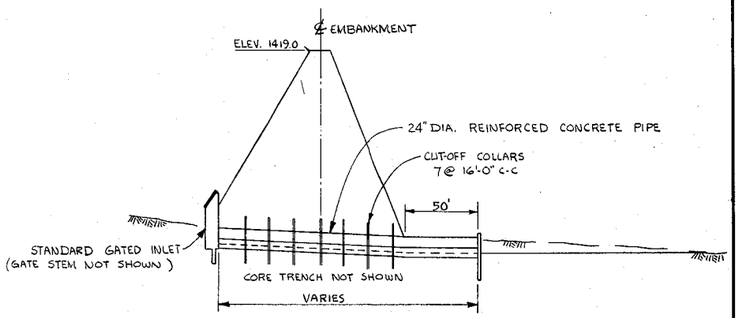
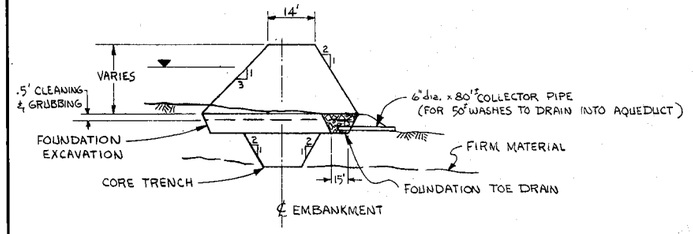
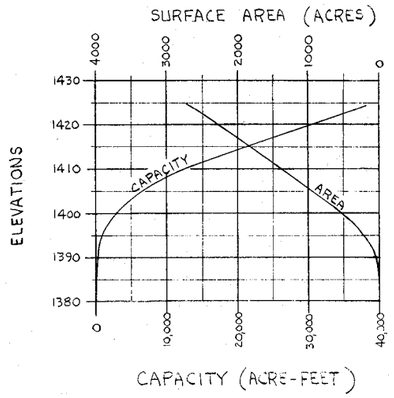
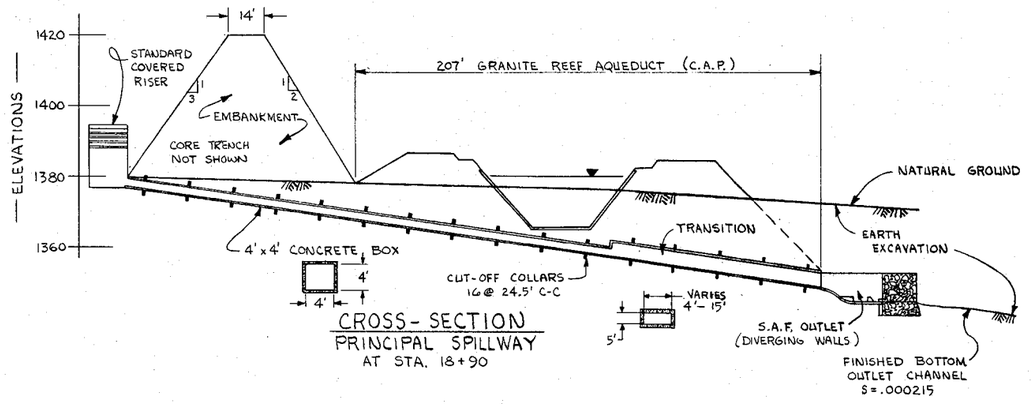


EMERGENCY GATED DRAIN OUTLETS



CROSS-SECTION
REACH 1





CROSS-SECTION
PRINCIPAL SPILLWAY
AT STA. 18+90

PLATE 2a
HARQUAHALA FLOODWATER RETARDING STRUCTURE
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION — STATE OF ARIZONA

	Date		
Designed B.F. Hilliff	2/10/76	Approved by	
Drawn	2/12/76	Title	
Traced		Title	
Checked		Sheet No. 2 of 2	Drawing No.

U.S. GOVERNMENT PRINTING OFFICE: 1968 O—294-742

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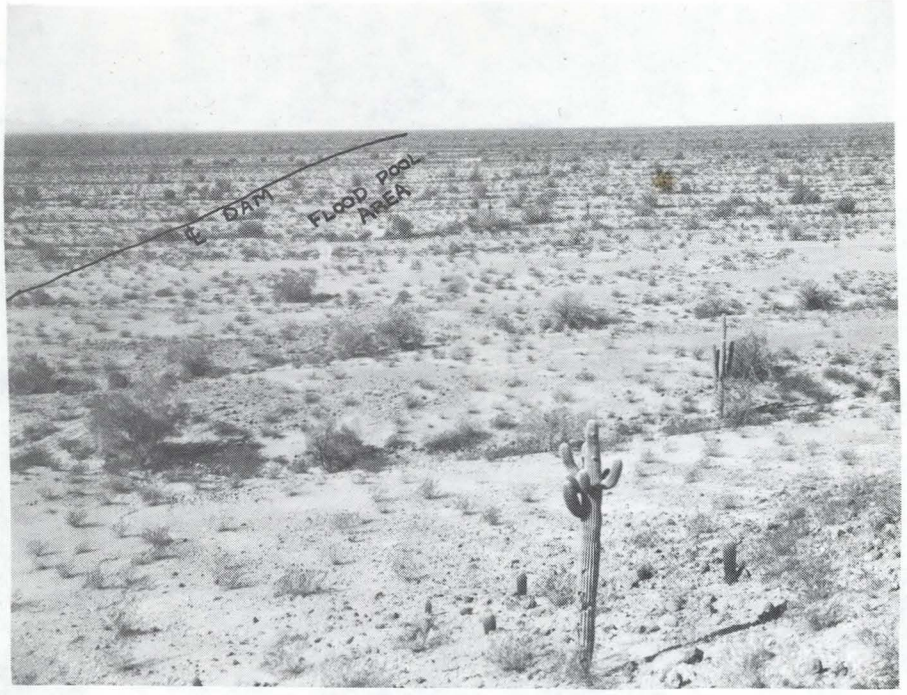


Figure P5. Looking west from Section 22,T3N,R9W, along the alignment of Harquahala F.R.S.

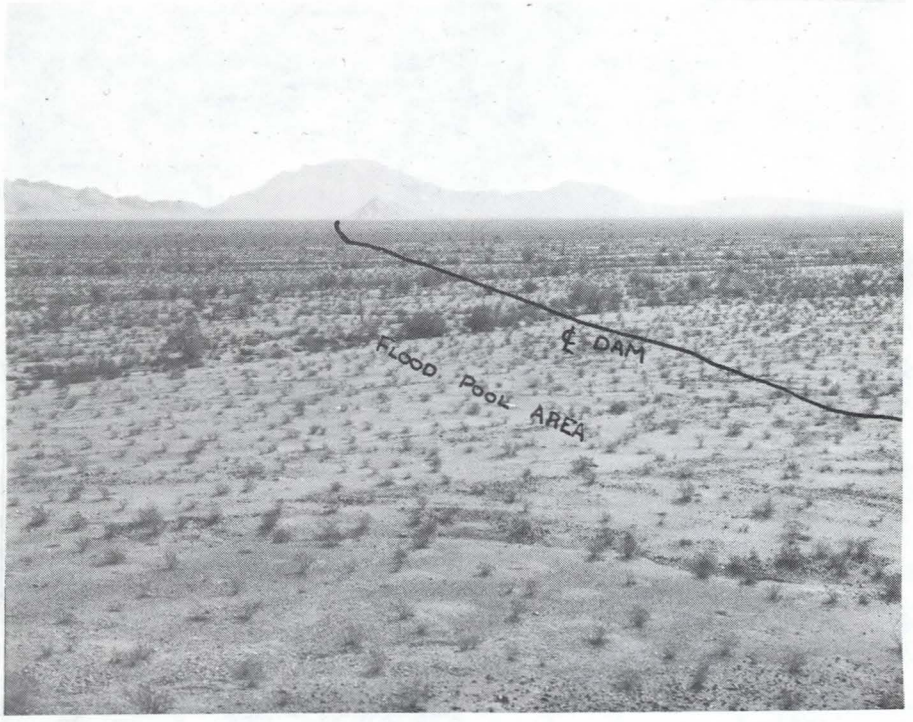


Figure P6. Looking east toward Burnt Mountain from Section 22, T3N,R9W, showing the alignment of Harquahala F.R.S.

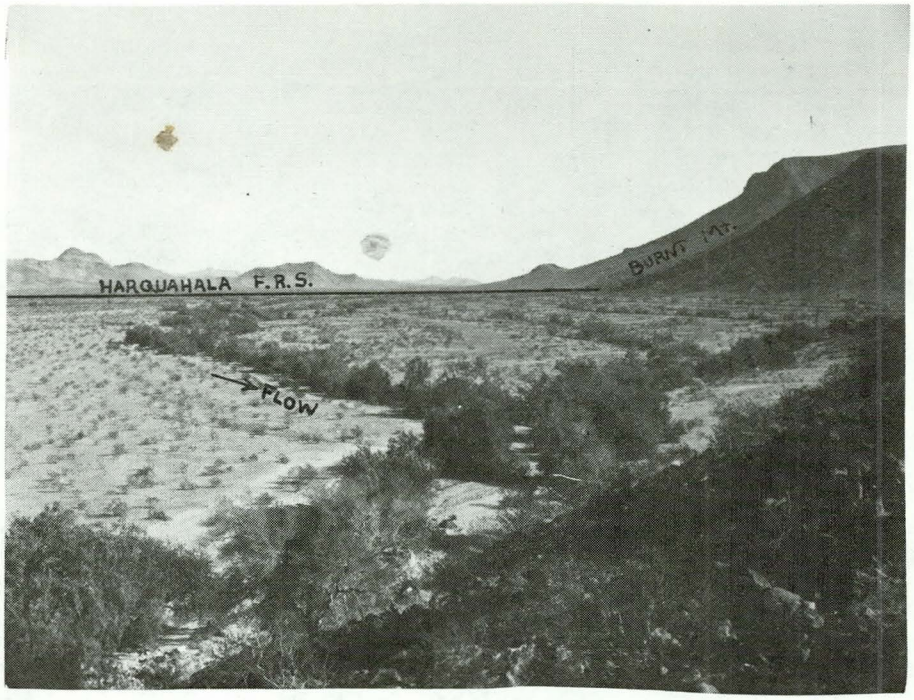


Figure P7. Looking north showing location of Harquahala F.R.S. and the natural wash section of Harquahala Floodway.

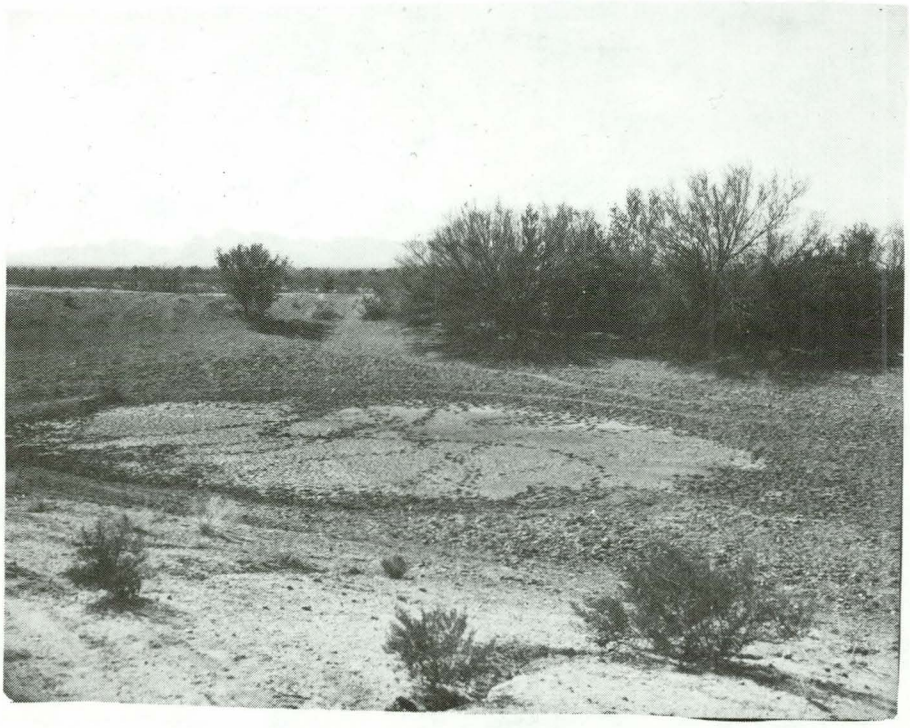


Figure P8. New Tank, Section 30,T3N,R9W.

culverts in the flood pool, therefore, floodwater impoundment will temporarily limit access from the south terminal of the road. However, access to the mines and ranch operations served by the road could still be accomplished by detouring in from the north terminal at the Eagle Eye Road junction.

The Harquahala Valley Irrigation District has requested that a gated outlet be provided to allow release of floodwater impoundments behind the dam into the District's proposed system for distribution of water from the Central Arizona Project. The actual sizing and installation of such a feature will be dependent upon several factors including water rights. Engineering studies presented to date for the distribution system are inadequate to serve as a basis for design of an outlet through Harquahala F.R.S., therefore, such a feature is not included as a part of the planned project. It can be added during the final design. Any costs associated with such a facility will be nonproject and ineligible for assistance under the Public Law 566 Act.

The construction of the dam will require land rights acquisition on 2,274 acres of land. This is for the area encompassed by the dam, flood pool, and emergency spillway. Of this total, 854 acres are in private ownership and 1,340 acres are public lands administered by the U.S. Bureau of Land Management and 80 acres are State Trust. All of the land required is unimproved rangeland.

No relocations of people, businesses, or farm operations will result from construction of the dam.

c. Channels and Floodways

(1) Harquahala Floodway

Harquahala Floodway will convey floodwater releases from Harquahala F.R.S. into Saddleback F.R.S. Total length of the floodway is 18,128 feet or 3.43 miles. (See Project Map, Plate 3, and Figures P7, P9, and P10. Structural Data is shown in Table III.)

For purposes of discussion, the floodway is divided into four reaches differentiated by the type of construction proposed. Progression is downstream in the direction of flow.

Reach 1 consists of a 1,028 foot excavated channel from the Harquahala F.R.S. outlet to an existing wash. Channel bottom width is 18 feet with 3:1 side slopes. Channel slope is 0.000215 ft./ft. Average velocity of flow at the design peak flow of approximately 500 cubic feet per second is about 1.9 feet per second. Design depth of flow is about 6.8 feet. Depth of cut varies from a maximum of 16.5 feet at the

inlet to 0.0 feet where the natural wash is intercepted. The channel bottom is founded on caliche fanglomerate or basalt rock for the first 1,000 feet, where the bottom grades into a GM-GW soil. No special stabilizing actions will be necessary except for the first 14 feet immediately downstream from the inlet where rock riprap will be placed to prevent localized scour.

Reach 2 of the floodway consists of 9,800 feet of natural channel between Reach 1 and Interstate 10. (See Figure P7.) The channel consists of a main wash that overflows into parallel secondary washes. All overflow out of the main wash is naturally reunited before reaching the Interstate 10 box culverts except for one reach where overflow enters a borrow pit left from theconstruction of Interstate 10.

Instead of altering this condition, the planned program will allow the flow to continue to braid with a portion entering the borrow pit. The borrow pit will trap sediments and debris that otherwise would be transported through the Interstate 10 box culverts. Vegetative growth within the borrow pit should also be aided. To assure that overflow from the borrow pit flows back into the floodway wash and on through the Interstate 10 box culverts, a small channel will be constructed. All upstream overflow out of the floodway wash will then be reunited prior to crossing Interstate 10.

The planned program will also include excavation of a channel about 700 feet upstream from the highway where rock revetment now exists. Construction will consist of widening the right or west side of the wash along the revetment reach from the present 6 foot bottom width to about 31 feet. Length of cut will be about 200 feet and approximately 710 cubic yards of material will be removed.

The two items of excavation, one to increase existing wash capacity along the revetment and the other to connect the borrow pit with the Interstate 10 box culverts, are the only construction activities to be conducted along Reach 2. No other modifications to existing conditions are planned.

Floodway Reach 3 consists of three existing 10 foot by 5 foot concrete box culverts through Interstate 10. They are designed for the 50-year flood event and have a capacity of 1,050 cfs. (See Figure P9.)

Between the dam and Interstate 10 there are 0.98 square miles of drainage area. The estimated 50-year peak discharge from this area is 765 cfs. The simultaneous peaking of the design release from Harquahala F.R.S. (485-500cfs) plus the 50-year discharge from the uncontrolled drainage area would result in a peak discharge to the culverts of 1,265 cfs

which would increase headwater depth by about 6 inches. The box culverts have sufficient capacity to handle this increased discharge without endangering the Interstate 10 roadbeds even if this highly improbable simultaneous peaking of discharges does occur.

Floodway Reach 4 extends from Interstate 10 to Saddleback F.R.S. It consists of a diversion of the natural channel immediately downstream from the box culverts eastward through a channel across the foot slope extension of Burnt Mountain to an outlet into Saddleback F.R.S. Total length of this reach is 7,090 feet. (See Figures P9 and P10.)

Soil conditions require that riprap be used for channel stabilization. The channel will have a 35 foot bottom width and 2:1 side slopes. Slope of the channel bottom will vary from .009 ft./ft. to 0.0 ft./ft. The channel will be maintained entirely in cut for aesthetic purposes. Where suitable, excavated material will be used as a part of the embankment of Saddleback F.R.S. A small berm approximately 2 feet in height will be constructed on the upstream (north) side of the channel to prevent local runoff from uncontrolled entry into the channel over the side riprap.

Two different discharges were used to design this channel. A design flow of 765 cfs was used to set the height of riprap. Depth of flow with 765 cfs is 2.1 feet. A design flow of 1,265 cfs was used to set the depth of channel excavation. Depth of flow with 1,265 cfs is 3.6 feet. With an added 1 foot of freeboard, the average depth of the channel cut below natural ground is about 4.6 feet.

Construction activities will be performed on 17.5 acres of land. This includes 1.8 acres in Reach 1 where a channel cut will be made in order to drain Harquahala F.R.S. into the wash, .4 acres in Reach 2 for the channel cut into the borrow pit and channel widening along the existing revetment, and 15.3 acres in Reach 4 where a new channel will be constructed. With the exception of 5.8 acres of private land on Reach 4, all work will be on public lands administered by the U.S. Bureau of Land Management or State lands administered by the Arizona Department of Transportation. In Reach 4, an additional 7.2 acres of private land and 47.8 acres of public lands between the structure and Interstate 10 may also be required due to severance.

Fee simple acquisition of land rights will be required for the private lands in Reach 4. Land Rights by permit may be possible for those areas where construction activities will be conducted on federal or State lands. Flowage easements will be required on the natural wash at least for the 485 cfs release rate from Harquahala F.R.S. All required right-of-way is on unimproved rangeland.

d. Floodwater Diversions and Levees

(1) Saddleback Diversion

Saddleback Diversion begins at the principal spillway outlet of Saddleback F.R.S. and proceeds in a generally southern direction along the west foot slopes of Saddleback Mountain for a distance of 4.64 miles outletting into an unnamed wash about 1.4 miles above its confluence with Centennial Wash. (See Project Map, Plate 4, and Figure P11. Structural Data is shown on Table III.)

The diversion is designed to carry the maximum outflow from Saddleback F.R.S. plus the 50-year flood event from the diversion drainage area. Design capacity varies from 810 cfs at the Saddleback F.R.S. outlet to 6,289 cfs at the end of the diversion (see Plate 4). The diversion will carry floodwater releases from Harquahala F.R.S. and Saddleback F.R.S. The total drainage area contributing runoff to the diversion is 140.6 square miles, of which 102.3 square miles are controlled by Harquahala F.R.S., 29.6 square miles are controlled by Saddleback F.R.S. and 8.65 square miles are above the diversion proper.

The diversion consists of a compacted earth embankment varying from 2 to 5.5 feet in height and an excavated earth channel of 3 feet average depth varying in bottom width from 35 to 232 feet. Design depth of flow for the 50-year event is 3.5 feet. The slope of the diversion is .0017 ft./ft. for the first 544 feet, .000797 for the next 956 feet, and .003 ft./ft. thereafter.

The diversion is designed to safely convey design discharges without excessive scour or excessive sediment deposition. However, geologic conditions show that some scour will initially occur in the channel bottom followed by the formation of erosion resistant pavement. At the outlet of the diversion, flood flows will be released over unimproved rangeland to a drainageway leading to Centennial Wash. Excessive scour is not expected due to the presence of shallow deposits of caliche conglomerate, gravelly and cobbly material, and very compact silty sands. The end of the diversion embankment ties into a basalt hill and is protected by the hill. The low flow channel at the end of the diversion is on caliche conglomerate and not subject to excessive erosion.

The diversion will cross Courthouse Road through four 10 foot by 5 foot concrete box culverts. Rock riprap will be placed at the inlet and outlet of the culverts as protection against localized scour.

Construction will require land rights acquisition on 177.3 acres of land. An additional 68 acres (State Trust lands) will be required as flowage right-of-way on the unimproved rangeland between the diversion outlet and Centennial Wash.

Of the 177.3 acres total, 19 acres are in private ownership, 42 acres are State Trust lands administered by the State Land Department, 116 acres are public lands administered by the U.S. Bureau of Land Management, and an estimated .3 acres are under the jurisdiction of Maricopa County at the Courthouse Road box culvert crossing.

Of the right-of-way required, 158 acres are unimproved rangeland. In section 4, T1N, R8W, 19 acres are in an inactive subdivision, however, there are no improvements in the area traversed by the diversion other than bladed roads.

No relocations of people, businesses, or farm operations will result from the construction of the diversion.

(2) Centennial Levee

Centennial Levee will be located on the west side of Harquahala Valley to provide protection from floodwaters to 7,440 acres of land that are either presently being irrigated or have a history of irrigation. Although the levee will be constructed as a continuous unit, for purposes of discussion it will be divided into two reaches. (See Project Map, Plate 5, and Figure P12. Structural Data is shown in Table III.)

Reach 1 has a northeast to southwest trend. The levee begins just south of Interstate 10 and extends about 3.7 miles to the Centennial Wash floodplain. The levee will prevent runoff from a 21 square mile residual drainage area downstream of the Granite Reef Aqueduct from entering the project area.

The levee has been located far enough to the west so as to protect a proposed canal that will distribute water from the Granite Reef Aqueduct into Harquahala Valley.

Reach 1 is designed to provide protection against the 100-year flood event. Design capacity is 7,540 cfs.

The levee for Reach 1 consists of a compacted earth embankment varying in height from 0 feet to 9.5 feet. Levee slope is .0002 ft./ft. Average velocity of flow is 1.2 feet per second. Velocity of flow has been kept very low to prevent scour in the prevailing light soils. Extra embankment height has been added to allow for expected sediment deposition behind the levee.

Reach 2 parallels Centennial Wash for approximately 5.75 miles. It will prevent the existing spreading of flow that presently occurs near Allison Tank. This condition is described in the Water and Related Land Resource Problems-Floodwater Damage section of this statement. (Also see Figures 1 and 2.)

Reach 2 will confine Centennial Wash flows to a definite floodplain. Drainage area at the beginning of the reach is approximately 652 square miles. This excludes the drainage area on Centennial Wash above the Bureau of Land Management's dam near Wendon and 166 square miles to be controlled by the Tiger Wash Detention Basin (U.S. Bureau of Reclamation).

Reach 2 is designed to protect for the 100-year flood event. Design capacity is 26,400 cfs. This includes flow diverted from Reach 1.

The levee for Reach 2 consists of a compacted earth embankment varying in height from 2.5 feet to 9 feet. Maximum height occurs where the curve is made into Reach 1. (See Plate 5.) The slope of Centennial Wash averages .00248 ft./ft. Velocity of flow during the design event will average 3.5 feet per second.

The embankment section for both reaches will have a 10 foot top width, an upstream side slope of 4:1, and a downstream side slope of 3:1.

Construction of the levee embankment will require 485,000 cubic yards of fill, of which 325,000 cubic yards are for Reach 1 and 160,000 cubic yards are for Reach 2. For Reach 1, this material will come from channel cuts upstream from the levee and within the required right-of-way line. As this reach is designed very flat with siltation expected, channel scour problems will not occur. However, on Reach 2, primary concern is to eliminate channel scour or head-cut formation; therefore excavation by borrow channel will not be conducted. Borrow material for Reach 2 can be obtained from several sources. The soils throughout the entire area traversed by the levee are basically similar so this is not a controlling factor. One source would be to expand the channel cuts for Reach 1 and haul the material to Reach 2. This would require haul distances of up to 6 miles. The material could be obtained by shallow borrow pits, either located upstream of the levee within the flood easement line of Centennial Wash or downstream of the levee in a combination borrow-leveling operation from downstream properties or agricultural lands. Reach 2 will require 160,000 cubic yards. This is equivalent to about 120 acre-feet of material with allowance for compaction shrinkage. This corresponds to a one foot cut on 120 acres, or a two foot cut on 60 acres, etc.

One source of borrow for both Reach 1 and Reach 2 is from expansion and deepening of Allison Tank. This tank provides valuable permanent surface water storage for livestock and wildlife (see Figure P28). Siltation since construction by the C.C.C. in the 1930's has greatly reduced storage capacity. A representative of the owner of this impoundment has verbally requested that borrow material for the

construction of Centennial Levee be obtained from the confines of Allison Tank to increase the available storage. This would be a beneficial endeavor. Final design of the levee may incorporate borrow excavation from the tank if the soils are suitable for dike construction and there are no conflicts with downstream water rights. No such conflicts are anticipated. Securing of all water rights is the responsibility of the project sponsors.

Construction of Reach 1 will require land rights acquisition of approximately 348 acres of land, including 159 acres in private ownership, 126 acres of State Trust lands administered by the State Land Department, and 63 acres of federal public lands administered by the U.S. Bureau of Land Management. Required right-of-way is for the area encompassed by the levee embankment, borrow channels, and flowage line up to the 100-year frequency event. All 348 acres are unimproved rangeland.

Construction of Reach 2 will require land rights acquisition on 6,307 acres, including 5,117 acres in private ownership (585 acres of presently irrigated cropland and 4,532 acres of unimproved rangeland or idle cropland), 1,152 acres of State Trust land and 38 acres of federal public land administered by the U.S. Bureau of Land Management. Of the total land, only about 98 acres are required for actual levee construction. The remainder are for the 100-year frequency flood delineation on Centennial Wash. (See Plate 5.)

Reach 2 will be constructed on the existing floodplain of Centennial Wash. The project sponsors will obtain land rights by flowage easements or fee simple title for the 100-year frequency event where significant changes in flooding occur to properties as a result of the project measure. The after-project 100-year flood lines on Centennial Wash are shown on Plate 5. The delineation covers a reach length of approximately 13 miles. The majority of these lands are already in the Centennial Wash floodplain and subject to floodwater damage under present flow conditions. An unofficial delineation of the 100-year flood lines under present conditions is as shown on Figure 2. The Flood Control District of Maricopa County is anticipating official floodplain delineations prior to project construction. These will serve as a basis for the before-project (existing) condition. The amount of land purchased by fee simple title will vary, depending upon the outcome of individual negotiations with affected landowners. Flowage easement would not preclude all future productive uses of these lands.

The cost of obtaining land rights for Centennial Levee is estimated at $712,450, of which $47,970 is for Reach 1 and $664,480 for Reach 2.

TABLE III

STRUCTURE DATA FOR DIVERSIONS, LEVEES, AND FLOODWAYS

Reach	Beginning Station	Drainage Area (Sq.Mi.)	Capacity (cfs) Req'd	Capacity (cfs) Design	Channel Dimensions: Bottom Width (ft)	Bottom Slope (ft/ft)	Depth of Flow (ft)	Side Slopes z_u	Side Slopes z_d	"n" Value Aged	"n" Value As Built	Velocities (fps) Aged	Velocities (fps) As Built	Type of Work 5/	Before Project 3/-4/
Saddleback Diversion - 4.64 mi.															
1	8+20	0	800	810	35	.0017	4.5	2	2	.035	.035	4.09	4.09 6/	I-R	O-E
2	13+36	(4 - 10'x 5', 90°, Box Culvert at Courthouse Road, L = 28')													
3	13+64		800	810	50	.000797	4.0	5	3	.035	.035	2.83	2.83	"	"
4	16+60	.30	800	857	56	.000797	"	"	"	.03	.025	2.53	3.11	I-E	"
5	23+20		1040	1663	56	.003	"	"	"	"	"	4.90	6.03	"	"
6	44+00	.86	1499	"	56	"	"	"	"	"	"	"	"	"	"
7	51+90		1499	1762	60	"	"	"	"	"	"	4.96	6.07	"	"
8	59+80		1499	1912	66	"	"	"	"	"	"	5.05	6.12	"	"
9	66+70		1499	2064	72	"	"	"	"	"	"	5.12	6.16	"	"
10	75+60		1499	2267	80	"	"	"	"	"	"	5.21	6.21	"	"
11	83+50	1.94	2197	2524	90	"	"	"	"	"	"	5.31	6.26	"	"
12	94+25		2197	3042	110	"	"	"	"	"	"	5.48	6.34	"	"
13	105+00	3.27	3029	3619	132	"	"	"	"	"	"	5.63	6.40	"	"
14	115+34		3029	3963	145	"	"	"	"	"	"	5.70	6.43	"	"
15	125+68		3029	4361	160	"	"	"	"	"	"	5.78	6.46	"	"
16	136+00	5.58	4230	5000	184	"	"	"	"	"	"	5.88	6.50	"	"
17	153+00		4230	5322	196	"	"	"	"	"	"	5.92	6.51	"	"
18	170+00		4230	5644	208	"	"	"	"	"	"	5.96	6.53	"	"
19	187+00		4230	5966	220	"	"	"	"	"	"	6.00	6.54	"	"
20	204+00	8.21	5467	6289	232	"	"	"	"	"	"	6.03	6.55	"	"
21	227+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
22	250+00		5467	"	"	"	"	"	"	"	"	"	"	"	"
	253+00	8.65	5610	(Natural Channel Outlet)											
Harquahala Floodway - 3.43 mi.															
1	11+72	0	485	500	18	.000215	6.80	3	3	.03	.025	1.59	1.91	I-E	N-E
2	22+00		485	500	(Natural channel)										N-E
3	120+00	.96	1265	1265	(I-10 crossing, 3 - 10'x 5' C.B.C.)										M(1964)-E
4	122+10		1265	1265	35	.0090	3.61	2	2	.035	.035	7.02	7.02	I-R	O-E
	177+00	.98	1265	1265	35	.0045	4.38	2	2	.035	.035	5.59	5.59	I-E	N-E
	185+00		1265	1265	35	0.0	4.38	2	2	.035	.035	5.59	4.49	I-E	N-E
	193+00		1265	(Natural Channel Outlet)											
Centennial Levee - 9.45 mi.															
1	41+00	0	0	7540		0 1/	0 2/			.035		0		I-E	O-E
	70+00	2.44	854	"		1356	380			"		.63		"	"
	95+00	6.08	1979	"		2249	800			"		.88		"	"
	120+00	10.18	3562	"		2944	952			"		1.21		"	"
	160+00	14.91	5218	"		4208	1330			"		1.24		"	"
	180+00	15.57	5450	"		4395	1500			"		1.24		"	"
	200+00	16.24	5683	"		4697	1288			"		1.21		"	"
2	238+00	20.99	7539	"		5026	1099			"		1.50		II-E	N-E
	300+00	652-	26390	26400		7411	5100			.035		3.56		"	"
	331+00	"	"	"		9356	5000			&		2.82		"	"
	361+50	"	"	"		7533	3550			.045		3.50		"	"
	388+50	"	"	"		8466	4000			"		3.12		"	"
	416+00	"	"	"		7317	3450			"		3.61		"	"
	442+50	"	"	"		7910	4650			"		3.34		"	"
	469+00	"	"	"		8192	4470			"		3.22		"	"
	498+00	"	"	"		7616	4000			"		3.47		"	"
	525+00	"	"	"		7584	3750			"		3.48		"	"
End Levee	540+00	652	"	"		7218	3350			"		3.66		"	"

1/ Cross sectional area below hydraulic grade line, (Ft.^{2}).

2/ Wetted perimeter below hydraulic grade line, (Ft.).

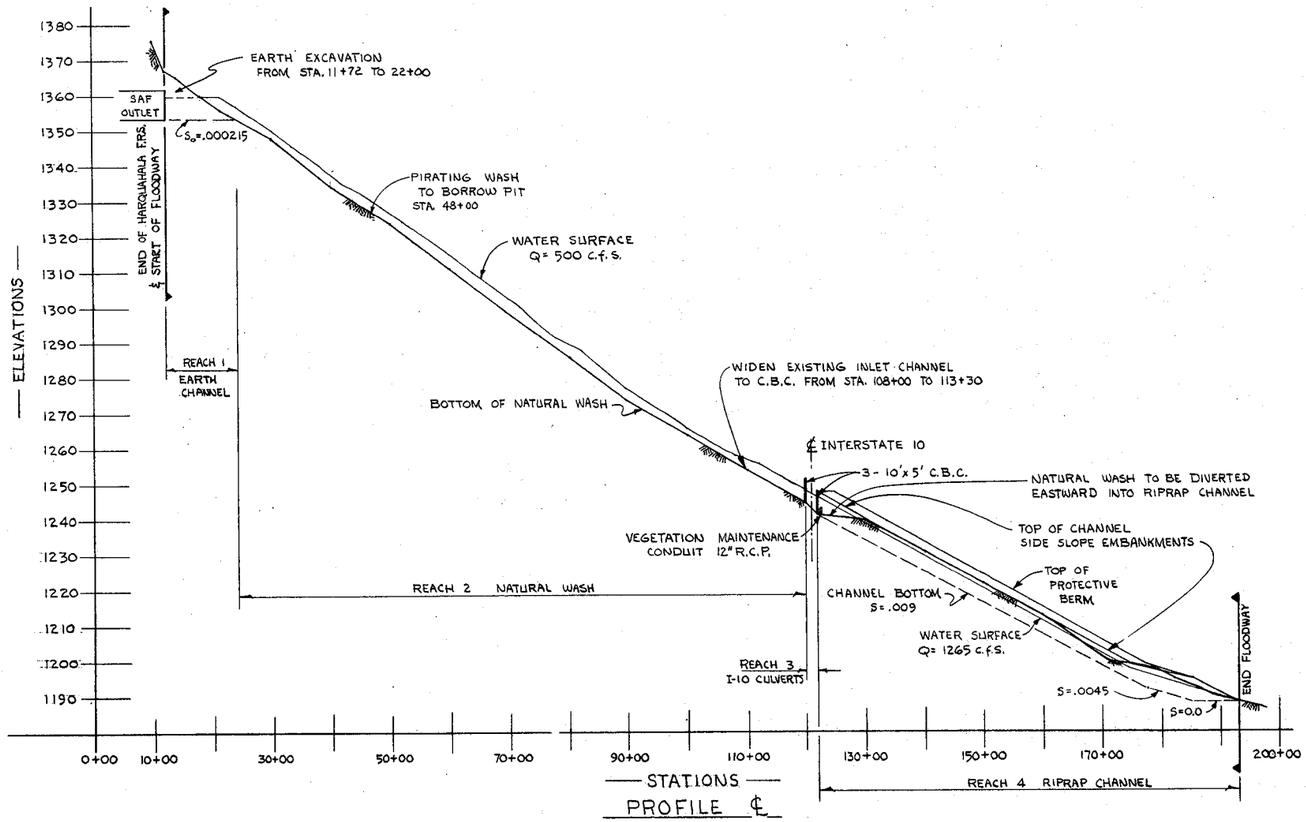
3/ N - An unmodified, well defined natural channel or stream.
M() - Manmade ditch or previously modified channel (approximate date of original major construction).
O - None or practically no defined channel.

4/ Pr - Perennial - flows at all times except during extreme drought.
I - Intermittent - continuous flow through some seasons of the year but little or no flow through other seasons.
E - Ephemeral - flows only during periods of surface run-off, otherwise dry.
S - Ponded water with no noticeable flow - caused by lack of outlet or high groundwater table.

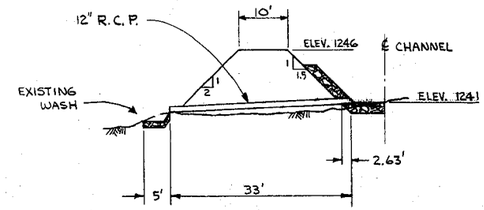
5/ I - Establishment of new channel including necessary stabilization measures.
II - Enlargement or realignment of existing channel or stream.
III - Cleaning out natural or manmade channel (includes bar removal and major clearing and snagging operation).
IV - Clearing and removal of loose debris within channel section.
V - Stabilization as primary purpose (by continuous treatment or localized problem areas - present capacity adequate).

E - Earth channel.
R - Rock riprap channel.

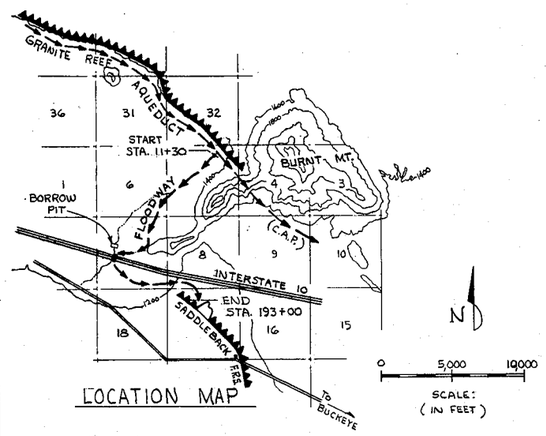
6/ 10YR-24HR storm depth = 3.0' (low flow channel).



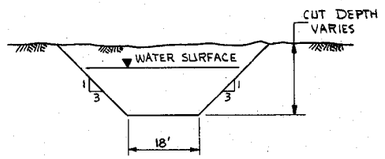
PROFILE ℄
HARQUAHALA FLOODWAY



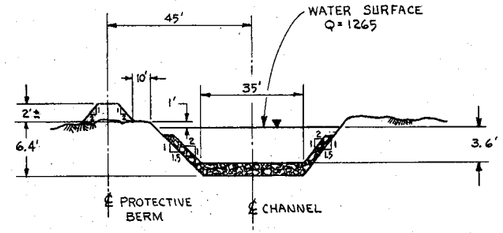
CROSS - SECTION
VEGETATION MAINTENANCE CONDUIT
STA. 123+00



LOCATION MAP



CROSS - SECTION
REACH 1



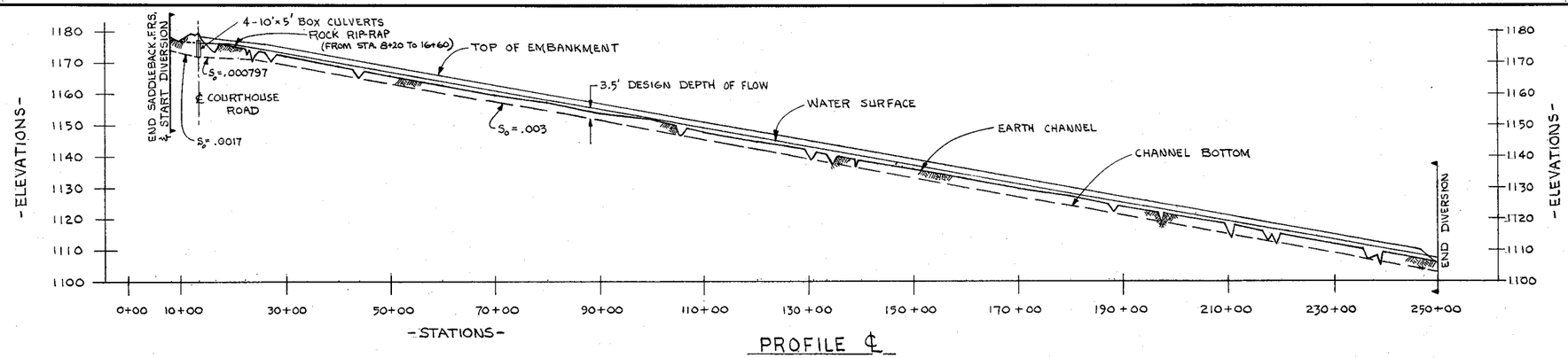
CROSS SECTION
REACH 4

PLATE 3
HARQUAHALA FLOODWAY
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION.
STATE OF ARIZONA

	Date	
Designed B. Freudhoff	2/10/76	Approved by:
Drawn	2/12/76	Title:
Traced		Title:
Checked		Sheet No. of / Drawing No.

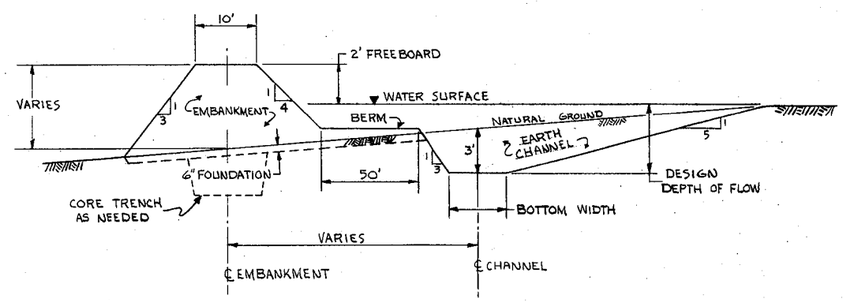
U.S. GOVERNMENT PRINTING OFFICE : 1959 O—394-163



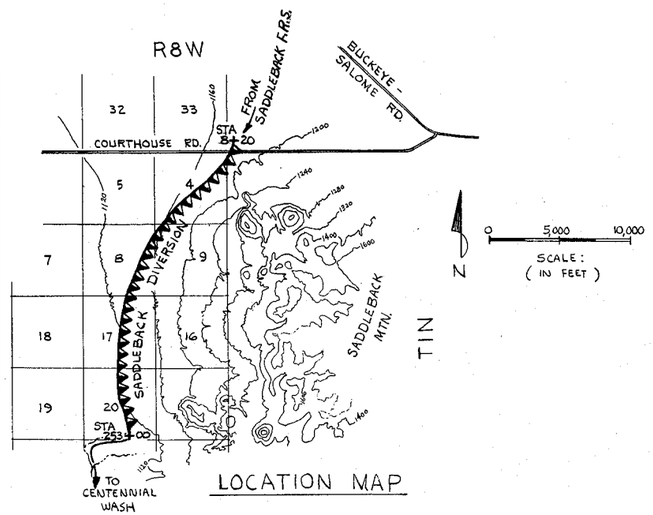
PROFILE ℄
SADDLEBACK DIVERSION

CHANNEL DESCRIPTION

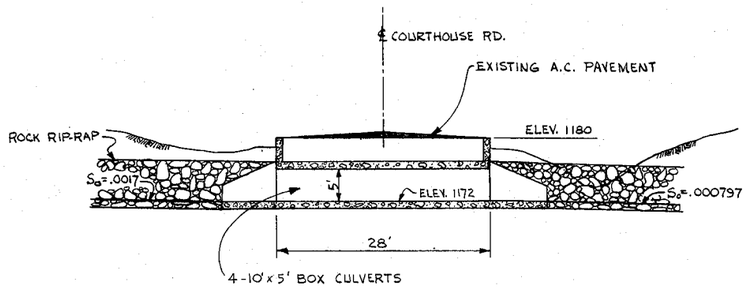
REACH	BEGINNING STATION	DRAINAGE AREA (SQ. MILES)	BOTTOM WIDTH (FT.)	DESIGN CAPACITY (C.F.S.)
1	8+20		35	810
2	13+36		4-10x5 C.B.C.	810
3	13+64		50	810
4	16+60	.302	56	857
5	23+20		56	1663
6	44+00	.861	56	1663
7	51+90		60	1762
8	59+80		66	1912
9	66+70		72	2064
10	75+60		80	2267
11	83+50	1.94	90	2524
12	94+25		110	3042
13	105+00	3.27	132	3619
14	115+34		145	3963
15	125+68		160	4361
16	136+00	5.58	184	5000
17	153+00		196	5322
18	170+00		208	5644
19	187+00		220	5966
20	204+00	8.21	232	6289
21	227+00		232	6289
22	250+00		232	6289
OUT LET	253+00	8.65	NATURAL CHANNEL	6289



CROSS-SECTION
CHANNEL & EMBANKMENT



LOCATION MAP



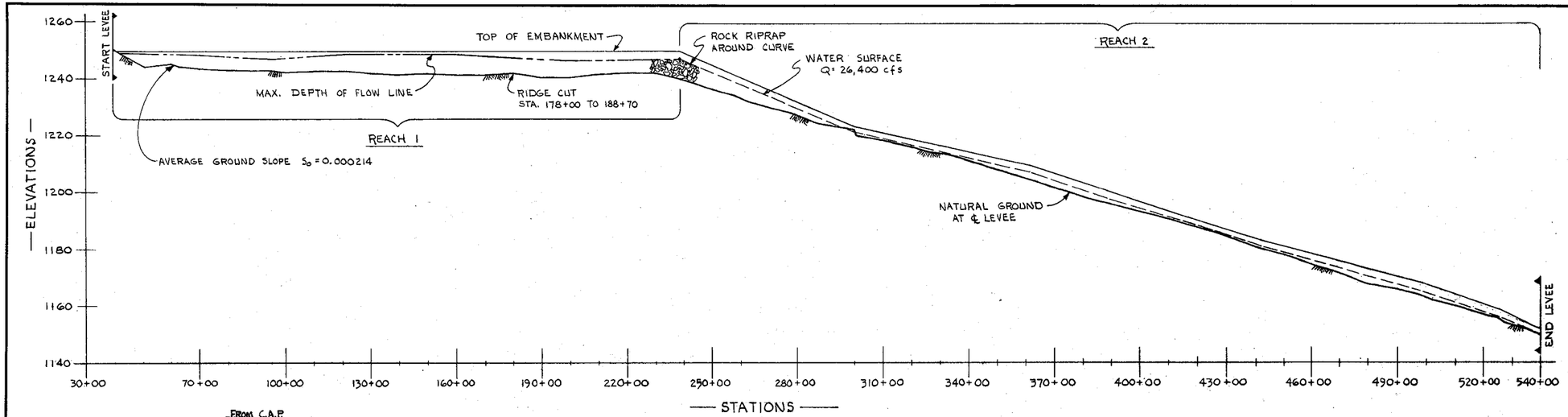
CROSS-SECTION
COURTHOUSE ROAD

PLATE 4
SADDLEBACK DIVERSION
HARQUAHALA VALLEY WATERSHED
MARICOPA & YUMA COUNTIES, ARIZONA
PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION — STATE OF ARIZONA

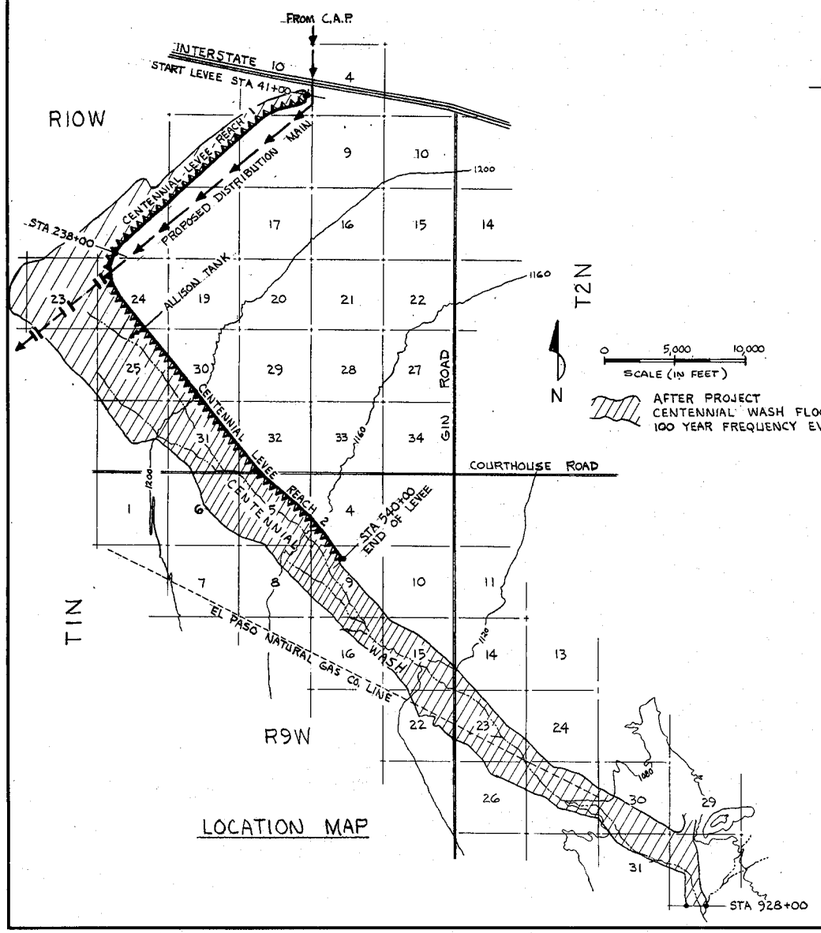
	Date		
Designed BJF	2/10/76	Approved by	
Drawn LM	2/12/76	Title	
Traced		Sheet No. of	Drawing No.
Checked			

U.S. GOVERNMENT PRINTING OFFICE : 1968 O—334-743

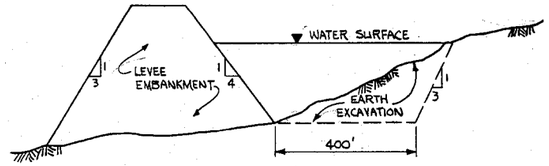
SCS-ENG-313-B Rev. 7-69



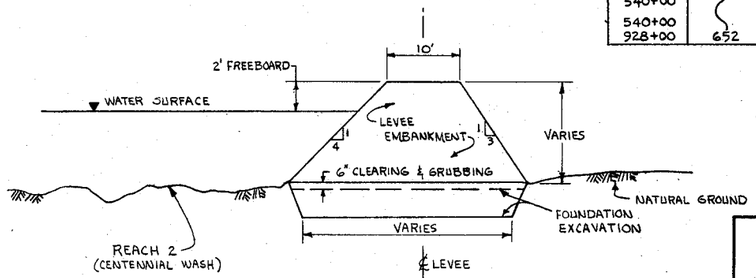
PROFILE ℄
CENTENNIAL LEVEE



LOCATION MAP



CROSS-SECTION
RIDGE CUT
(STATION 178+00 TO 188+70)



CROSS-SECTION
LEVEE EMBANKMENT
(TYPICAL)

LEVEE DESCRIPTION

STATION	D. A. (sq. miles)	REQUIRED CAPACITY (C.F.S.)	VELOCITY (f.p.s.)	NATURAL GRADIENT (ft./ft.)
REACH 1		1% EVENT		
41+00	0	0	0	.000214
70+00	2.44	854	1.28	
95+00	6.08	1979	.88	
120+00	10.18	3562	1.21	
160+00	14.91	5218	1.24	
180+00	15.57	5450	1.24	
200+00	16.24	5683	1.21	
238+00	20.99	7539	1.50	.000214
REACH 2				
238+00	652 -	26,400		
300+00			3.56	.0039
331+00			2.82	.0021
361+50			3.50	.0025
388+50			3.12	.0028
416+00			3.61	.0034
448+50			3.34	.0031
469+00			3.22	.0026
498+00			3.47	.0031
525+00			3.48	.0034
540+00			3.66	.0032
540+00			NATURAL WASH	
928+00	652	26,400		

PLATE 5
CENTENNIAL LEVEE
HARQUAHALA VALLEY WATERSHED
MARICOPA COUNTY, ARIZONA

PRELIMINARY PLANS
MARCH, 1976
ARIZONA WATER COMMISSION — STATE OF ARIZONA

	Date		
Designed B. Friedhoff	2/10/76	Approved by	
Drawn [signature]	3/12/76	Title	
Traced		Title	
Checked		Sheet No. of	Drawing No.

U.S. GOVERNMENT PRINTING OFFICE : 1969 O—334-759

Figure P9. Looking southwest showing where Harquahala Floodway will cross Interstate 10.

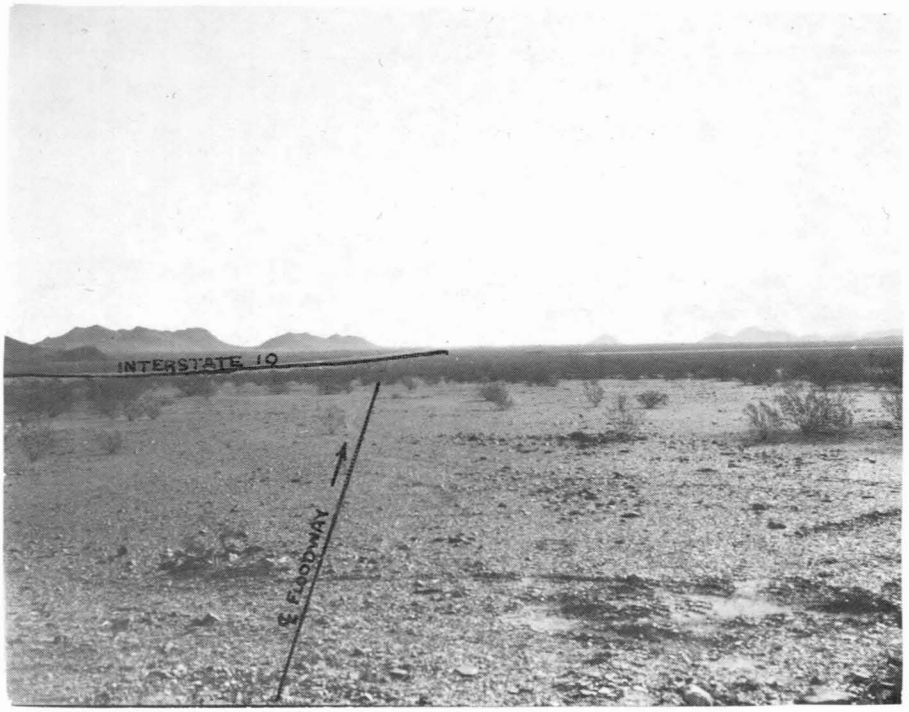


Figure P10. Looking east showing alignment of Harquahala Floodway Reach 4.

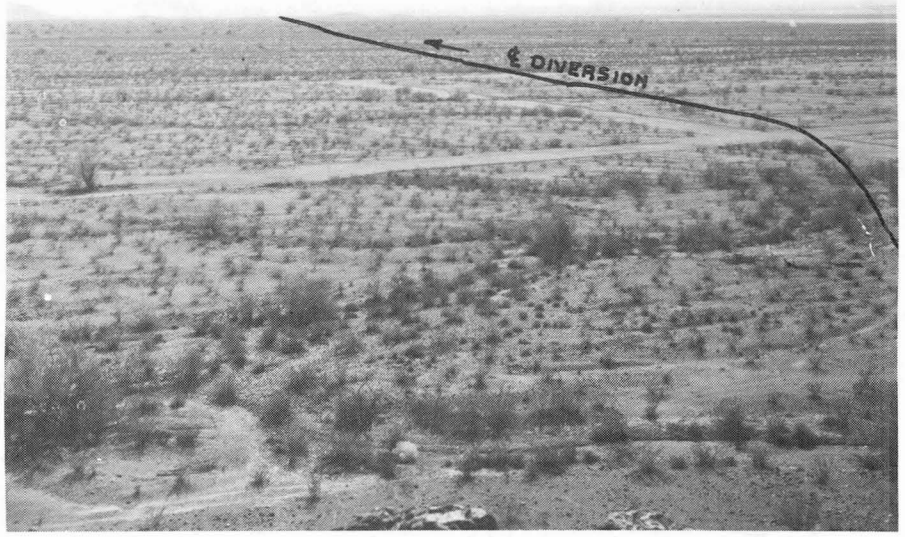


Figure P11. Looking southwest from Section 4,T1N,R8W, showing alignment of Saddleback Diversion. Area in foreground is idle subdivision.

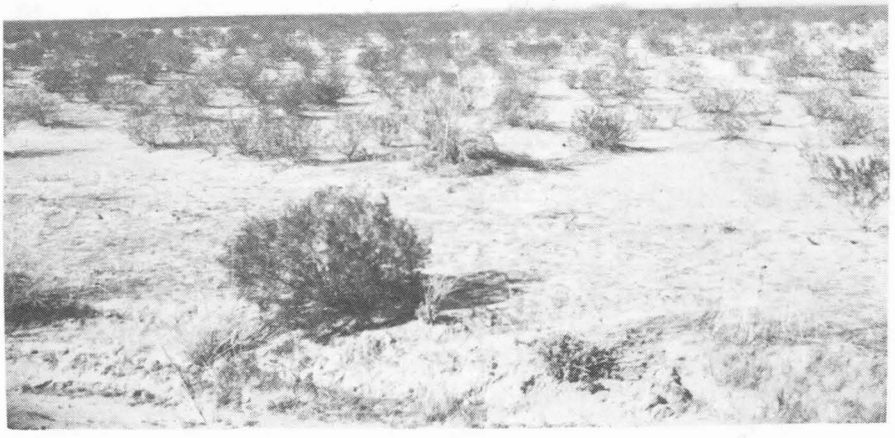


Figure P12. Typical terrain along the alignment of Centennial Levee.

No relocation of people, businesses, or farm operations will result from the construction of Centennial Levee.

A 12 foot by 15 foot log cabin exists in the middle of section 15, T1N, R9W. This structure is within the flowage easement line for Centennial Wash. Local valley residents relate that transients living in the cabin found the structure (origin unknown) lying in the ditch along Gin Road and dragged it to its current location. The provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 - Public Law 91-646, are deemed unapplicable. Costs for removing the structure from the floodplain will be treated as a land rights item.

Hog pens have been constructed in the middle of section 25, T1N, R9W, at the south edge of a salt cedar thicket. These pens are within the 100-year flowage line, but are not currently in use and do not constitute a flow obstacle. No costs are included for their relocation.

4. Environmental Features

The proposed project has the potential to damage the natural environment, primarily, wildlife populations and aesthetic values. Adverse impacts on wildlife populations in the area are generally proportional to losses of woody pseudo-riparian vegetation. Specific species of value are mesquite, ironwood, paloverde and acacia trees. Impacts on aesthetic values result primarily from the protrusion of an unnatural shape into the existing landscape or from a change in the shape of the terrain. This impact is compounded if the vegetative pattern on the changed landscape does not blend with the surrounding natural area.

Since changes in vegetation will produce the principal impact on the natural environment, several features and provisions will be incorporated into the design and construction of the proposed structures to minimize these impacts.

All structure embankment slopes will be treated to reduce rilling and the adverse visual departure from the surrounding natural setting. Several methods of such treatment have been utilized on other structures with varying results. Studies are underway to determine the best method. The U.S. Bureau of Reclamation has established vegetative test plots on the Paradise Valley Detention Dike. The Soil Conservation Service has also established vegetation plantings on the Buckeye and Guadalupe Structures, and their Plant Materials Center is conducting an intensive planting and evaluation program. The Center is presently experimenting with germination of ironwood trees. Results to date appear very promising.

The actual concepts to be used for the structures in the Harquahala Valley Watershed will be determined in final design. The above mentioned studies should provide a valuable base for their determinations. These are open-ended studies under continuous evaluation. Final design features will be based on the best information available at the time of design. It is currently contemplated that the surface of all embankments, borrow areas, and disturbed areas will be scarified and/or furrowed and left in a rough scraggy condition and seeded to several different vegetative species. Establishment of indigenous tree species will be accelerated; however this will not be done on embankments. The locations of the trees will be based upon the recommendations of plant scientists and wildlife biologists. It is intended that trees be reestablished at location as near as possible to where they are lost. However, other areas may prove to be better suited. At this time the most obvious areas are the periphery of the pool areas, along washes within the flood pools, along the natural wash section of Harquahala Floodway, downstream of the vegetative maintenance conduits through Saddleback F.R.S. and Saddleback Diversion, and downstream of the Saddleback Diversion outlet. Factors to consider in the location of the trees will include the possibilities of best survival, wildlife access, extent of downstream right-of-way, well location, aesthetics, etc. It is recognized that the proposed revegetation measures will be expensive with some risk of failure. However, such effort is considered necessary.

Seeded and treated areas will be fenced for protection from livestock and off-road vehicles. Corridors will be left for free movement of livestock and wildlife. The location of the fencing will vary by structure. Fencing on the downstream side of the embankments for Saddleback F.R.S., Saddleback Diversion, and Centennial Levee will probably be located about 20 feet downstream of the embankment toe. The downstream side of Harquahala F.R.S. will not be fenced as part of this project because the Granite Reef Aqueduct will create a barrier and serve the same purpose as a fence. The U.S. Bureau of Reclamation has expressed the intent to fence the downstream side of the aqueduct.

The fences on the upstream side of Saddleback Diversion and Centennial Levee will be placed far enough upstream to be above the design flowage lines so that they will not catch debris and interfere with the operation of the floodways.

The flood pools of Saddleback F.R.S. and Harquahala F.R.S. will be fenced to exclude livestock. This will provide a means for maintaining the expected increase in vegetation resulting from increased water behind the embankments. The distance upstream from the embankment where the fencing will be placed will be determined in final design. Factors to be

considered include the desired frequency of inundation, existing vegetation, and steepness of terrain. It is not currently contemplated that the fencing will include the entire 100-year flood pools except possibly in those areas of steep terrain where most of the flood pool can be included without excessive expense. Both Saddleback F.R.S. and Harquahala F.R.S. are designed to have pool areas. At these areas, the upstream fencing through the flood pool areas will be placed so that livestock and wildlife can have free access to water when available. Also, corridors will be constructed to allow livestock and wildlife movement over the embankments. On Harquahala F.R.S. these corridors will be placed to match crossings over the Granite Reef Aqueduct.

Appropriate and careful consideration has been given to the environmental aspects of this project. The environmental features as described in this section and elsewhere in this statement should minimize adverse environmental effects. The Maricopa County Parks and Recreation Department has set forth environmental guidelines for the construction of flood control projects in Maricopa County. By resolution, the Maricopa County Board of Supervisors has adopted these guidelines. These guidelines are included in Appendix C following the letter from the Maricopa County Board of Supervisors. The present design of the project measures is not in full compliance with these guidelines. A further discussion on these guidelines is included in Section IX, page 138 where a reply is given in response to comments received from the Parks and Recreation Department.

Specific environmental features for each structure are shown below. There are provisions for storage of floodwater. Sponsors will be required to file for water rights.

Saddleback F.R.S.

The dam does not have the normal excavated earth type emergency spillway. The principal spillway serves also as the emergency spillway. The most structurally feasible location for an earth spillway would be on the extreme north end of the dam around the right abutment. A spillway at this location would present an unpleasing visual scar to travelers on the nearby Interstate 10. This was one factor leading to the decision not to have an earth spillway.

The dam is designed to have borrow areas and two basin areas that will store any runoff until depleted by wildlife use or evaporation. The basins can be drained. The provisions for drainage of the borrow areas will be decided in final design.

There are two mesquite thickets located along the alignment of the dam immediately downstream from

Basins No. 1 and No. 2 (see Plate 1). To maintain a continued water supply to this vegetation, 12-inch pipes will be constructed through the embankment from each basin. These vegetative maintenance conduits will be gated to drain the basins for maintenance or emergency. However, they will provide for ungated flow when the water level is above the sediment pool. The maximum discharge through each conduit is estimated to be 6 cfs. In addition to the conduits at Basins No. 1 and No. 2, there will be two other ungated 12-inch conduits through the embankment at other locations where downstream pseudoriparian vegetation is present.

An estimated 160 acres encompassing the embankment, borrow, and disturbed areas will be seeded to provide ground cover and promote the return of native desert vegetation. A minimum of 21 acres will be additionally treated or seeded to promote establishment of indigenous tree species. This includes 9 acres lost from the construction of Saddleback Diversion.

Harquahala F.R.S.

In the 11.5 mile length of Harquahala F.R.S., approximately 95 washes are intercepted. To drain the structure, a small low flow channel will be constructed upstream of the embankment draining from west to east across the washes. The bottom of the channel will be placed from 2 to 3 feet above the bottom of many of the washes and will create small storage basins. Impounded runoff will remain until depleted by evaporation, seepage, and wildlife use. This will probably induce greater vegetative growth in the flood pool area.

In section 22, T3N, R9W, approximately 3,000 feet of the dam and aqueduct has been located downslope out of normal alignment to clear a large basalt hill. A storage pond will be created here. Maximum depth will be 15 feet. Volume of storage will be 142 acre-feet. This storage will remain until depleted by evaporation, seepage and wildlife use, however, the pond can be drained.

The dam will intercept drainage to an existing stockwatering pond. This pond, referred to as New Tank, is located approximately one-half mile downstream of the Granite Reef Aqueduct. (See Figure P8.) It is proposed to move the pond upstream so it will be within the flood pool area of Harquahala F.R.S. This location will increase the runoff yield to the tank and pool storage can be maintained for longer periods,

benefitting both wildlife and livestock. The U.S. Bureau of Reclamation will provide a suitable crossing over the Granite Reef Aqueduct for access to the tank. Animals can walk over the dam embankment, therefore, no structural crossing is required.

An estimated 250 acres encompassing the embankment, borrow, and disturbed areas will be seeded to provide ground cover and promote the return of native desert vegetation. A minimum of 11 acres will be additionally treated or seeded to promote establishment of indigenous tree species.

Harquahala Floodway

The planned diversion of the natural wash immediately downstream from Interstate 10 would block flow that presently provides water to downstream pseudo-riparian vegetation. There are heavy stands of ironwood and some paloverde trees in this area. To continue water flow to these trees, a 12-inch diameter pipe will be placed through the wash diversion barrier so that some of the floodwater passing through the box culverts can continue down the existing wash.

An estimated 2.0 acres will be treated or seeded to promote the establishment of indigenous tree species. These trees will either be established in the Interstate 10 borrow pit or elsewhere as a part of the mitigation features for Harquahala F.R.S. About 30 acres of the Interstate 10 borrow pit or other areas will be treated or seeded to promote return of native desert vegetation.

Saddleback Diversion

The diversion will intercept approximately 55 washes. Ungated 12-inch diameter pipes will be placed through the embankment on five washes in order to provide water to downstream vegetation. The release rate will be approximately 5 cfs.

The diversion will intercept flow to one existing stockwatering tank located in section 20, T1N, R8W, approximately 1,800 feet downstream from the diversion. The tank is located on public lands administered by the U.S. Bureau of Land Management. This tank is of shallow depth and only has storage for short periods following storm runoff. To maintain flow to this tank, two alternative actions are available. One is to install a conduit through the diversion embankment. Flow would be diverted through the conduit to the present tank location. The other alternative proposes

to eliminate the existing tank and construct a new one as an integral part of the diversion. This could be accomplished by excavating between the embankment and diversion channel for a short reach. The actual alternate to be used will be decided during final design of the diversion. Either alternative would greatly improve existing runoff yield to the tank.

Another watering tank is located downstream of the diversion outlet in section 29, T1N, R8W. This tank is on State Trust lands. It is maintained by irrigation tailwater and almost always has permanent storage. It is an important source of water for wildlife use, including waterfowl. The construction of Saddleback Diversion will increase the amount of surface water runoff to the tank and help maintain permanent storage.

An estimated 150 acres encompassing the embankment, borrow, and disturbed areas will be seeded to provide ground cover and promote the return of native desert vegetation. The diversion channel areas will be restricted to grasses or similar small plants that will not restrict flow.

Centennial Levee

This levee has been located through an area of sparse desert vegetation consisting primarily of creosotebush. The primary environmental features considered in the structure are the location of the structure and borrow areas. As previously described, some or all of the borrow areas may be nondraining and Allison Tank may be deepened and enlarged to increase the permanent storage potential available at this site. Allison Tank is privately held.

An estimated 200 acres encompassing the embankment, borrow, and disturbed areas will be seeded to provide ground cover and promote the return of native desert vegetation. A minimum of 2 acres of this area will be additionally treated or seeded to promote establishment of indigenous tree species.

5. Mitigation for Aesthetics and Wildlife

The anticipated long-term impact on vegetation and, thus, related impacts on wildlife and aesthetics will be beneficial. However, during construction and for several years thereafter, vegetative cover will be less than what presently exists.

Proposed mitigation is to undertake measures which will

accelerate the establishment of native vegetation, including indigenous trees which provide valuable wildlife habitat. This will be accomplished by treating or seeding areas to promote return of suitable species, and by protecting the new growth from livestock and vehicles. If new growth is not established from these initial efforts, additional measures such as watering will be used.

Seeding will be done on almost all disturbed areas. An estimated 790 acres are involved. Species seeded will include indigenous grasses, shrubs and forbs. Approximately 36 acres will be treated or seeded to promote establishment of woody tree species. Primary species will be mesquite, paloverde, and ironwood.

6. Archaeological and Historical 29,30,42,45

Archaeological Reconnaissance Surveys of the proposed structure sites and flowage areas were completed by the Department of Anthropology, Arizona State University, Tempe, Arizona, in January 1975 and December 1976. Copies of these reports have been sent to the State Historical Preservation Officer, Arizona State Museum, National Park Service, and the U.S. Bureau of Land Management.

Several sites were recorded. Appropriate investigation and recording of the sites was accomplished by the survey team. The archaeologist's opinion is that none of the sites are of significant value to warrant inclusion in either the Arizona or National Register of Historic Places.

These two surveys covered all of the project impacted area except the flowage easement area of Centennial Wash and the natural wash flowage easement area of Harquahala Floodway. The Centennial Wash area covers approximately 6,209 acres of Centennial Wash floodplain subject to floodwater damage under present flow conditions. After-project flow condition in this area will be essentially unchanged from present conditions. The floodwater retarding effect of the project dams and the U.S. Bureau of Reclamation Tiger Wash Detention Basin is offset by the fact that Centennial Levee will prevent floods from spreading out over Harquahala Valley. The Harquahala Floodway area covers approximately 40 acres of natural wash.

The State Historical Preservation Officer, National Park Service and other archaeological authorities will be consulted as to the need for a detailed archaeological and historical survey for both the Centennial Wash and Harquahala Floodway areas. If there is factual evidence that significant cultural properties are likely to be adversely affected and that further investigation is necessary, then a survey will be conducted prior to construction.

A copy of all survey reports will be sent to all concerned agencies. The State Historical Preservation Officer, National Park Service, and the U.S. Bureau of Land Management will be notified if any previously unidentified evidence of cultural values are discovered during the surveys or during detailed investigations or construction. The procedures in Public Law 93-291 will be followed. Since this is a federally assisted local project, there will be no change in the existing responsibilities of any federal agency under Executive Order 11593 with respect to archaeological and historical resources.

7. Construction Activities [6]

Soil Conservation Service policy requires that care be exercised during construction to preserve and protect the natural landscape and to minimize erosion, water, air, and noise pollution. Construction contracts for the planned project will contain specific provisions to insure this end. Sample guidelines for construction include:

Construction Facilities

1. The preservation of the landscape shall be an imperative consideration in the location of construction camps, storage areas, and buildings required temporarily in the performance of the work. Contractors' plans showing campsites, storage and housing facilities shall be submitted for approval before construction begins.

2. Such sites shall be kept as small as possible and will be located in available areas of minimum vegetation and slope. Full restoration and reshaping of these areas shall be made.

3. Borrow material area and batch sites will be authorized only by special permit. Full restoration and reshaping of these areas will be necessary.

4. All portions of work areas shall be maintained in a neat, clean and sanitary condition at all times. Toilets will be furnished where needed for the use of construction workers.

Public Safety and Protection of Property

1. Operations shall be conducted so as not to close or obstruct any portion of any railroad, road or other property until permits have been obtained from the governmental or other authorities having jurisdiction.

2. Any phase of operation may be temporarily halted

for muddy ground conditions which would unnecessarily disturb the site. All operation may be required to cease during heavy rains.

3. All planted and natural vegetation such as trees, plants, chrubs and grass on or adjacent to the premises, which do not reasonably interfere with the performance of work, shall be preserved and protected.

4. Reasonable precautions shall be taken to protect, in place, all public land survey monuments and private property corners. If any such landmarkers or monuments are inadvertently destroyed, they shall be reestablished or referenced in accordance with the procedures outlined in the "Manual of Instructions for the Survey of the Public Land of the United States" or the specifications of the county engineer, in the case of private property.

Access Roads and Vehicle Movement

1. Travel will be permitted only on designated system or construction roads. No off-road travel will be allowed. This includes movement of equipment between sites.

2. System roads and other existing roads will be marked for use as access roads wherever feasible. It is the intent to hold construction of new roads to the absolute minimum.

3. New roads shall follow approved routes and shall be constructed with the minimum possible clearing and soil disturbance.

4. The road width shall be determined by need, such as equipment size, and shall be no wider than necessary. The maximum allowable width shall be 14 feet.

5. Unauthorized cross-country travel and creation of roads beyond those approved will be strictly prohibited. Measures to control all activity of this type will be enforced.

6. The limits of where construction equipment and vehicles can and cannot go will be clearly marked at each new site before equipment is brought in. Construction foremen and personnel shall be well versed in recognizing these markers and shall understand the restrictions on equipment movement that is involved.

Clearing and Grading

1. Clearing for roads and right-of-way in desert scrub shall be limited to crushing rather than uprooting

brush. Plants may be clipped off at ground level leaving roots undisturbed so that they may resprout. This will be done by brush blades or by hand.

2. Unless large plants within the construction area interfere excessively with equipment movement during construction, such vegetation will not be removed but will be marked for preservation. This applies particularly to saguaro cactus and other vegetation of particular value.

Erosion

1. The area and duration of exposure of erodible soils will be reduced to the greatest extent practicable.

2. Runoff from the construction site will be mechanically controlled as needed to prevent downstream problems.

3. During or after heavy storms, it may be necessary to cease operations if vehicle movement is resulting in ruts or other major damage to soil surface.

Dust Control

1. All excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas within or without the project area shall be maintained free from dust that would cause the standards for air pollution to be exceeded or that would cause an extended hazard or nuisance to others.

2. Approved methods of stabilization consisting of sprinkling, chemical treatment, light bituminous treatment or similar methods will be used to control dust.

3. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

Control of Fires

1. A fire plan shall be proposed that will set forth in detail the plan for prevention, control and extinguishing of fires on and in the vicinity of the project area.

2. Full compliance with fire laws and regulations shall be considered a necessity.

3. Blasting caps and powder shall be stored only in approved areas.

Waste Disposal

1. General cleanup will be expected along working areas throughout the duration of the project to prevent littering.

2. Disposal of any materials, wastes, effluents, trash, garbage, oil, grease, chemicals, etc., shall be subject to the approval of property owners.

3. All used oil or other petroleum products shall be hauled away. There shall be no release of crankcase oil, etc., into surface waters, washes, or the soil anywhere.

4. Sanitary wastes shall not be discharged into any surface waters or washes.

5. Water used in embankment material processing, aggregate processing, concrete curing, foundation and concrete lift cleanup, and other waste waters shall not be discharged into surface waters.

6. All noncombustible wastes such as concrete waste or metal scraps shall be hauled away or buried. Permission will be obtained from property owners before burial.

7. Combustible wastes such as packaging material shall be hauled away and disposed of upon leaving any work area.

8. In instances where disposal by burning seems preferable, it shall be done with small fires.

9. All burning of materials including materials removed during clearing and grubbing operations will be carried out in accordance with Maricopa County Health Department regulations.

Noise Control

1. Large earthmoving equipment produces a high level of noise. All machinery and equipment is inspected prior to operation at the site. Improper muffling is cause for rejection.

Native Vegetation [23,24]

1. Disturbance of vegetation will be reduced to the minimum necessary for orderly and economical construction of the project. Native vegetation will be saved or salvaged where practical. Special attention will be afforded vegetation protected by State law.

2. Native vegetation that has been saved during construction shall be nurtured and allowed to grow. This shall include pruning away all broken limbs, clearing away all rubbish that might restrict growth, and mulching where available and appropriate.

Post-Construction Cleanup

1. All signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction shall be obliterated.

2. Filling and plowing of roadways will be required where appropriate to restore the area to near natural conditions which will permit the growth of vegetation thereon and discourage future traffic.

3. Any landscape feature scarred or damaged by equipment or operations shall be restored as nearly as possible to its original condition. Large damaged vegetation shall be treated and healed or removed and disposed of under requirements for clearing and grubbing.

4. Restoration of disturbed areas will be accomplished by seeding, transplants and/or special treatment to accelerate natural regrowth.

8. Public Access

The availability of the structural measures for public use will be controlled by the Flood Control District of Maricopa County. The fencing for protection of the planned revegetation will restrict access. Heavy use is not anticipated. If past trends are indicative, the use will be limited to isolated visits by rockhounds, and hunting of dove, quail, and other small game. If future use is of such magnitude as to damage the natural environmental setting or create health and safety problems, the District will limit public accessibility.

9. Operation and Maintenance 5,6

a. Land Treatment Measures

Farmers and ranchers cooperating with the Buckeye-Roosevelt and Wickenburg Natural Resource Conservation Districts will be responsible for operation and maintenance of land treatment measures installed on their farms and ranches, including State leases.

Land treatment measures on federal lands will be maintained by the Bureau of Land Management or the lessees.

b. Structural Measures

The Flood Control District of Maricopa County will be responsible for the operation and maintenance of all structural measures after installation. The District obtains all necessary funds for operation, maintenance, and replacement from tax or assessment levies. On past instances, the District has entered into special operation and maintenance agreements with other entities for the performance of operation and maintenance on specific structures.

A specific operation and maintenance agreement will be entered into between the sponsors and the Soil Conservation Service prior to the signing of a land rights or project agreement.

The responsible Soil Conservation Service employee and a sponsor's representative will make a joint inspection annually, after unusually severe floods, and after the occurrence of any other unusual conditions that might adversely affect any of the structural measures. These inspections will continue for three years following installation of each structure. Inspections after the third year will be made annually by the sponsors and a report sent to the Soil Conservation Service employee responsible for operation and maintenance inspections.

Representatives of the federal, State, and county governments shall have free access at all times to the structural works of improvement, including flowage easement areas, for official activities. These activities shall include inspection and necessary operation and maintenance activities.

All phases of operation and maintenance of these facilities shall comply with applicable local, State, and federal regulations.

Total annual operation and maintenance cost of structural measures is estimated at $27,400.

Those items considered necessary for the proper operation and adequate maintenance of the structural works of improvement are as follows:

Operation

1. The structural measures for flood prevention are automatic in their operation. The principal spillways are ungated allowing floodwater to emit into the floodways as soon as the floodwater reaches the reservoir and exceeds below ground storage volumes.

2. The gates in the basin portions of the Saddleback F.R.S. and the emergency drain outlets on Harquahala F.R.S. will be closed at all times except in the case when emergency repairs or special inspection and maintenance may be required. The gates may be opened to drain the water impounded in the sediment pools.

3. Most of the conduits installed to maintain downstream water flow are ungated and automatic in their operation. The two gated conduits for Saddleback F.R.S. have open risers and flow is ungated and automatic when a certain water stage is reached. (See Plate 1.)

Maintenance

1. Keep all gated outlets in operating condition.

2. Remove trash and debris from principal spillway inlets and from inlets to the conduits installed to maintain downstream water flow.

3. Keep emergency spillways clear of obstructions and repair damage caused to the spillways.

4. Exercise control and removal of debris and vegetation other than short grasses from the low flow channel of Saddleback Diversion.

5. Remove sediment deposits from channels if needed to maintain capacity, giving particular attention to areas where defined tributaries intersect the channels. Sediment will be disposed of in accordance with local environmental policies.

6. Refill and compact scoured areas along all embankments.

7. Stabilize excessively scoured areas in the channel areas of Saddleback Diversion and Harquahala Floodway.

8. Special attention must be given to bridges, road crossings, telephone cable and other utility crossings for excessive scour so that immediate remedies can be effected.

9. Trash and debris will be removed, and repairs made as necessary, to continue vehicular traffic on all roads that transverse flood pools of the structural measures.

10. Project Installation Costs 5,6,34

The project installation cost includes all P.L. 566 and other costs, including the cost of work required to comply with mandatory State law or regulations, in cash or its equivalent, for installing the project works of improvement. Cost includes the cost of establishing the land treatment and structural measures. These obligations may be met by cash payment or expenditure, and by donation of goods and services. The following tabulation summarizes the total project costs:

	P.L.566 Funds	Other	Total
Total Project	$8,611,910	$3,201,240	$11,813,150
Land Treatment	(56,100)	(1,879,900)	(1,936,000)
Structural Measures	(8,555,810)	(1,321,340)	(9,877,150)

E. Environmental Setting

Harquahala - pronounced Har-kwa-hey-la, from Mohave Indian word Ah-ha-qua-hale meaning "water there is high up." Referred to a spring on the south side of the Harquahala Mountains. White man attempts to pronounce the indian word resulted in various spellings. Generally spelt Harquahala since about 1869.

.....Arizona Place Names

1. Physical Resources

a. Physical Setting [2,7,27,28]

Harquahala Valley Watershed is in west central Arizona, approximately halfway between Phoenix and the Colorado River. The watershed contains 239,360 acres - 235,410 in Maricopa County and 3,950 acres in Yuma County. The watershed includes the southern end of the Harquahala Mountains, the Big Horn Mountains, Burnt Mountain, the west slopes of Saddleback Mountains, and a broad alluvial plain referred to as the Harquahala Plains.

The watershed is within the Gila Water Resource subregion of the Lower Colorado Region as defined by the U.S. Water Resources Council. The Lower Colorado Region includes the State of Arizona and parts of Nevada, Utah, and New Mexico. The Gila River, the largest surface water system in the Region, originates in western New Mexico and flows generally west through Arizona to the Colorado River at Yuma. The Harquahala Valley Watershed is drained by Centennial Wash which enters the Gila River approximately 10 miles southwest of Buckeye, Arizona. The watershed is approximately 23 miles upstream on Centennial Wash from this point.

The physical characteristics of the Gila subregion vary from the broad open expanses of the Sonoran Desert to high rugged mountains. Harquahala Valley Watershed is entirely within the Sonoran Desert portion of the subregion. The watershed is well-defined as an arid, remote setting within the subregion. Of the total watershed area, 85% could be properly classified as uninhabited.

There are no towns in the watershed although some businesses have been established. The developed farming area is about 40 miles west of Buckeye, population 5,000, and 70 miles west of Phoenix.

The unincorporated community of Aguila is located

on U.S. Highway 60 about 5 miles north of the upper end of the watershed and 35 miles north of Harquahala Valley. Access to Aguila from the valley is via the unpaved Eagle Eye Road.

The unincorporated communities of Salome and Wenden, which are also on U.S. Highway 60, are located 11 miles northwest of the watershed area and 35 miles from Harquahala Valley. Access to Salome is via the Buckeye-Salome Road. The portion of this road within the watershed is unpaved.

The first settlement in the area, Harrisburg, was established in 1886 in a small valley, later called Harrisburg Valley, where Centennial Wash passes between the Harquahala and Little Harquahala Mountains about 8 miles west of the western boundary of the watershed. The Bonanza, or Harquahala vein system, was discovered in 1888 and the mine became the largest in the area, with a total production of more than 2½ million dollars in gold, mostly prior to 1900. This find stimulated interest in the area and numerous smaller mines were developed.

The Arizona and California Railroad (now a part of the Atchison, Topeka, and Santa Fe Railroad) was completed through the McMullen Valley in 1907 and the towns of Salome and Wenden were founded along the railroad. McMullen Valley is located about 10 miles north of the watershed boundary.

Cattle ranching has been practiced in the area for many years. The first farming on the Harquahala Plains was an attempt at dry farming by homesteaders during the depression years beginning in about 1928. Veterans were allowed 320 acres and non-veterans were allowed 160 acres. There were many homesteaders in the valley during the late 1920's and early 1930's. In the words of a resident of the area during that period, "In the evening, the locations of homesteads appeared as a vast sea of lantern lights across the valley." 27/

The remains of abandoned homesteads are to be found throughout the area. Some homesteaders had wells for domestic, stock, and small gardens but evidently no successful attempt was made to use groundwater for irrigation. At the abandoned Mosher homestead in section 31, T3N, R9W, the well was reportedly dug entirely by hand to a depth of about 330 feet. In the late thirties, wells in the lower end of the valley were developed for irrigation, but most of the water was transported to land out of the Harquahala Valley.

Concentrated agricultural development began in the early 1950's, with the first well being drilled in 1951. Development proceeded at a rapid pace. By 1963, the irrigated land had increased to about 19,000 acres and has remained relatively static since that time.

Interstate Highway 10 was completed through the watershed in 1973. Until that time, the entire watershed could only be described as being in a remote area. There are several county roads, of which two, Courthouse Road and Gin Road, are paved through the developed areas of Harquahala Valley. A major gas line of the El Paso Natural Gas Company system and an A.T.&T buried main telephone cable also traverse the watershed. The alignment of the authorized Granite Reef Aqueduct of the Central Arizona Project traverses the watershed about 5 miles north of the developed agricultural areas.

b. Major Soil and Water Resource Problem Areas

The major problem area in the watershed is on the portion of the alluvial floodplain of Harquahala Valley which has been highly developed for irrigated agriculture. The floodplain is directly below the desert mountains which produce floodwaters that enter the floodplain from the northwest and west. Natural, well-defined flood channels are almost nonexistent on and adjacent to the floodplain. Floodwater is primarily overland flow. The topography of the floodplain is such that regardless of origin, the floodwater funnels down through the center of the developed farmland. Grades are so flat that almost all of the farmland is inundated by large storms.

Land is being intensively farmed and is highly productive. As a result, flood damage to irrigation systems, roads, homes, and equipment is severe.

c. Topography

Elevations in the watershed range from 1,050 feet on Centennial Wash to 5,681 feet in the Harquahala Mountains. Over 44 percent of the area is in the hills and mountains where slopes range from 5 percent to vertical.

d. Soils [2,4,40]

On the mountains and mountain foot slopes, soils are rocky, cobbly or gravelly with shallow and very shallow depths. In the steeper areas, as in the Harquahala, Big Horn, Burnt, and Saddleback Mountain ranges, soils are very shallow and from 40 to 60 percent of the surface is rock outcrop. In the less sloping areas the soils are from 4 to 14 inches deep and have a thin, medium, or moderately coarse textured gravelly to stony surface soil. The deeper soils have a medium or moderately fine gravelly to stony subsoil. Most of the soils are residual on granite, gneiss, limestone, schist, andesite, basalt, or shale. Smoother slopes generally have a dark desert varnish coating on the gravel

surfaces. Local areas of soils have a strongly cemented lime hardpan. Soils here are only slightly erosive. The coarse testures of the soils, gravelly surfaces, and lime hardpans are factors which impeded erosion in the area. The soils have a high runoff potential because shallow soils and rock outcrops have a very slow rate of water transmission and very slow infiltration rates when thoroughly wetted.

Deep or moderately deep soils on alluvial outwash plains constitute most of the plains area. Medium or moderately fine surface soils and subsoils are found on the smoother slopes near the center of the valley. Coarse or moderately coarse textured soils comprise the upper fans of washes from the granitic mountains. Along the foot of the mountains, there is usually an area of shallow to moderately deep residual soils. These often have a medium textured surface with gravel that is covered with dark desert varnish. They have moderately fine textured subsoils underlain at 12 to 28 inches by a strongly cemented lime hardpan. Alluvium for the valley fill soils originates in the granite, granite gneiss, schist, limestone, andesite, basalt, and shale rocks of the adjacent mountains. Slightly to moderately erosive soils are present. Where the land slope is relatively flat and a sheet flow runoff condition prevails, erosion is generally not significant. Erosion is active, however, in some of the channels and diversions constructed in and around the cultivated area where flood flows are concentrated. Generally, the soils have a slow to very slow rate of water transmission and a slow to very slow infiltration rate when thoroughly wetted because of moderately fine to fine texture. These soils have a moderately high to high runoff potential.

e. Land Capabilities

Water is the limiting factor in this watershed. There are approximately 60,000 acres of potential irrigable land in the watershed of which about 40,000 acres are located in the flatter portions of the Harquahala Plains that would be highly productive if sufficient water was available for development. The area is ideally suited to irrigated agriculture with a growing season of about 310 days.

f. Geology [8,9]

Physiographically, southwestern Arizona lies in the Sonoran section of the Basin and Range Province and is characterized by northwest trending mountains separated by wide alluvial plains. The topography of the area suggests that the mountains are tilted or uplifted fault blocks, and the basins are the downfaulted counterparts. The mountains are composed of a variety of rock types. The basins are filled with alluvium from the weathering

and transportation of rock material from adjacent highlands.

The portion of the Harquahala Mountains included in the watershed area is composed mainly of Pre-Cambrian granite gneiss and schist; Paleozoic and Mesozoic shale, quartzite, limestone; and Laramide granite and related crystalline rocks. The portion of the Big Horn Mountains included in the watershed is made up of Cretaceous andesite and andesitic tuff; Pre-Cambrian granite and granite gneiss; and Quaternary basalt with small areas of rhyolite, shale, quartzite, and limestone. The Saddleback Mountains are composed mainly of Pre-Cambrian schist, Cretaceous andesite and andesitic tuff, and Quaternary basalt. Burnt Mountain is composed of Quaternary basalt.

Gentle alluvial slopes extend basinward from the mountains. Quaternary-Tertiary sand, gravel, and conglomerate are present near the mountain fronts with Quaternary clay, silt, sand, and gravel occurring at the lower elevations.

The maximum thickness of alluvial materials in the basin is not known, although limited well log data indicates basement rock in excess of 2,000 feet deep. The upper part of the alluvial fill is considered to be of Quaternary age, but alluvial beds of Tertiary age probably are present at depth.

Vulcanism is believed to have begun in the Cretaceous period and to have continued intermittently into the Quaternary period. The era of vulcanism was marked by minor structural movements and periods of explosive activity. Some of the tuffs accompanying the vulcanism probably were deposited in water. Basin and Range block faulting probably began in the early Tertiary, although the landforms resulting from this activity have since been modified and in some places obliterated. The block faulting that produced the present mountains probably occurred at the beginning of the Quaternary period. Since that time erosion of the mountains and deposition of alluvial material in the basins have been the principal geologic agents at work.

g. Climate

Climate in the watershed is arid with average annual precipitation ranging from 7.5 to 10 inches. During July, August, and September, high intensity thunderstorms and dissipating tropical disturbances moving north and east from the Gulf of California and Pacific Ocean account for the heaviest rains. Mean monthly precipitation is as follows:

Month	Mean Precipitation (Inches)
January	.92
February	.92
March	.69
April	.35
May	.06
June	.11
July	1.11
August	1.37
September	.62
October	.50
November	.39
December	.92
Total	7.96

Precipitation and temperature distributions at Salome, 15 miles north of the watershed boundary, are typical for the watershed. Mean monthly temperatures range from 48.7°F. in January to 88.1°F. in July with a mean annual temperature of 67.1°F. The highest recorded temperature was 118°F. in 1929 and the lowest was 15°F. in 1950. There are an average of 321 days with minimum temperatures above 28°F. Estimated annual mean relative humidities are 46 percent at 6:00 A.M. and 21 percent at 6:00 P.M.

h. Mineral Resources

The mineral resources of the watershed were investigated in 1967 by the Bureau of Mines, U.S. Department of the Interior, as part of the agency's review of the original watershed work plan. Comments made by the Bureau are paraphrased below:

1. The Aguila manganese district is situated in the north central part of the watershed area. This district centers around the township, T5N, R9W. About 25 manganese mines occur in the district from which about 35,000 tons of ore have been obtained. The mines in this district are now idle.

2. Several gold mines occur in the same area as the manganese mines. Production records are very poor, but one mine (El Tigre) yielded ore valued at nearly $15,000 in 1923. It is probable that the total district production of gold is less than $100,000.

3. In 1953, sections 20, 21, 22, 23, 28, 29, 31, and the north halves of sections 26 and 27, T4N, R9W

were covered with placer claims. The 32 placer claims, called the Black Magic Group, were held in 1953 by the Black Magic Mining Association of Phoenix, Arizona. Another group of claims, the E. N. Greenleaf group, was located south of the Black Magic claims. Thorite and monazite had been reported in the black sand, but neither was found in five samples taken by a Bureau of Mines engineer in a 1953 examination. Most of the black sand was found instead to contain magnetite, and the slight radioactivity was due to, or associated with, sphene and altered zircon. No ore reserves could be calculated for the Black Magic claims.

4. A few copper prospects are located high on the north flank of Saddleback Mountain.

At the present time, there are no known mining operations being conducted in the watershed.

i. Land Use [2,4,32]

The watershed contains 239,360 acres. Of the total, 19,000 acres (7.9%) is irrigated cropland of which about 1,500 acres were idle in 1974. (See Land Status and Resources Unit Map - Appendix B.)

Road right-of-way occupies 3,760 acres (1.6%). Approximately 0.8 percent of the total watershed area, or 1,600 acres, has been approved for subdivision by the Maricopa County Planning and Zoning Commission. All of this is located in Harquahala Valley. Except for a few isolated houses and mobile homes, these subdivisions have not been developed.

Of the total watershed area, 213,500 acres (89%) is unimproved desert classified as multiple-use land primarily for livestock grazing, wildlife, and limited recreation. Some of this area is within the higher elevations of the Saddleback and Big Horn Mountains which are too steep and rugged for cattle.

Approximately 1,500 acres (0.6%) are occupied by farmsteads, businesses, old mines, and other miscellaneous uses.

j. Surface Water Resources [2,4]

The term to best describe the surface water resources in this watershed is "meager." There are no perennial streams. The average annual runoff from the total watershed to Centennial Wash is approximately 0.1 inches per year which is 1.2 percent of the average annual rainfall.

There are numerous intermittent flow washes in the watershed with characteristics typical of the semi-arid setting. The major washes head in the Harquahala, Big Horn, and Saddleback Mountains. Surface water flows occur after intense thunderstorms or prolonged rains. From the mountains, the wash channels increase in size attaining maximum width at slopes of about one percent. When slopes approach .5 percent, the flows can no longer sustain heavy bedload transport and the channels fan or braid out into smaller ill-defined washes. Bedload deposits remain in the drainage pattern and result in constant shifting of channels.

The entire watershed is tributary to Centennial Wash which forms the southwestern boundary for about 17 miles. Centennial Wash is an ephemeral stream with most of its drainage area outside of the Harquahala Valley Watershed boundary. The drainage area above Harquahala Valley exceeds 700 square miles.

Tiger Wash is the main wash within the watershed boundary. The wash originates in the Harquahala and Big Horn Mountains and drains the extreme northern and western areas of the watershed. Major tributaries are Browns Canyon Wash and Pump Mine Wash. At the developed areas in Harquahala Valley, Tiger Wash has a drainage area of about 160 square miles with a length of 35 miles. In the upper reaches, Tiger Wash is well-defined. However, as the wash leaves the mountains at a narrow gap between the Harquhala and Big Horn Mountains and enters the flatter Harquahala Plains area, the wash braids out into several smaller washes; therefore, flows from Tiger Wash enter the downstream Harquahala Valley area at widely separated points in a sheet flow condition.

There are seventeen manmade stock watering tanks scattered over the watershed. This equates to one surface water impoundment for every 22 square miles of area. Eight are in the lower Harquahala Plains area and the remainder in the upper portions of the watershed. Sixteen of the tanks are solely dependent upon surface water runoff. The exception is a small tank located at the southeast corner of the watershed in section 30, T1N, R8W. This tank is maintained by irrigation tailwater and consequently has a more permanent nature than the others.

The total area of semipermanent surface water is estimated at no more than 10 acres, a very low proportion when compared to the total watershed area of 239,360 acres.

There are five natural springs in the watershed. All five are located in the Harquahala Mountains at elevations above 3,500 feet.

k. Groundwater Resources [2,4,8,9,10,11]

The Harquahala Valley watershed, for the purpose of

discussion on the occurrence of groundwater, may be divided into the mountain or bedrock part, and the plain or alluvial part. The principal aquifers occur in the alluvial deposits.

The greater part of the mountain masses is made up of igneous and metamorphic rocks. These are relatively impermeable but may carry very small quantities of water along fracture zones. The principal aquifers in the watershed are the sand and gravel lenses in the alluvium of the Harquahala Valley or Plains area. The depth of the alluvium is unknown but is probably several thousand feet. The alluvium contains discontinuous lenses of clay, silt, sand, and gravel. The best wells in the area are those which penetrate sand and gravel lenses. Because of the discontinuity of these lenses, it is difficult to forecast the productivity of potential wells. Wells not more than a mile apart may penetrate a preponderance of fine-grained sediments and produce only a few hundred gpm (gallons per minute); another may encounter coarser materials and yield as much as 3,500 gpm.

The occurrence of groundwater is similar to that in many areas in the basin and range lowlands of Arizona. In the developed southeastern part of the valley the alluvium occurs at depths of from less than 300 feet near the mountains to more than 1,200 feet in the center of the irrigated lands of the valley. One of the deepest wells in the area, 2,010 feet deep, penetrated granite at a depth of 1,995 feet. Several wells bottom in the alluvium at depths of more than 1,500 feet. In general, the groundwater occurs under free water table conditions, although artesian conditions may be present in places. It has been estimated that the saturated zone of this alluvium for the entire valley had 7.4 million acre-feet of recoverable groundwater in storage as of 1966. This includes that portion of the basin outside the Harquahala Valley Watershed. Adjusting for the withdrawals since 1966, it is estimated that the saturated zone had 6.5 million acre-feet of recoverable groundwater in storage as of the end of 1973. The amount recoverable for that portion of the valley within the project area has not been determined. An estimated 2,452,000 acre-feet of groundwater has been withdrawn from the entire aquifer through 1973.

In December 1966, the static depth to water ranged from about 40 feet below the land surface near where Centennial Wash leaves the valley (Mullen Well) to about 480 feet near the southeast end of the Eagletail Mountains. For that portion of the valley within the project area, the static levels averaged about 380 feet. In January of 1974, static level tests were made on 24 wells within the project area of Harquahala Valley. The average static depth to water at these wells was 439 feet. In August 1974, pump tests were conducted on 21 wells within the project area and the average dynamic level of these wells was

547 feet. The average discharge of the same wells was about 1,434 gpm.

Groundwater pumping depths have increased rapidly since intensive irrigation began in the early 1950's. The water level in a well in section 11, T2N, R9W, was about 230 feet below the land surface when measured in 1917. In 1966, the water level near this well had declined to more than 440 feet. However, the January 1974 measurement of a well in the same section places the depth at 458 feet, so the depth has not greatly increased in the last eight years at this particular location. It may be that 400 - 460 feet depth may be the optimum range and/or a limiting factor.

In 1954, the slope of the groundwater surface was from the northwest to the southeast in alignment with Centennial Wash and groundwater movement was southeastward at a gradient of about 2 feet per mile. As early as 1957, the withdrawal of groundwater had reversed the direction of groundwater movement, and by 1963 the groundwater gradient was relatively steep with most of the groundwater moving toward a well-defined cone of depression centered near section 30, T2N, R8W, and some of the groundwater moving toward two small cones of depression in the southwestern part of the cultivated area. Contours of the elevation of the water level in December 1966 show that the three cones of depression have expanded and coalesced, and that groundwater is moving from all directions into a cone of depression that encompasses the entire cultivated area. Although an evaluation of the January 1974 tests has not been completed preliminary indications are that the cone of depression has enlarged and the center of the depression has shifted southwestward.

The quality of the groundwater from wells in Harquahala Valley, including that portion of the valley outside the project boundaries, is generally good for irrigation. A report issued in April 1971 by the U.S. Geological Survey and Arizona State Land Department entitled "Groundwater Conditions in the Harquahala Plains, Maricopa and Yuma Counties, Arizona," by E. E. Denis and designated as Water Resources Report Number 45, lists 19 samples of water from wells within the project portion of Harquahala Valley. These samples were taken during the period 1952 to 1966.

The average of the samples shows a Total Dissolved Solid (TDS) of 590 milligrams per liter (mg/l). The lowest concentration was 432 mg/l while the highest was 1,060 mg/l. The groundwater in the northeast part of Harquahala Valley generally contains less than 500 mg/l of dissolved solids. In general this coincides with the deepest part of the cone of depression caused by pumping of groundwater and may indicate that the water at depth

is of better quality. Data is insufficient to make direct comparison of water from different depths on any specific location.

The percent sodium in the total cation concentration of the samples is high, ranging from 63% to 95%. Most of the water sampled ranges from medium to high in the sodium (alkalinity) hazard. The sodium absorption ratio (S.A.R.) ranges from a low of 3.9 to a high of 20. Much of the water sampled is classified as high in salinity hazard. No soil alkalinity or salinity problems are apparent at the present time except for about 400 acres of idle land with heavy soils that have a sodium tie-up problem.

The underground water in Harquahala Valley would qualify as very good for domestic or industrial uses were it not for the fluoride content. Recommendations of the U.S. Public Health Service set lower, optimum, and upper limits for the fluoride content in water for drinking purposes. The limits are based on the annual average of maximum daily air temperature. For Harquahala Valley, these limits are 0.6 mg/l (lower), 0.7 mg/l (optimum), and 0.8 mg/l (upper). Fluoride concentrations in the water sampled range from 1.4 mg/l to 5.2 mg/l and most of the water would not be considered acceptable for drinking purposes although underground water is the source of all domestic water in the valley. This is not unusual as high fluoride content is prevalent in many communities in southern Arizona.

The highest fluoride concentrations are found in the water from wells nearest the mountain fronts. The andesite and basalt outcrops in the mountains contribute large amounts of fluoride to the water. In the central part of the valley, it is probable that wells drilled to greater depths than the existing wells also will yield water containing large amounts of fluoride.

The concentrations of nitrate, calcium, magnesium, sulfate, chloride, and bicarbonate in the samples were with few exceptions lower than recommended minimum levels. There is no record of analyses for the trace elements manganese, chromium, nickel, copper, zinc, lead, cadmium, and cobalt.

1. Wetlands

Wetlands of the watershed are restricted to the 17 manmade stock tanks described in Section j, Surface Water Resources. These wetlands are classified as Type 1, Inland Fresh Areas, in the publication Wetlands of the United States, U.S. Fish and Wildlife Service Circular 39, 1971.

2. Present and Projected Population [32]

The watershed lies within Bureau of Census Enumeration Districts 7, 41, 52, and 53. Those portions of the watershed in districts 7, 41, and 52 are uninhabited. The 1970 Census lists 783 people for all of district 53 which extends beyond the boundaries of the watershed. Based upon extrapolation of Bureau of Census data, school records, number of telephone hookups, and interviews with persons knowledgeable about the area, the total permanent population of the watershed is estimated at 275 people. All of the residents are located in the southern part of the watershed area referred to as Harquahala Valley, where irrigated agriculture has been developed. There are no known permanent residences in the remainder of the watershed.

There is one elementary school, with grades 1 through 8, in the watershed. Fall enrollment in 1974 was 80 full-time students of which 27 percent are Spanish speaking.

Almost all employment opportunities in the watershed are in lower income farm labor positions. In the major agricultural areas of Arizona, these positions are usually filled by minorities. Based on school records and general observations, it is estimated that 50 - 60 percent of the watershed residents are from minorities - predominantly Spanish speaking.

Maricopa County Planning and Zoning Department does not project any urbanization in the watershed at least up to the year 2000. Therefore, for evaluation of the watershed structural measures, it was assumed that there would be little change from the predominant agricultural development that exists today.

The future population within the watershed is difficult to predict. Population changes will depend upon future developments in agricultural practices or urbanization. A limited amount of urbanization and/or "mini-farms" could be induced by the completion of the CAP Aqueduct, and the construction of the nuclear power electrical generating plant at nearby Wintersburg (20 miles).

3. Economic Resources [2,4]

a. Land Ownership

The watershed area contains 239,360 acres, of which 49,233 acres (20.56%) are in private ownership; 26,240 acres (10.96%) are in State lands administered by the State Land Department; and 163,887 acres (68.47%) are federal lands administered by the Bureau of Land Management. There are also minor amounts of land administered by others such as the county road right-of-way by Maricopa County and Interstate 10 right-of-way by the

Arizona Department of Transportation. (See Land Status and Resources Unit Map - Appendix B.)

b. Current Land Values

Values for developed irrigated lands are approximately $600 to $1,000 per acre. Unimproved rangeland value is estimated at $50 to $300 per acre depending upon location.

c. Watershed Economy [2,4]

The watershed economy is based primarily on agriculture. There are 20 farm establishments farming about 19,000 acres of irrigated land. Six are currently inactive. Sixteen of the farms are either incorporated or have absentee owners. Of these 16, one is entirely on State lease land. The average farm size is 968 acres.

In 1974, cotton, alfalfa, and small grains were the principal crops grown, with smaller amounts of land utilized for fruit and vegetable production. The following tabulation shows the crops under cultivation and estimated yields:

TABLE IV

Average Crop Yield Per Acre

Crop	Average Yield Per Acre
Cotton	1150 lbs.
Alfalfa	7 tons
Grain	
Wheat	2 tons
Barley	2 tons
Sorghum	2½ tons
Lettuce	600 cartons
Grapes	275 lugs
Fruit	
Apricots	NA
Plums	NA

Another segment of the agricultural economy is livestock production. Approximately 10,000 sheep are wintered on farmland in the floodplain area. About 900 cattle are pastured on portions of six ranches in the watershed four months each year when there is enough rainfall to produce forage.

The large number of acres cultivated, coupled with

the high value crops and modernized production methods, have brought industrial and commercial establishments to the watershed. These include two fertilizer companies, a service station, a laundry, a dry goods and grocery store, a cafe, bars, a trailer court, and a cotton gin, all in the floodplain area. A new elementary school is also in the floodplain.

Paved roads, including Interstate 10, provide excellent accessibility to markets. A paved road also provides access to a main east-west line of the Southern Pacific Railroad. A vegetable packing and loading facility is at the railroad to expedite transportation of perishable crops to market.

All cultivated land is presently irrigated from groundwater. The Harquahala Valley Irrigation District has submitted a request for imported water from the Central Arizona Project, however, the amount that the district will receive has not yet been determined.

The current economic and social conditions in the watershed could be considered as being below par in comparison with similar agricultural areas of Central Arizona. Contributing factors include the complete dependency upon groundwater, high pumping costs, declining water table, isolated locality, and an absence of industry or tourism to expand the almost 100 percent agricultural base.

With the exception of 3,950 acres of the watershed in Yuma County, all of the area is within the Hohokam Resource Conservation and Development Project.

4. Plant Resources [4,12-20,41]

a. General

This section is divided into two parts. The first part is a discussion of the general vegetation of the entire watershed. The southern part of the watershed lies within Major Land Resource Area (MLRA) D 30, Sonoran Basin and Range. The northern part of the watershed lies within MLRA D 40, Central Arizona Basin and Range. Individual plant species and densities in the watershed were determined by vegetative transects. Thirty-three separate sites were sampled.

The second part of this section is a description of the vegetation present at each of the proposed structural measure sites. Descriptions are presented by range sites. Individual plant species and densities were determined by on-site transects, counts by test plots, counts by wash reach length, and from aerial photographs.

b. General Vegetative Patterns within the Watershed

Hills and Mountainous Areas - Elevations range from 1,500 to 5,700 feet. Annual precipitation ranges from 7.5 to 10 inches.

The shallow, rocky soils support a sparse perennial cover of trees, shrubs and grasses. Characteristic species are creosotebush, mesquite, ironwood, bursage, catclaw, acacia, ocotillo, paloverde, saguaro cactus and numerous other cactus species. The dominant shrubs are creosotebush and white bursage. The dominant perennial grasses are bush muhly and threeawn species. Vegetation sampling transects were established at twelve locations within the hills and mountainous areas. Average ground cover (vegetation and litter) was slightly less than 6 percent. The ground cover varies from about 3 to slightly more than 10 percent. The remainder of the ground surface is bare ground on rock. The bare ground generally has a desert pavement that tends to reduce the ability of the soil to absorb water and, in turn, increase runoff from thunderstorms. The sparse vegetative cover is typical of the Sonoran desert hills and mountains. Although the lack of cover influences erosion and runoff, climatic and soil conditions preclude any significant increase in cover.

Lower Plains Areas - Elevations of the lower plains areas range from 1,000 to 1,500 feet. Annual precipitation ranges from 6.0 to 10.0 inches. Long periods of no precipitation are common. These plains are nearly level to gently sloping and the soils are deep. About 14 percent of the plains are cultivated and the rest has a cover of native desert vegetation. Creosotebush, bursage, mesquite, ironwood, paloverde, various cacti, smokethorn, bush muhly, and threeawns are characteristic species. Vegetation is mainly confined to drainageways. Desert pavement, creosotebush, and bursage are usually found between the drainageways. There are many annual forbs and grasses; however, these plants will germinate and grow only when ample winter moisture is available. The dominant shrub is creosotebush. The dominant perennial grasses are tobosa, bush muhly, and threeawns. Vegetation transects were established at 21 locations. Average ground cover (vegetation and litter) is slightly less than 6 percent. The ground cover varies from about 1 percent to about 14 percent. Litter ranges as high as about 3½ percent and is inconsistent. The remainder of the ground surface is bare ground or rock. The bare ground generally has a desert pavement.

c. Vegetation at Proposed Structure Sites

The proposed structures will be constructed in the lower plains areas. Desert shrub vegetation at these sites is characterized by xeric shrubs varying in height from 4 inches to several feet. Plant populations are generally sparse with

large areas of bare soil and desert pavement exposed. In some areas, stands may be relatively dense. Understory vegetation is generally sparse. Production of annuals varies greatly from year to year depending on the moisture supply. Following is a discussion of the vegetation at each proposed structure site.

Harquahala F.R.S. - This structure lies within the following five range sites:

basalt hills
limy upland
sandy loam upland
sand bottom
deep sand

This discussion of the vegetation will begin at Burnt Mountain (basalt hills) and proceed westward along the proposed centerline. (See Figures P5, P6, and P7.)

In the vicinity of Burnt Mountain, the limy upland range site is encountered except for the sandy washes which are in the sand bottom range site. Vegetation along the washes consists of paloverde, ironwood, and acacia trees. Abundant amounts of saguaro cactus, cholla cactus, barrel cactus and ocotillo are between the washes.

From the south section line of section 32, T3N, R8W, northeastward to the east section line of section 24, T3N, R9W, a distance of approximately 2¼ miles, the land surface consists of very coarse desert pavement (limy upland). Vegetation is dominated by abundant amounts of saguaro, barrel, and cholla cactus, and ocotillo. In an area approximately one mile in length by 600 feet in width, 200 saguaro cactus, 32 barrel cactus, and 20 ocotillo were counted. Paloverde and ironwood trees line the washes (sand bottom). Along one typical wash, 14 paloverde and 12 ironwood trees were counted in a 500 foot section.

From the east section line of section 25, T3N, R9W, westward to the west section line of section 22, T3N, R9W, a distance of approximately 3¼ miles, the vegetation consists of paloverde and ironwood trees, creosotebush, saguaro, barrel, and cholla cactus, and ocotillo (sandy loam upland). Increasing amounts of creosotebush are encountered from east to west as the range site changes from a sandy loam upland to a deep sand. For the entire reach, creosotebush and saguaro cactus are dominant. In the eastern 2½ mile length of the reach, 135 saguaro, 56 barrel and approximately 20 ocotillo were counted in a strip width of 600 feet. Several species of cholla cactus are also present but not in numerous quantities. The entire reach is typified by large areas of desert pavement cut by numerous deep washes. Along a 500 foot length section of one typical wash, 8 paloverde and 13 ironwood trees were counted.

From the west section line of section 22, T3N, R9W, to the west end of the dam at the Buckeye-Salome Road (sandy loam upland), the vegetation consists mainly of creosotebush and scattered cholla, barrel, and prickly pear cactus. There are scattered groups of ocotillo. (Over 24 plants were observed at one location in the middle of section 21, T3N, R9W.) Paloverde and ironwood trees line the washes in the area. Along one typical wash, 8 ironwood trees were counted in a 500 foot length section. A total of 46 ironwood trees were counted in a one-half mile section of another wash. Along the western reaches of the dam, there are spotty areas of dead vegetation such as dead mesquite and large creosotebush which have only a few live center branches. Live mesquite trees are found around the manmade New Tank, located in section 30, T3N, R9W, approximately one-half mile downstream of the dam. Mesquite trees also line the larger braided washes.

Saddleback F.R.S. - This discussion of vegetation will begin at Courthouse Road and proceed northward to the north end of the dam. The dam lies within the limy upland, loamy upland and sand bottom range sites. (See Figures P1, P2, and P3.)

In section 34, T2N, R8W, the dominant vegetation is creosotebush. A series of small washes in the area are lined with large creosotebush, crucifixion thorn, and mesquite. In the south one-half of section 34, approximately 75 creosotebush 3 to 4 feet high were counted in a 100 feet square inventory area. Many of the creosotebush are dead or have only a few live center branches. No cactus species were observed. There are scattered patches of bursage in the area. In the north one-half of the section (sand bottom) an inventory was taken in another 100 feet square area. Mesquite trees were dominant. Approximately 40 mesquite ranging in size from 3 to 10 feet were counted. Remaining vegetation consists of about 10 creosotebush 6 feet to 10 feet high, thick clumps of bursage and a few smokethorn trees. There is a thick stand of mesquite and large creosotebush present in the northwest one-quarter of section 34 downstream of the dam.

The alignment of the dam through section 27, T2N, R8W, is through an open cleared field (limy upland). Vegetation consists of widely scattered creosotebush up to about 3 feet in height.

The alignment through section 28, T2N, R8W, (loamy upland), passes just north of a large andesite knoll. The vegetation in this area consists of scattered creosotebush and grasses. There are large areas of desert pavement. Sixty-five small creosotebush were counted in a 100 feet square inventory area located approximately 1,000 feet northwest of the andesite knoll. One barrel cactus was found.

The vegetation through section 21, T2N, R8W, (limy upland), is dominated by creosotebush ranging from 2 feet to 5 feet high. Scattered mesquite and paloverde line some of the washes. Sixteen mesquite trees were counted in a 500 foot reach length of one wash located in the southeast one-quarter of the section. There are large areas of desert pavement with scattered cholla cactus up to 2 feet high and some barrel cactus.

Much of the creosotebush in the area appears to be greatly stressed with only center branches showing life. An old road running diagonally from southeast to northwest across the section which acts as a water collector has induced heavy growth of creosotebush in the bottom of the old road. Some bushes are up to 10 feet in height. There are a few scattered paloverde trees lining a wash where the alignment crosses the Buckeye-Salome Road.

The alignment through the south one-half section 17, T2N, R8W, (loamy upland), is over an abandoned fallow field where thick patches of white bursage are dominant. Creosotebush dominates the north one-half of the section except where the alignment crosses a large wash which extends to Interstate 10. A mesquite thicket is located along the wash (sand bottom), both upstream and downstream of the dam. One thicket is located in the south one-half section 8, T2N, R8W, immediately south of Interstate 10 and within the flood pool area of the dam. This thicket contains over 200 mesquite trees although many are dead. Thick clumps of big galleta occur throughout the thicket. Creosotebush in the area are large and numerous. Other vegetation consists of smoketree, greythorn, bitter condalia, crucifixion thorn, and whitethorn.

Saddleback Diversion - The vegetation in this area falls into the sandy loam upland and sand bottom range sites. The vegetation survey began at the northern end of the diversion at Courthouse Road. The first one-half mile of the Saddleback Diversion will be constructed through an open area of desert pavement and scattered creosotebush. The diversion then will encroach upon the southern half of an unimproved subdivision in section 4. Almost all vegetation in this area has been removed except some scattered creosotebush and cholla cactus. (See Figure P11.)

The diversion will cross through the east portion of section 8, T1N, R8W, in a southwesterly direction. Fifteen mesquite trees were counted along a 300 foot section of a typical wash (sand bottom) in the southeast one-quarter of section 8. Other vegetation consisted of scattered creosotebush, cholla cactus and a few paloverde trees. The land surface consists of medium to coarse desert pavement.

Along the diversion alignment in section 17, T1N, R8W, vegetation along two typical washes were counted. Five paloverde trees, 4 ironwood trees and 2 smokethorn trees were counted in a 300 foot section of the first wash. Vegetation along washes in the northern part of section 17 was very sparse and scattered. Along a 0.2 mile section of the second wash in the southern part of section 17, 25 paloverde trees and 12 ironwood trees were counted. Desert pavement covered the land surface throughout section 17 with scattered creosotebush and some cholla cactus occurring.

The diversion ends near a small andesite hill in the southern part of section 20, T1N, R8W. The land surface throughout the section is covered by very coarse desert pavement. Along one of the typical washes, 47 paloverde and 6 ironwood trees were counted in a 500 foot section. Other vegetation consists of moderately thick areas of creosotebush and various other shrubs.

Harquahala Floodway (See Figures P7, P9, and P10.) North of Interstate 10 the floodway consists of an existing natural wash (sand bottom range site). Paloverde trees are dominant. In a distance of one-half mile along the wash, 30 paloverde trees, ironwood, and 8 smokethorn trees were counted. Other vegetation in this reach consists of jumping cholla, white bursage, ocotillo, saguaro, barrel cactus, and whitethorn acacia (sandy loam upland range site).

Vegetation along the floodway south of Interstate 10 is very sparse. There are a few barrel cactus scattered throughout the area.

As described previously in the Planned Project Section, the existing wash is to be diverted immediately downstream from the Interstate 10 crossing. There are heavy stands of ironwood lining this wash. A count of vegetation along the wash shows 36 ironwood trees in a one-half mile reach with a few paloverde trees also present.

Centennial Levee - Reach 1 will cross an area that is in the sandy loam upland range site. (See Figure P12.) Vegetation along the first mile of the construction area is scattered and very stressed. Vegetation consists of creosotebush and other shrubs. A row of mesquite trees and large creosotebush were observed in the area where the levee will cross the section line between sections 5 and 8, T2N, R9W. This row of trees and bushes is the only significant woody vegetation in these two sections. Section 8 is mostly devoid of vegetation and it appears that this area may have been cleared at one time. Section 7, T2N, R9W, is very similar to section 8 with large areas devoid of vegetation.

Vegetation that does exist consists of scattered creosotebush and various other shrubs. In the southwest corner of section 7, a mesquite thicket surrounding a small stock tank represents the only major area of vegetation until the levee nears Allison Tank.

Near Centennial Wash, the levee will pass through an area of dense stands of creosotebush. Other vegetation in the area consists of scattered ocotillo, crucifixion thorn, mesquite, and smokethorn.

Vegetation along Reach 2 is also in the sandy loam upland range site.

The area immediately north of Allison Tank is covered by dense stands of creosotebush with scattered mesquite trees and ocotillo. Heavy stands of mesquite trees are all around Allison Tank. The vegetation south and east of the tank appears to be dead or greatly stressed in an area that extends about two or three hundred yards from the tank. (See Figure P28.)

Between Allison Tank and Courthouse Road, the vegetation is dominated by creosotebush with scattered mesquite trees occurring throughout the area. Other species of shrubs were also observed but not in significant quantities. This vegetation continues to the point where the levee will cross Courthouse Road. South of the road, dense stands of creosotebush extend to near Van Buren Street. Scattered shrubs such as small creosotebush are found in areas that have been cleared.

d. Rare and Endangered Plants [20,21,43]

There are two lists available pertaining to plant species in danger of being destroyed through the activities of man and animal. One is the unofficial publication, "Rare and Endangered Plants of Arizona" 1973 Edition. This was the only list available at the time that detailed investigations for the draft environmental statement were conducted. Consequently, the investigators concentrated on the plants on the State list. The draft environmental statement was submitted to the Council on Environmental Quality for interagency review on April 9, 1976, with a due date of June 8, 1976, for comments. On June 16,1976, the U.S. Fish and Wildlife Service published a tentative federal listing of Endangered and Threatened Plants. Additional studies were conducted after the federal listing was received, even though the listing was published after the due date for the interagency review on the draft statement.

The State publication lists five plants that definitely will or may be affected by the construction of the

structural measures: (1) Saguaro Cactus (Cereus giganteus) - this plant is definitely within the proposed construction area and flood pool area of Harquahala F.R.S. (2) Desert Night-blooming Cereus (Cereus greggii) - this plant is commonly referred to as Arizona queen of the night or sweet potato cactus. It is an inconspicuous plant that usually grows 1 or 2 feet high, with slender stems arising from a turnip-shaped root. The spines are abundant but short. Flowering occurs primarily on one or two nights late in May or in June. The plant exhibits beautiful white flowers. It almost always grows through another protecting plant such as a mesquite or paloverde. One plant was discovered along the alignment of Harquahala F.R.S. underneath a large creosotebush. (3) Desert holly, Goosefoot family (Atriplex hymenelytra) - this shrub is probably not within the area of the structural measures or in the watershed. The plant has been located in western Maricopa County but at elevations lower than 1,000 feet. The lowest point in the watershed is about 1,050 feet on Centennial Wash at the extreme southeast corner of the watershed. The lower point where construction disburbance will occur is about 1,140 feet at the outlet of Saddleback Diversion. (4) Bristlegrass (Setaria villosissima) - this is a tall perennial grass with flat villous leaf blades. The presence of this plant within the watershed is unknown. (5) Barrel cactus (Echinocactus species) - there are 14 species of barrel cactus that are considered rare and endangered. Two species, the blue and woollyheaded, may be present within the watershed although none were located at the structure sites. The primary distribution of the woollyheaded is in the Mohave Desert west of the watershed. The blue is a foothill type cactus usually found at about 3,000 to 3,500 feet elevation. None of the structure sites are above elevation 1,420 feet.

There are four plant species on the federal list that may be in the project area but not in substantial quantities. The plants are:

Status	Scientific Name	Common Name
Endangered	Astragalus lentiginosus var. maricopae	loco weed
Endangered	Echeveria collomae	echeveria
Endangered	Echeveria rushyi	echeveria
Endangered	Opuntia basilaris var. treleasa	beavertail cactus

e. Arizona Protected Plants [23,24]

The authority for protection of Arizona native plants is vested with the Arizona Commission of Agriculture and Horticulture under the requirements of the Arizona Native Plant Law, Arizona Revised Statutes, Chapter 7.

TABLE V

PARTIAL LISTING OF ARIZONA PROTECTED PLANTS AT PROPOSED STRUCTURE SITES

P = Primary Occurrence s = Minor Occurrence

S = Secondary Occurrence blank = Few or none present

Protected Species	Structure Site				
	Saddleback F.R.S.	Harquahala F.R.S.	Saddleback Diversion	Harquahala Floodway	Centennial Levee
Barrel Cactus (Ferocactus)					
Compass	S	P	s	s	
Fishhook	S	P	P	P	
Covillei	s	S	P	S	
Cholla Cactus					
Teddy Bear		S		P	
Staghorn				S	
Desert Christmas					S
Diamond		P			S
Cane	S	S	P		
Buckhorn		S		S	s
Crucifixion Thorn (Holocantha)	S				P
Fishhook Pincushion	s	s			
Hedgehog		S		S	
Ocotillo		P			S
Prickly Pear		s			
Saguaro		P	S	S	
Smokethorn Tree	s	s	s		

There are several kinds of protected plants present throughout the watershed. A partial listing of prominent protected plant species that are present at the sites of the proposed structure is presented in Table V. The salvage, removal, and preservation of protected plants affected by construction activities will be conducted in accordance with Arizona State Law.

5. Animal Resources

a. Fish and Wildlife [25,26]

Permanent surface water in the Harquahala Valley watershed is restricted to stock tanks and ponds. No fish species have been recorded in these reservoirs, however, it is not uncommon for mosquito fish to be stocked to reduce insect vector problems.

Good desert wildlife habitat conditions require diversity of vegetation. This diversity is provided by the natural interspersion of desert wash woody vegetation at regular intervals, breaking up the otherwise relatively uniform desert shrub condition. Generally, at least in the lower two-thirds of the watershed, the woody vegetation ranges from 3 to 8.5 percent canopy cover possibly averaging slightly over 4 percent. The 3 to 5 percent range appears to be somewhat less than the potential for the area and indicates that the habitat condition and wildlife carrying capacity is a below average condition.

Approximately 326 species and subspecies of terrestrial vertebrate wildlife either inhabit or use the watershed, many of which are in transit. The distribution consists of 220 species of birds, 56 species of mammals and 49 species of reptiles and amphibians. A list of these terrestrial vertebrates is included as Appendix F of this report.

Twenty-two species of birds in the watershed are considered as game birds. Waterfowl make up 19 of these game species, seasonally using stock tanks, irrigation tailwater areas, and flood irrigated fields for resting and feeding during periods of migration.

The remaining three game birds are mourning dove, white-winged dove, and Gambel's quail. These species concentrate their activity around areas of woody vegetation, the doves nesting, roosting, and resting; the quail feeding on mesquite seeds. All of these birds will be found in open areas feeding on seed bearing grasses, feeding in small grain fields, and concentrating around open water.

A great variety of birdlife is represented in the 196 species of nongame birds of the watershed. Included in this group are the birds of prey, and song and insectivorous birds.

Mammals of the watershed include three species of big game, one of small game, 11 classed as fur animals and predators, and 42 are nongame.

Big game species include bighorn sheep, mule deer, and mountain lion. Bighorn sheep inhabit the rough rocky terrain of the higher mountain areas where sufficient water and forage occurs and where human intrusion is minimal. Sheep may also be seen moving across desert valleys between mountain ranges. They are found principally in the Big Horn and Harquahala Mountains. Mountain lions may not inhabit the watershed on a permanent basis as these animals have a large home range. They will however pass through periodically in search of food. They more normally travel the mountain country, but may be found anywhere in the watershed.

Mule deer are also found in the watershed. They occur in greater numbers in the foothill areas and in the Harquahala Mountains, where food, water, and cover are more available. They also travel the more vegetated washes and feed on agricultural crops such as alfalfa.

The cottontail rabbit, the only small game mammal inhabiting the watershed,are found in small numbers throughout the area. They tend to occur in greater numbers around available waters, however, they appear to be able to survive on succulent vegetation in the absence of water.

The group of animals taken for sport or fur include those normally considered as fur animals and small predators. These eleven species include the foxes, skunks, furbearing rodents, coyote, bobcat, badger and raccoon. Species such as the foxes, skunks, coyote, and bobcat range throughout the watershed while furbearing rodents and the raccoon are found more around stock tanks and other available water.

Nongame mammals inhabiting the watershed include 42 species including shrew, bats, ground squirrels, pocket gopher, and mice and rats including kangaroo rats and woodrats. As with nongame birds, there is a nongame rodent to occupy nearly every habitat niche occurring in the watershed.

Forty-nine species of reptiles and amphibians inhabit the watershed. These include 4 species of toads; 2 frogs; 1 tortoise - the desert tortoise; 1 softshell turtle; 1 gecko; 13 iguanid lizards; 1 whiptail lizard; 1 venomous lezard - the Gila monster; and 25 species of snakes. Seven of the snake species are venomous including one species of coral snake and 6 species of vipers or rattlesnakes.

Harquahala watershed includes portions of three hunt units, as designated by the Arizona Game and Fish Department. These are units 41, 42, and 44. Detailed hunter

information concerning these areas is available in the Arizona Game and Fish Department's game investigation publications.

Big game hunting in the watershed is restricted to mule deer hunting on a permit basis. Deer hunting is relatively popular in the watershed although hunter success is somewhat lower than the better deer producing areas in the State. Hunter success ranges from about 7 to 14 percent.

The most popular small game hunting in the watershed is for mourning dover, followed closely by whitewing dove and Gambel's quail with some hunting for cottontail rabbit. Comparison of 1971 and 1965 reports (statewide) indicates that hunter success averages about 6 birds per day for mourning dove, 4 birds per day for whitewing dove and 4 birds per day for Gambel's quail.

Trapping for fur is insignificant, although hunting for fur and/or sport is relatively common. No estimates have been made of use rates in this activity.

Animal and bird watching and photography is becoming more popular in Arizona due to the diversity of wildlife species seasonally associated with the watershed, no attempt has been made to estimate the rate of use of the resource.

b. Endangered and Threatened Fish and Wildlife [25,26]

The Federal Register for September 26, 1975, (40 Federal Register, 44412-29) contains the United States List of Endangered or Threatened Species as compiled by the U.S. Fish and Wildlife Service. Two bird species on the Federal list may be found in the watershed. These are the endangered Bald Eagle and the endangered Peregrine Falcon. These birds probably do not nest or otherwise congregate here, however, an occasional observation might be made.

The Arizona Game and Fish Department has compiled an unofficial list of threatened wildlife of Arizona. There are 3 reptiles, 7 birds, and 2 mammals on this list that may be in the watershed. These species are:

Group II. Species or subspecies in danger of being eliminated from Arizona.

*Southern Bald Eagle (Haliaeetus leucocephalus leucocephalus)
*Peregrine Falcon (Falco peregrinus anatum)
Yuma Mountain Lion (Felis concolor browni)

Group III. Species or subspecies whose status in Arizona may be in jeopardy in the foreseeable future.

* On Federal Endangered List

Snow Egret (Egretta thula brewsteri)
Black-crowned Night Heron (Nycticorax nycticorax hoactli)
Black Hawk (Buteogallus anthracinus anthracinus)
Osprey (Pandion haliaetus carolinensis)
Desert Sheep (Ovis canadensis mexicana)
Gila Monster (Heloderma suspectum)

Group IV. Species or subspecies sufficiently limited in distribution in Arizona that major ecological disturbances could jeopardize their existence in the State.

Tropical Kingbird (Tyrannus melancholicus occidentalis)
Desert Boa (Lichanura trivirgata gracia and L. t. trivirgata)

6. Recreational Resources [3,38]

Based upon data compiled by the Arizona Outdoor Recreation Coordinating Commission, the most popular outdoor recreation activities in Arizona are swimming, outdoor games, fishing, camping, picnicking, horseback riding, golfing, bicycling, gardening, hiking, and snow skiing. All activities except fishing, golfing, swimming, and snow skiing are available in the watershed. In addition, the area receives minor use for small and big game hunting, mountain climbing, and amateur prospecting.

The Maricopa County Planning Department indicates in their future land use plan that the watershed area will be primarily utilized for irrigated agricultural and grazing purposes. At this time, there are no public recreational developments within the watershed. The National Park Service has suggested a plan for an aquatic recreational site at the Salome interchange on Interstate 10, which is about 16 miles west of the western boundary of the watershed. The site would obtain water from the Granite Reef Aqueduct. The U.S. Bureau of Land Management has site plans for the development of Saddleback Mountain as a General Outdoor Recreation Area. The Maricopa County Parks and Recreation Department is currently conducting studies for a future county regional park in the Big Horn Mountain Range.

No conflicts are evident between these proposed recreational developments and the project.

7. Archaeological, Historical, and Unique Scenic Resources [7,29,30,39,42,45]

a. Archaeological and Historical

Archaeological and historical resources in the

project area are described in detail in the two reports completed by Arizona State University. See references Nos. 30 and 45. The data presented in these reports has not been reproduced and included in this statement because of the volume of material involved. The reports are available for inspection at the University, at the office of the State Historical Preservation Officer, and from the Soil Conservation Service. Copies have been sent to the Arizona State Museum, National Park Service and U.S. Bureau of Land Management.

One historic site recorded by Arizona State University has been destroyed by vandals after the report was completed. This is site ASU S:8:1. See Figures P13 and P14.

Additional archaeological studies may be conducted prior to construction. All concerned agencies will be fully consulted with and informed of any cultural resources that may be affected by the project.

In addition to the field work conducted by the University at the proposed structure sites, available records were studied to determine the existence of archaeological and historical resources within the total watershed area. The National Register of Historic Places lists Harquahala Peak Observatory.

b. Scenic

There are features of natural scenic value throughout the entire watershed area. Saddleback Mountain is undoubtedly the most prominent. This steep rugged mountain rising about 1,800 feet above the surrounding valley floor resembles a saddle when viewed from the east or west.

8. Soil, Water, and Plant Management Status [2,4]

Land use has remained essentially agricultural since development. The types of crops grown and total acreage under cultivation may change annually with demand and price fluctuations.

Urbanization has been limited to building a few homes and moving in mobile homes. Maricopa County Planning and Zoning Department records show subdivision plats registered on 1,920 acres, or 0.8 percent of the total watershed area. The 320 acre subdivision in the north one-half of section 22, T2N, R8W, has no homes or roads. The 320 acre subdivision in the west one-half of section 4, T1N, R8W, was developed in 1968 and now has four homes. A 640 acre subdivision in section 20, T2N, R8W, is a "mini-farm" type development limited to a few houses or mobile homes. Completion of Interstate 10 and the Granite Reef Aqueduct may generate some change in land use,

Figure P13. Stone house homestead located in Section 8,T2N,R8W, before being vandalized. Photograph taken in November, 1974

Figure P14. Stone house after being vandalized. Photograph taken in January, 1975.

however, the Maricopa County Planning and Zoning Department projects the watershed to remain largely in its existing state as uninhabited rangeland and irrigated agriculture.

The twenty farm operations on 19,000 acres of cropland within the watershed are cooperators with the Buckeye-Roosevelt Natural Resource Conservation District. Ten of the cooperators have developed conservation plans on more than 11,000 acres. One of the above ten cooperators has entered into a long-term agreement with the Agricultural Stabilization and Conservation Service, in which he is obligated to accomplish the planned land treatment. An additional five active cooperators are now developing conservation plans. Nearly 9,000 acres are considered to be adequately treated at the present time.

There are six ranching operations utilizing the noncropland within the watershed. Investments made to date by these operators have been primarily limited to development of livestock water, fencing, and application of proper grazing use.

9. Projects of Other Agencies [2,3,31]

No projects have been completed by other agencies in the watershed. The Granite Reef Aqueduct of the authorized Central Arizona Project will traverse the watershed from west to east. The aqueduct will be a concrete lined canal, 24 feet bottom width and 16.43 feet deep. Design capacity is 3,000 cubic feet per second. A 20 foot diameter tunnel is proposed through Burnt Mountain. The aqueduct will be located immediately downstream from Harquahala F.R.S. for approximately a 10½ mile reach length from Buckeye-Salome Road eastward to Burnt Mountain. The emergency spillway for Harquahala F.R.S. will discharge into the aqueduct.

The U.S. Bureau of Reclamation is constructing a floodwater retarding dike (Tiger Wash Detention Basin) upstream of the aqueduct and extending from Buckeye-Salome Road westward to Centennial Wash. Total drainage area above the dike is 166 square miles, of which 140 square miles are within the boundaries of the Harquahala Valley Watershed. The dike will control the Tiger Wash drainage area. Floodwater releases and the emergency spillway will outlet into Centennial Wash upstream from where Interstate 10 crosses the wash. The dike will be located approximately 6 miles upstream from Centennial Levee. This structure will reduce the drainage area and therefore the installation cost of Centennial Levee. Construction began in August 1976. (See Project Map.)

The Harquahala Valley Irrigation District has prepared a preliminary irrigation water distribution plan for the

distribution of water from the Granite Reef Aqueduct. In general, the plan is designed to take advantage of the flood control structures currently proposed. Detailed designs will be prepared when a firm allocation of Central Arizona Project water is made to the District. Centennial Levee has been located immediately upstream from the proposed canal on the west side of the valley. The levee will provide flood protection for about a 3.7 mile length of the canal. On the east side, Saddleback F.R.S. and Saddleback Diversion would protect about a 10.8 mile reach if a canal is to be located below these structures. Protection to the proposed irrigation laterals and associated facilities would be provided by all of the project structural measures.

Two large floodwater retarding reservoirs and three water spreading systems, constructed by the Bureau of Land Management, are located on Centennial Wash. One structure* is located 11 miles northeast of the town of Wenden. The other is 7 miles southeast of the town of Salome (Narrows Dam). Although the dams are not located in the watershed, their detention capacity does provide the lower agricultural area of the watershed some protection from Centennial Wash flooding.

F. Water and Related Land Resource Problems

1. Land and Water Management 2,4

A major portion of the watershed is rangeland. Because of climatic conditions the area supports few perennial grasses and forbs. Principal plants are chiefly desert shrubs and trees. Heavy use of the range by livestock has further reduced the amount of palatable vegetation. All of the range sites in the proposed structure area are presently in poor or fair condition. Most of the grazing is during the spring when the grasses are most abundant.

Changes in vegetation types and amounts have been characterized by a reduction of perennial grasses and desirable shrubs and an increase in annual grasses and unpalatable shrubs, such as creosotebush. These vegetative changes have increased the already large amount of bare soil subject to erosion.

Improved management of the land and the establishment of vegetation is necessary in many areas to improve cover conditions. Economic return per acre on these desert lands is low. (Most grazing is done on an open range basis.) Ranchers cannot afford to spend large sums of money to treat the land.

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*NOTE: This structure failed in July 1975. To date it has not been repaired.

In the irrigated areas, the lack of a dependable water supply and reoccurring floodwater damages limit the ability of landowners and operators to obtain maximum economic return from the land. Although the land is highly productive, irrigated farming in the desert requires considerable expenditures. Pumping costs are high. Well establishment and the deepening of existing wells is expensive. Mechanized farming requires large investments in machinery and related operation and maintenance costs. All of these necessary expenses detract from the installation of land treatment measures and other farm improvements.

2. Floodwater Damage 2,4.27,28

Floodwater damage in the watershed is concentrated in the Harquahala Valley since this area is the only part of the watershed where development has occurred.

The majority of the land in the valley is considered as floodplain land. Grades are so flat that almost all of the farmland is inundated by the larger storms. Natural well-defined flood channels are almost nonexistent.

On the east side and south of Courthouse Road, floodwaters from the west slopes of Saddleback Mountain enter the valley via numerous small washes on approximately a 5 mile front. Total drainage area above the perimeter of the valley is about 11.0 square miles. Floodwater damage occurs to irrigated farmland and a partially developed subdivision located in section 8, T1N, R8W.

On the east side and north of Courthouse Road, floodwaters are generated from the north slopes of Saddleback Mountain, the south and east slopes of Burnt Mountain, the alluvial fan between the mountains, and an alluvial fan area on the east side of the Big Horn Mountains. Total drainage area above the perimeter of the valley is about 30.3 square miles. Concentration of flood flows occur at three major locations. A small diversion along the west section line of section 34, T2N, R8W, directs runoff northward into a channel running west along the north section lines of sections 32 and 33, T2N, R8W. The channel decreases in size and capacity as it enters the irrigated areas and eventually becomes nonexistent. There is also a small diversion running north to south along the east section line of section 20, T2N, R8W, that funnels floodwater down into the irrigation areas. The third point of concentration occurs around the northeast quarter of section 19, T2N, R8W, resulting from a diversion constructed around the southwest quarter of section 17, T2N, R8W.

Floodwaters occurring in the north part of the valley originate in the Big Horn Mountains and a large alluvial area

between the mountains and Interstate 10. Floodwater must pass through about a 5 mile reach of Interstate 10 before entering the valley. In this reach, there are concrete box culverts at 12 major wash crossings. Pipe culverts are located at numerous smaller reach crossings. The drainage area above this reach is about 48.5 square miles.

A major concentration of flow occurs just west of the Buckeye-Salome Road overpass. Ten 10 feet by 5 feet concrete box culverts under Interstate 10 funnel floodwater southward in a channel adjacent to Gin Road.

Floodwater enters the northwestern part of the valley primarily as sheet flow on about a 3 mile front. Total drainage area affecting the northwest side is about 92 square miles measuring from the northwest edge of the irrigated lands. Contributing drainage area includes the Big Horn Mountains and a large alluvial fan area between the mountains and the valley. Drainageways are intersected by about 4 miles of Interstate 10 between the Gin Road box culverts and the middle of section 35, T3N, R10W. Pipe culverts are located at many small wash crossings, however, the only major drain is through fifteen 10 feet by 5 feet concrete box culverts located approximately where Interstate 10 crosses the north section line of section 1, T2N, R10W.

The valley is particularly vulnerable to damage from the west where two large drainage areas, Tiger Wash and Centennial Wash, enter.

Tiger Wash drains the northern and western parts of the watershed. The wash is well-defined until it leaves the mountains and enters the flatter Harquahala Plains where braiding of flow occurs in section 4, T4N, R10W, and the wash splits into two separate forks. The east fork continues across the Harquahala Plains and enters Harquahala Valley as primarily sheet flow through section 19, T2N, R9W, and section 24, T2N, R10W. The wash crosses Interstate 10 through twelve 10 feet by 5 feet concrete box culverts located in section 34, T3N, R10W. The west fork enters Centennial Wash on a broad front several miles northwest of the irrigated lands in the valley. The total drainage area of Tiger Wash above the west side of the irrigated lands is about 160 square miles. Floodwater from this drainage area enters the valley either as direct sheet flow or comingled with flow from Centennial Wash.

Centennial Wash enters the valley from the west and serves as a drain for the entire watershed. The total drainage area of Centennial Wash at Gin Road, including Tiger Wash, is about 835 square miles.* A major division of flow occurs in

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*NOTE: Drainage area as shown for Centennial Wash is that downstream from the U.S. Bureau of Land Management dam near Wendon.

Centennial Wash at Allison Tank where floodwater goes north and south around the tank. The north division continues due east for several miles and swings southward through the heart of the irrigated lands in Harquahala Valley. All along this eastern path, the flood flows continuously spread over the valley. Under high stage, floodwater advances on a broad front of approximately 3½ miles in width across the valley. The 100-year frequency flood on Centennial Wash would inundate an estimated 8,000 acres of irrigated land in Harquahala Valley. (See Figure 2.) The extreme vulnerability of the valley to flood flows from the Centennial Wash and Tiger Wash drainage area is illustrated on Figure 1, which depicts the actual path of the 1960 flood. The frequency of this flood was not determined, however, it was not a rare occurrence.

The total drainage area affecting Harquahala Valley is summarized below:

Area	Drainage Area
East Side	
South of Courthouse Road	11.0 square miles
North of Courthouse Road	30.3 " "
North Side	48.5 " "
Northwest Side	92.0 " "
West Side	
Tiger Wash	160.0 " "
Centennial Wash	675.0* " "
Total	1,016.8 square miles

*NOTE: Drainage area as shown for Centennial Wash is that downstream from the U.S. Bureau of Land Management dam near Wendon.

The farmland is highly productive and is being intensively farmed. Most of the irrigation ditches are concrete lined. Farm roads are well maintained. Expensive homes have been built on many of the farms. Each farm has a large inventory of expensive equipment that is vulnerable to flooding. Regardless of where a storm may center, sediment laden floodwater flows across the floodplain. Crops are either damaged or destroyed. Concrete lined irrigation ditches are broken and field ditches and furrows are eroded. Floodwater either scours or deposits sediment on county and farm roads. Floodwater flows through homes damaging structures, contents, and yards. Mechanical parts and interiors of vehicles are damaged. Sheep and other livestock drown. Fences and farm structures are damaged.

A storm expected to occur once every 100 years, on the average, will inundate 16,000 cultivated acres and cause damages estimated at $2,638,000. This would seriously affect the economy of this watershed for several years.

A storm expected to occur once every other year will inundate 3,050 cultivated acres. Damages estimated at $503,000 would result from a storm of this size.

The principal floodwater damage results from overland flow during high intensity summer storms. An estimated 48 percent of all floods are expected to occur during the months of July, August, and September.

The history of flooding in the valley coincides with the history of development. The accounts of a resident of the area during the homesteading period describe the washing away of a farmhome during a flood on Centennial Wash in the 1930's.

In 1951 heavy rains fell in the mountains to the north and east of Harquahala Valley and caused a flood in Centennial Wash. The floodwaters floated out one mile of 26-inch and 30-inch diameter pipe of the El Paso Natural Gas Company. Cost of repairs totalled approximately $200,000.

In 1960 a storm washed out 8 miles of Gin Road from Salome Road to Centennial Wash. The storm also washed out about 4 miles of Courthouse Road and uncovered Arizona Public Service gas lines which had to be repositioned and recovered. The actual area inundated from flows that occurred on Centennial and Tiger Washes is shown on Figure 1.

The storm of September 9 and 10, 1963, caused extensive damage. Electrical power to the valley was lost for 32 hours due to downed lines. Five miles of concrete irrigation ditch was washed out or damaged. Floodwaters inundated 5,753 irrigated acres and caused an estimated $442,600 in damages.

An August 26, 1964, storm which inundated 8,400 cultivated acres was the principal storm evaluated. (See Figure 3.) During this storm 2.5 inches of rain fell on the south slopes of Burnt Mountain and produced a peak discharge of about 7,000 cfs. Floodwater, sediment, erosion, and indirect damages amounted to approximately $883,500. More than forty miles of farm roads were damaged. About 10 miles of concrete lined ditch and 70 miles of earth ditch were either destroyed or filled with sediment. Twenty-nine homes and apartments were flooded to interior depths of from 2 to 8 inches. Values of these homes range from $2,000 to $20,000. Furniture was damaged as were carpets, electrical appliances, and improvements. Several miles of dike were overtopped and broken by this flood. The manmade channels were filled beyond capacity and had to be reworked following the flood only to be damaged again the following September and again in February. Agricultural damages due to floodwater from the August 1964 storm are estimated at $489,200. Damages, other than agricultural, are estimated at $35,500. This storm killed 204 head of sheep and 65 head of cattle were either killed or unaccounted for. (See Figures P15, P16, and P17.)

The September 13, 1964, flood inundated 5,000 acres of irrigated cropland and washed out ditches and roads. Damage amounted to $400,000. Frequency of occurrence of this storm is estimated to be 44 percent.

The February 6 and 7, 1965, flood with an estimated frequency of occurrence of 50 percent, inundated 3,000 acres of irrigated cropland. Damages were approximately $387,410.

The August 16, 1965, flood caused damages on both the east and west sides of the valley. Storms were centered on the east side of the valley and over the mountains in the Tiger Wash drainage area. Total damages were not evaluated. One residential home had 18 inches of water around it and floated off the foundation. There was extensive damage to roads. An estimated 360 acres of cropland required releveling.

A major storm occurred during August 1971, causing considerable damage in the valley. Floodwaters entered the valley from the north off Burnt Mountain and the Big Horn Mountains, and from the northwest and west in Tiger Wash and Centennial Wash. The actual extent of flood damages was not documented, however, many photographs were taken both from the ground and from the air during and following the flood. These photographs show extensive flooding and damage. (See Figure P19.)

At the time of the flood, Interstate 10 was not open for traffic, but construction of the highway was essentially completed. Roadbeds were up to rough grade but not paved. Cross drainage concrete box culverts and pipes were in place. The flood damaged an estimated 8 to 10 mile reach of the highway. Roadbeds were overtopped at many locations with considerable erosion. Drainage culverts were undercut primarily at the outlets and left hanging in the air supported only in cantilever. (See Figure P18.)

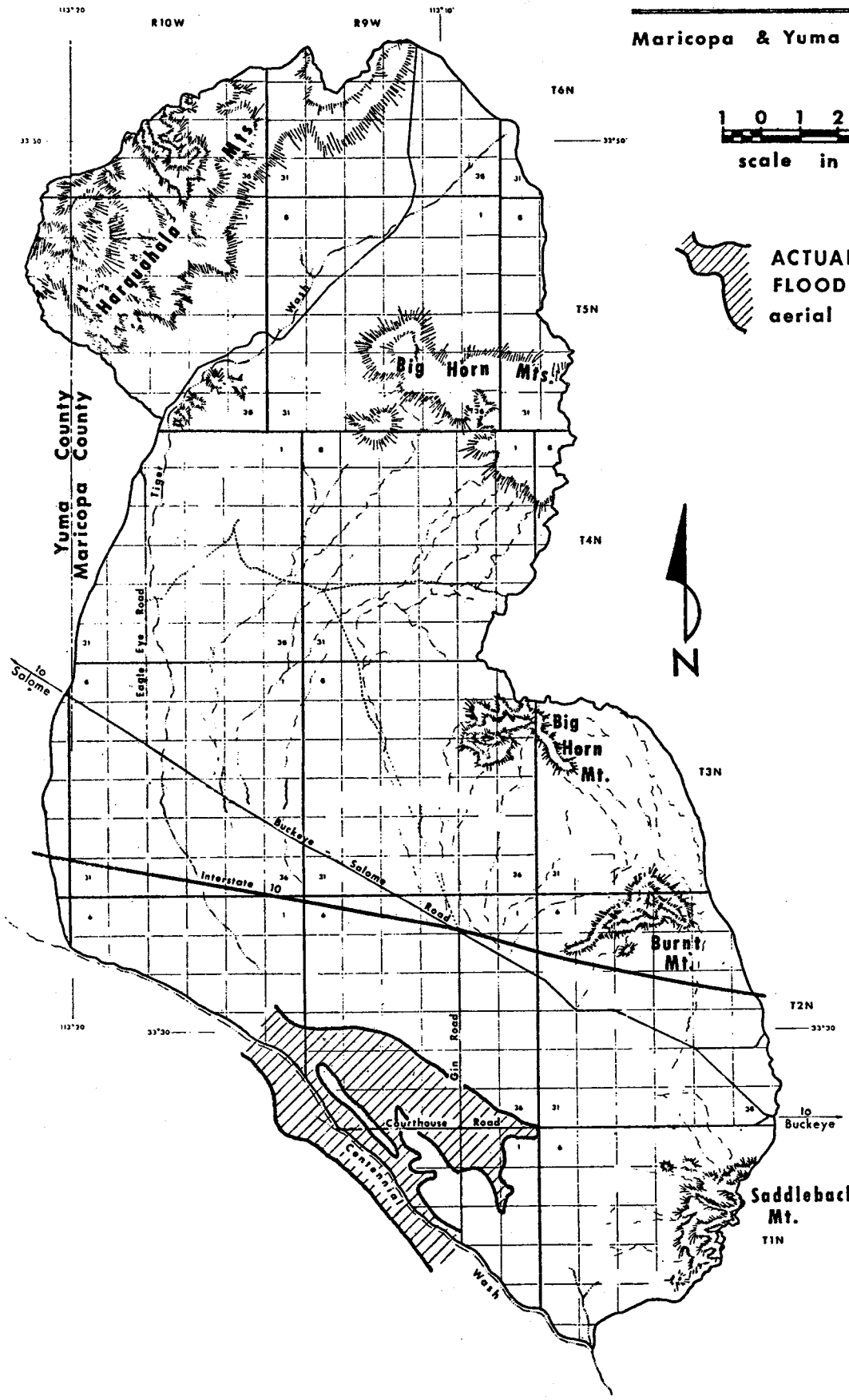
Although total damage to the highway is unknown, considerable expense was obviously involved in repair. Following the storm, additional drainage structures were installed through the highway. As an example, the concrete box culverts at the Buckeye-Salome Road overpass that outlets down Gin Road were increased 67 percent in size and capacity by adding four more 10 feet by 5 feet openings to the existing six 10 feet by 5 feet concrete box culverts. Flow from these culverts washed out an 8 foot width of the paved Gin Road roadbeds for about 4 miles. Flow undercut and washed out about 60 feet of a 24-inch diameter concrete irrigation pipe at a siphon under Gin Road. (See Figure P20.)

Flood flows into the west side of the valley came from the Tiger Wash and Centennial Wash drainages. The path

CENTENNIAL WASH FLOOD PLAIN
1960 FLOOD

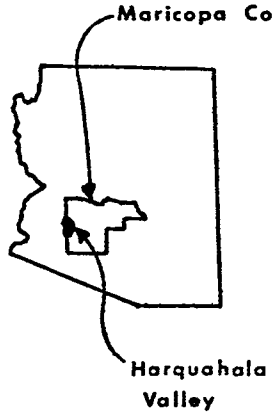
Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona



1 0 1 2 3 4 5
scale in miles

ACTUAL MINIMUM AREA FLOODED. Determined from aerial photo during flood.



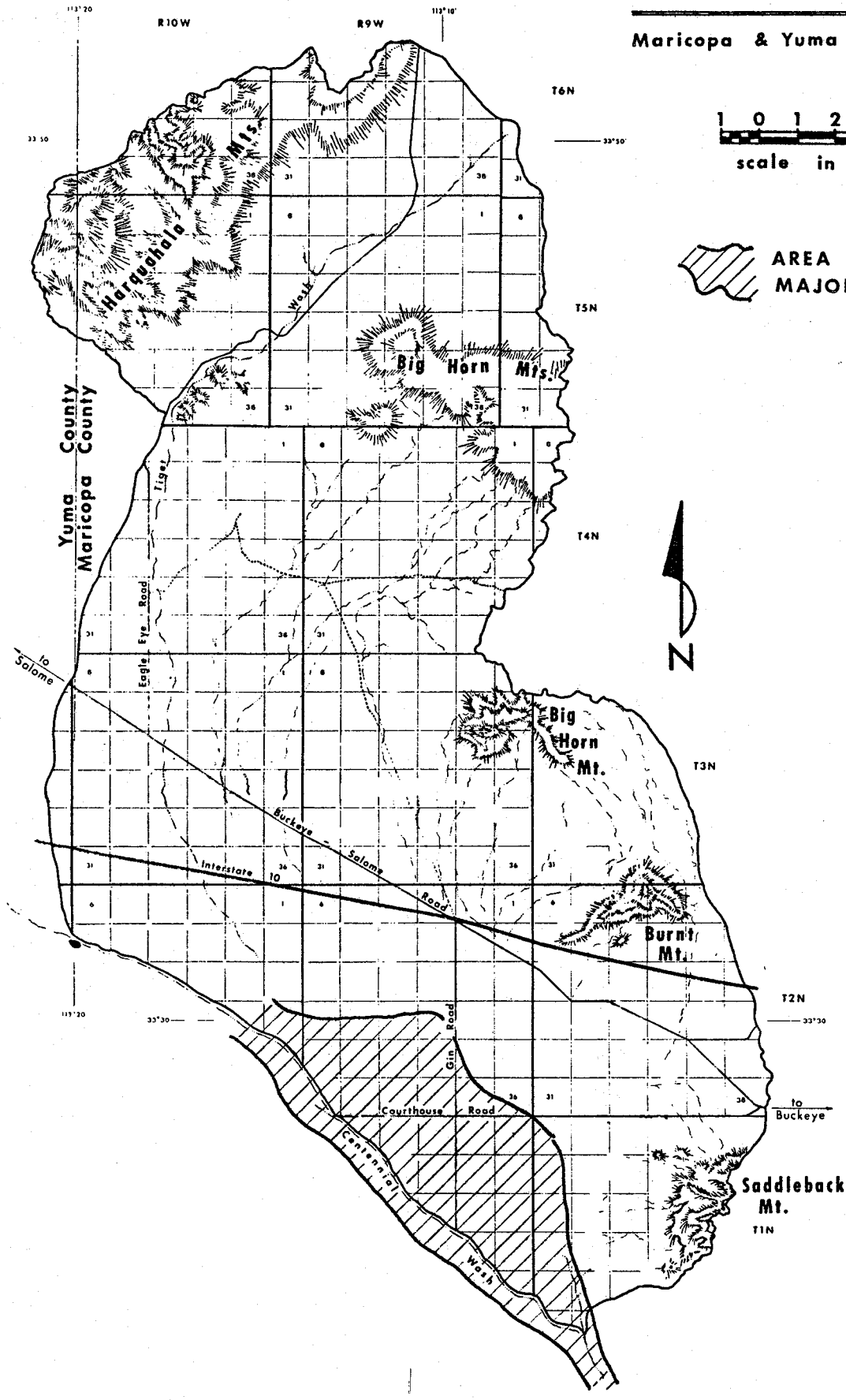
LOCATION MAP

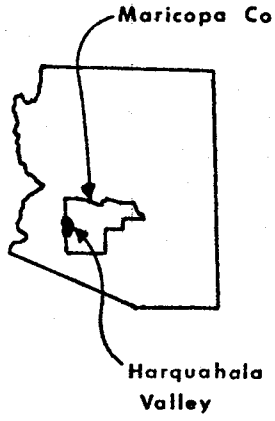
Figure 1

CENTENNIAL WASH FLOOD PLAIN
MAJOR EVENT

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona





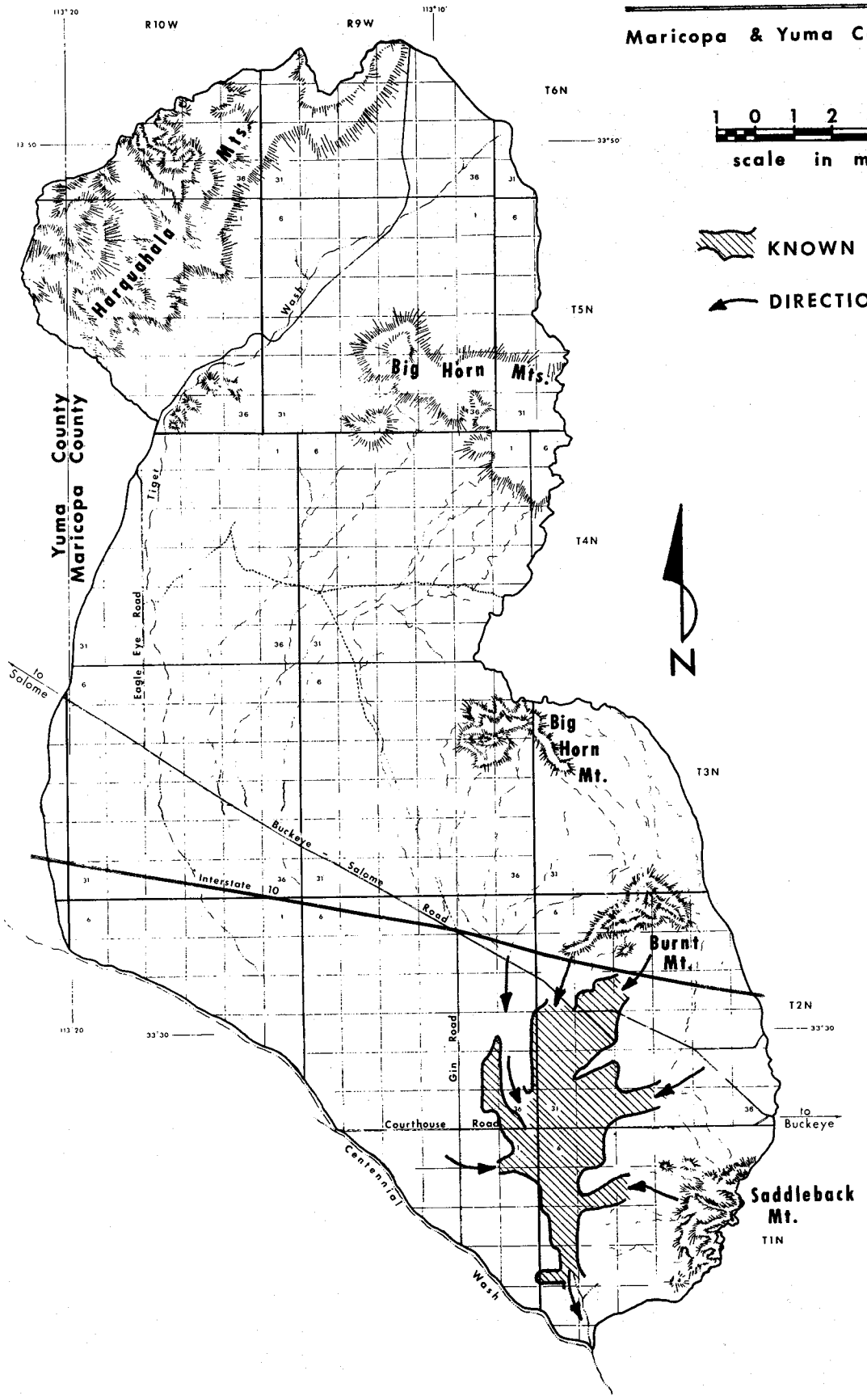
LOCATION MAP

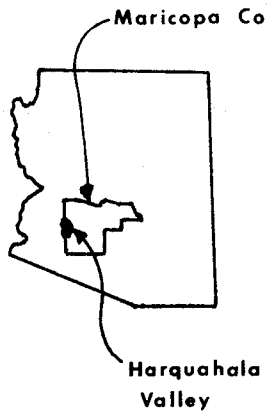
Figure 2

FLOOD OF AUGUST 26, 1964

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona





LOCATION MAP

Figure 3

Figure P15. Flood and sediment damages in Harquahala Valley from storm of August 26-27, 1964.

Figure P16. Floodwaters from the storm of August 26-27, 1964. Looking west along Courthouse Road.

Figure P17. Irrigation canal washed out by the flood of August 26-27, 1964. Looking east along mid-section line, Section 7, T1N,R8W.

Figure P18. Flood damage to Interstate 10 culverts from storm of August 1971.

Figure P19. Looking northwest across irrigated lands of Harquahala Valley showing floodwaters from storm of August 1971.

Figure P20. Flood damage to pavement and irrigation pipeline washed out from storm of August 1971. Looking north along Gin Road toward Interstate 10.

of the flood followed the same path as the 1960 flood previously discussed and shown on Figure 1. The flow braided out in the vicinity of Allison Tank and entered the valley on a broad front. The actual acres inundated by the 1971 flood were not determined, however, the flood did not appear to have the extent of the 1960 flood. Frequency of the 1971 flood and peak discharge was not determined.

The storm of October 6 and 7, 1972, centered over the north side of the valley and produced runoff from the south slopes of Burnt Mountain and the Big Horn Mountains. As in 1971 floodwater went through the Interstate 10 box culverts at the Buckeye-Salome Road overpass and washed out about 3 miles of Gin Road including from 2 to 5 feet of the west edge of the paved roadbed. There was no damage to Interstate 10 except for some minor ponding. About one mile of concrete ditch was either washed out or filled with sediment. In sections 26 and 35, T2N, R9W, the water that had been flowing along Gin Road broke to the east and flooded idle land. The damages from this storm were not extensive and are probably in the range of annual to biannual storm damages.

The storm of September 26, 1976, inundated approximately 3,800 acres of agricultural land. Most of the floodwaters came from Centennial Wash and followed the path as shown on Figure 2. Direct crop and road damages were high. Total damages were estimated at $250,000. These damages would have been prevented by Centennial Levee.

3. Erosion Damage [2,4]

A total of eight Hydrologic Soil Groups were mapped in the watershed. On-site erosion rates for these units are shown on Figure 4. The rates range from a low of 103 tons/sq.mi./year for fine grained basin fill deposits to 300 tons/sq.mi./year for the rocky higher mountains. Figure 4 does not reflect erosion rates for irrigated lands in production. These rates are quite low, averaging about 50 tons/sq.mi./year.

Erosion has not caused any major problems in the undeveloped portions of the watershed. The few unimproved roads are periodically washed out at wash crossings causing travel delay and access problems.

The major erosion damages occur in Harquahala Valley. In 1970 and again in 1971 approximately 3 miles of the paved Gin Road roadbed was washed out from flow through Interstate 10 box culverts. There is annual damage to farm and county roads, irrigation ditch berms, borders, fields and crops.

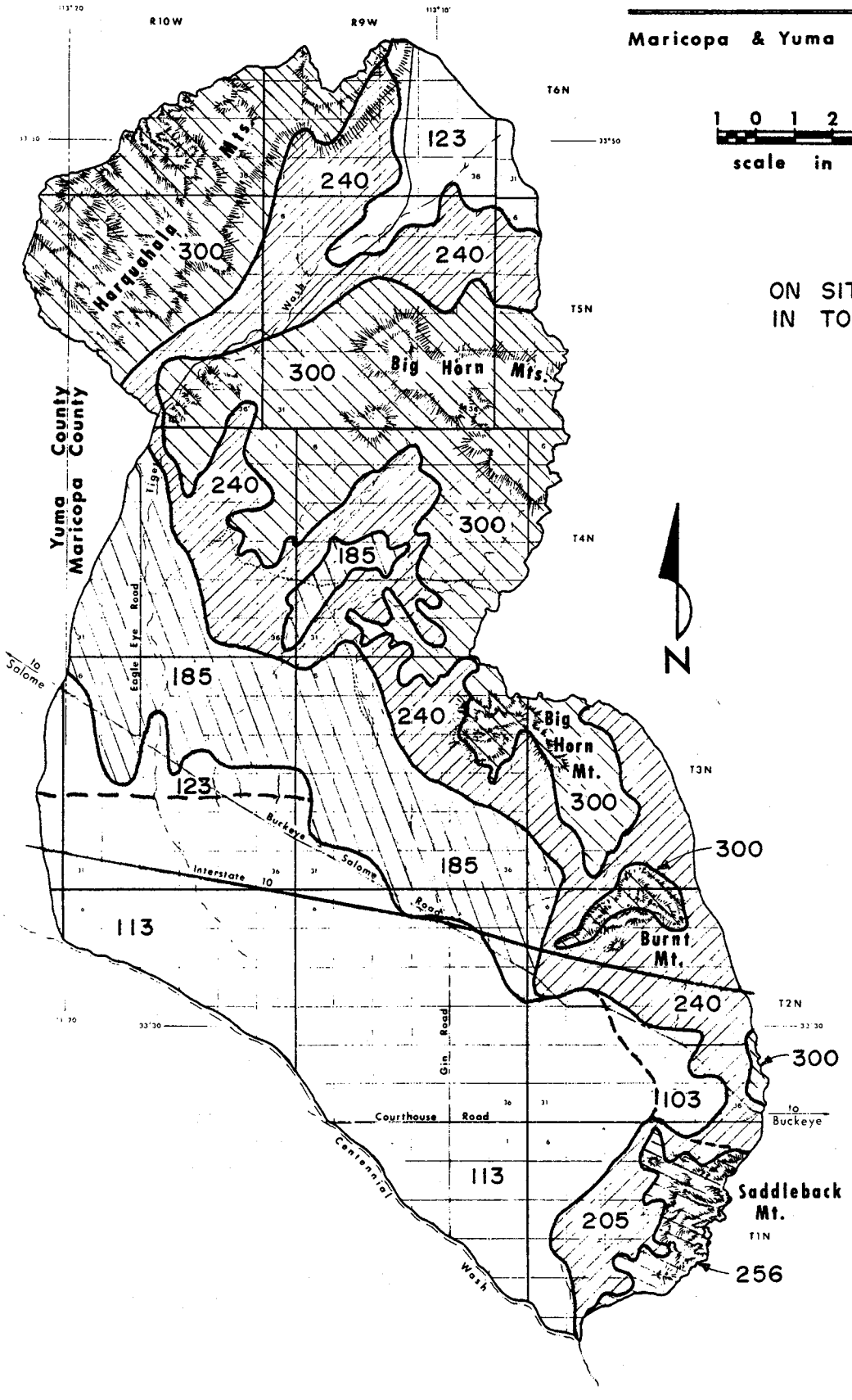
4. Sediment Damage [2,4]

Sediment yield is a function of several factors - runoff, type of soil, underlying soil conditions, vegetation

ON-SITE EROSION RATES

Harquahala Valley Watershed

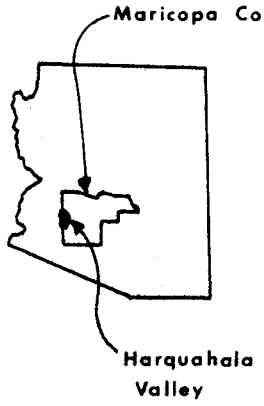
Maricopa & Yuma Counties, Arizona



1 0 1 2 3 4 5

scale in miles

ON SITE EROSION RATES
IN TONS / SQ. MI. / YR.



LOCATION MAP

Figure 4

cover, slope, drainage area characteristics, etc. The yield must be expressed in reference to a particular location or point within a drainage area. Common terminology is to express sediment yield as tons/year or tons/sq.mi./year to define the annual sediment production reaching a certain point from the upstream drainage area.

The annual sediment yield in the watershed varies from about 50 tons per square mile on the upper Tiger Wash drainages to about 360 tons per square mile in light soils of Harquahala Valley. The annual sediment leaving the watershed averages about 30,000 tons.

As floodwater flows over the floodplain there are many areas where large amounts of sediment are deposited and damage sustained. Irrigation ditches are frequently filled with sediment. Lower ends of fields bordering sumps, high borders, or dikes are areas of heavy sediment deposition. Often entire fields must be releveled to restore proper grade for irrigation. Sediment may cover vegetable, nursery, or alfalfa crops, smothering the plants and destroying production.

Sediment is also deposited inside homes and yards causing extensive damage. A large amount of time and money is spent in cleaning up sediment and debris. Sediment laden floodwater damages automobiles and farm machinery. Normal farm operations are disrupted by the necessary dismantling and repair of machinery damaged by sediment. Sediment damages caused by the August 1964 storm were estimated at $293,700 for agriculture and $7,900 for nonagriculture.

5. Drainage Problems [4]

There are no high water table surface drainage problems in the watershed. There are about 400 acres in the southeast part of Harquahala Valley that have a sodium tie-up problem creating some difficulty in penetration and drainage of applied irrigation waters.

6. Irrigation Problems [4,11]

The area is not exempt from problems normally found in irrigated agricultural areas. Problems are encountered in developing, controlling and efficiently using irrigation water, maintaining soil condition, erosion control and maintaining crop yields.

Compaction of soil through the use of tillage and harvesting machinery and loss of organic matter through decomposition adversely affects soil conditions over all the irrigated cropland. The rate water is absorbed by the soil, the rate of movement of air and water through the soil, and root development all tend to decrease with continued cultivation. A land treatment program that minimizes the number of machinery operations, returns organic matter from crop residue to the soil and adds

soil amendments, such as sulfuric acid, will continue to maintain satisfactory crop yields. The program must be adjusted to meet the needs that vary somewhat from year to year.

Periodic deepening of irrigation wells to maintain a constant water supply is necessary. Distribution of water to fields is relatively simple since the wells are close to the area irrigated. However, problems are encountered in measuring the amount of water needed in the crop root zone, measuring the water onto the fields from ditches and determining when irrigation is needed. Precise measurement of these factors is necessary to obtain potential crop yields and increase the efficiency of water use.

Soil movement on individual fields occurs during thunderstorms and from irrigation particularly where the land slopes more than 0.4 percent. Properly designed and operated irrigation systems are installed on more than half the cropland and therefore generally control soil movement from irrigation water. The remaining acreage presents some soil movement problem, though minor. Storm runoff may cause sediment deposits and some scour over nearly any part of the cropland.

7. Municipal and Industrial Water Problems

There are no problems evident in this area. The water quality is adequate, with the exception of high fluoride content. The supply is adequate to meet demands for more than 50 years.

8. Recreational Problems

Although there are numerous passive outdoor recreational activities available in the watershed, the remote location and rugged landscape limits access to much of the area. The only developed roads are in the center of the watershed, away from the mountains. Access to most of the mountain area is therefore limited to off-road vehicles, horseback or hiking.

There is a complete absence of water based recreation in the watershed. This lack is typical of central Arizona as a whole. Water is a relatively scarce and most valuable resource in Arizona. Present and future demand for water based outdoor recreational activities can probably never be satisfied. For the watershed residents interested in this type of recreational activity, participation requires a considerable amount of travel. The nearest surface water recreational resources to the watershed are: Alamo Lake State Park, 85-90 miles northwest in Yuma County; Lake Pleasant, 85-90 miles northeast in Maricopa County; and the Colorado River, 95-100 miles west in Yuma County.

9. Plant and Animal Problems

The vegetative condition throughout the watershed is sparse and is dominated by low value creosotebush. Some reports indicate that prior to the introduction of livestock in the late 1800's that range grasses were much more prevalent, not only in the watershed but throughout the entire desert areas of Arizona. Some authorities report that climatic changes have occurred in the last 100 years contributing to the degradation of vegetation throughout the desert.

Ninety-two percent of the watershed remains undeveloped. The basic problem remains one of a shortage of water for wildlife and some areas of overgrazing by livestock. In the 1950's and 1960's portions of the Harquahala Valley were developed for intensive irrigated agricultural use. Wildlife problems associated with this change in land use varies depending upon the wildlife species. Some habitat was lost through associated clearing activities, reducing the numbers of species dependent on this habitat. Other species increased in numbers because of the more readily available water and feed crops. Some species which were extremely sensitive to human intrusion were reduced in numbers and perhaps lost from some areas.

The period mid-1960's to present has brought the construction of Interstate 10 and the scheduled construction of the Granite Reef Aqueduct through the valley. These corridors have the potential of changing the face of the valley. Habitat is lost and major drainage patterns altered through construction. Animal movement routes are cut off and human intrusion increased.

10. Water Quality Problems [2,4,8,9,10]

The extent of chemical or organic pollution in watershed flood flows has not been determined. Neither the Arizona Health Department nor the Environmental Protection Agency has a water quality monitoring program for runoff from this watershed area. High sediment concentrations in flood runoff average 3,500 parts per million. Annual sediment leaving the watershed average about 30,000 tons. High sediment concentrations detract from the value of water impounded in stockwater ponds and irrigation tailwater sumps. Pumping of this water causes high pump wear and early replacement. Sediment deposition decreases the beneficial capacity of stockwater ponds and tailwater sumps. Floodwaters pollute water wells and flood septic tanks, causing sanitary and health problems.

Irrigated agriculture requires the application of fertilizers and pesticides. Due to the limited runoff that occurs from leveled fields, and an absence of perennial streams, the application of fertilizers and pesticides does not constitute a hazard to surface water supplies. These chemicals are leached through the soil horizon. The effect, if any, on

underground water supplies has not been evaluated. There is a need for studies to determine the long-term impact on underground water supplies from the application of fertilizer and pesticides to overlying irrigated lands.

11. Economic and Social Problems

There are twenty farm operations in the watershed area. Only four of these establishments have resident owners. None of the farms are classified as family farms as they all utilize hired labor in excess of 1½ man-years. Average farm size is 968 acres and average annual gross income per acre was estimated to be $745 in 1967. Based upon this data, none of the farms can be classified as low income producing units.

Almost all employment in the area is directly or indirectly related to the farming and ranching activities. Employment levels fluctuate with the degree of agricultural activity. The project area cannot be classified as an economically depressed area.

There are no incorporated or unincorporated communities in the watershed. There is a small concentration of business establishments consisting of a cotton gin, service station, tavern, laundry, trailer court and community store. Most people live on or near the farms. Rural community development programs would have limited applicability in the watershed.

SECTION IV

RELATIONSHIP TO LAND USE PLANS, POLICIES AND CONTROLS

IV. RELATIONSHIP TO LAND USE PLANS, POLICIES AND CONTROLS [32]

There are no known conflicts between the project and any approved or proposed federal, state, or local use plans, policies, or controls. The plan will not conflict with provisions of the Clean Air Act or the Federal Water Pollution Control Act Amendments of 1972.

Neither the State of Arizona nor Maricopa County has developed land use plans for the project area. The majority of the land in the watershed is federal land administered by the U.S. Bureau of Land Management. The project area is in the Vulture Planning Unit. A revision to the Management Plan for this unit is due for completion at the end of Fiscal Year 1977. BLM is presently preparing Environmental Impact Statements for all lands under their administration. These statements are aimed primarily toward grazing use, however, other uses will be addressed. The statement for the Harquahala Valley Watershed area is due in Fiscal Year 1981. BLM has prepared proposed rules for implementation of Executive Order 11644, Off-Road Vehicle Use. Public hearings are being conducted on these proposed rules. There are no known major conflicts between the project and BLM's plans, policies, and controls in effect as of this writing.

Maricopa County has adopted and is enforcing floodplain regulations in accordance with Arizona State Law. These regulations provide that no development may take place in a 100-year floodplain if it will divert or obstruct the flow. They also require that the finished floor elevation of any new residence be above the 100-year flood elevation and that any nonresidential structure be floodproofed or have the finished floor above the 50-year flood elevation.

There has been no delineation of either the 50 or 100-year floodplains in Harquahala Valley. The county regulations are therefore not fully effective, although building permits are reviewed to determine if an abvious flood hazard is present. Floodplain delineations are planned and upon completion will bring regulations into full effect.

Projected land use in Harquahala Valley for the life of the proposed project is not expected to change from the current predominant agricultural use. The draft publication, "A Report upon Future General Land Use for Maricopa County, Arizona," prepared by the Maricopa County Planning and Zoning Department shows only agricultural development to the 1995 projection date. This projection should remain valid with or without the proposed structural flood control measures or floodplain regulations, since other factors such as distance from metropolitan area will have a more dominant influence on determining future development.

SECTION V

ENVIRONMENTAL IMPACT

V. ENVIRONMENTAL IMPACT

A. Impacts from Conservation Land Treatment

The planned land treatment program for the irrigated lands will reduce floodwater, erosion, and sediment damages from storms that occur below the structural measures. The most beneficial practices to effect this will be land leveling, crop residue use, conservation cropping system and irrigation water management.

The program will reduce the sheet erosion from 0.08 tons per acre per year to 0.06 tons per acre per year on 13,000 adequately treated acres of irrigated cropland. Sediment yield from the agricultural lands to the mouth of the watershed will be reduced from 1,820 tons per year to 1,430 tons per year. After completion of the project, 67 percent of the irrigated cropland will be adequately treated.

The irrigated lands treatment program will provide flood damage reduction benefits estimated at $36,400 annually. The program will reduce the acres inundated by the 100-year storm by 0.9 percent and the 5-year storm by 0.8 percent.

The planned land treatment for the upstream rangelands consists of "proper grazing use." No floodwater, erosion, or sediment reduction benefits have been claimed for this program. Reliable determination of these impacts is not possible because of the extremely varied and unpredictable nature of rainfall in this desert setting.

Irrigation ditch and canal lining and pipelines will reduce seepage losses by 4,100 acre-feet per year. Better designed irrigation systems and irrigation water management practices will provide for more efficient use of applied irrigation water. A higher percentage of the amount applied will be available for crop use. Current losses will be reduced by an estimated 5,000 acre-feet per year.

Crop yields will be maintained or increased, and the quality of the crops will improve. The increase in efficiency of water use will demand less from the water supply.

Several planned practices will have beneficial impacts that cannot be realistically quantified. Irrigation ditch and canal lining, pipelines, structures for water control, and land leveling reduce farm labor inputs for weed removal, ditch cleanout, water application monitoring, etc. Tailwater recovery ponds provide habitat for aquatic wildlife and water for small game and birds. Crop residue use and conservation cropping systems will reduce runoff, increase crop yield, reduce air pollution from blowing

dust and stubble burning, and leave some crop residue available for wildlife food. Concurrently, practices such as irrigation ditch and canal lining and others that occur as a result of more intensive agricultural development removes wildlife habitat for some animal and bird species.

Little change is expected in land use. There will be no adverse effects on archaeological values from the land treatment program. The land surface has already been disturbed where further land treatment will be applied. Most of these measures require soil movement on the surface of less than a foot deep.

The effect of land treatment on aesthetics should be minimal.

B. Impacts from Structural Measures

1. Reduced Floodwater, Sediment, and Erosion Damages

The proposed structural measures will reduce floodwater, sediment, and erosion damages on 16,000 acres of cultivated land on 20 farms and on 27,300 acres of presently unimproved land. Economic damages from floodwater, sediment, and erosion damages will be reduced by an estimated 59 percent.

A 100-year frequency storm from the drainage areas controlled by Harquahala F.R.S., Saddleback F.R.S., Saddleback Diversion, and Reach 1 of Centennial Levee would inundate 16,000 acres of cultivated land under present conditions. This would be reduced by 57 percent to 6,850 acres by the proposed structural measures. The August 26, 1964, flood occurred from a storm over the drainage areas controlled by the above mentioned structures and inundated 8,400 cultivated acres. This storm can be expected to occur once in seven years. The project would reduce flooding from this event by 4,400 cultivated acres.

The proposed structural measures would reduce the 100-year peak flows from Harquahala Valley Watershed into Centennial Wash by 84.3 percent from 38,200 cfs to 6,000 cfs and reduce the 50-year peak flows by 81.8 percent from 28,600 cfs to 5,300 cfs.

Centennial Levee will prevent the present widespread sweep of Centennial Wash flows through Harquahala Valley. At present, a major flood event on Centennial Wash would inundate 8,000 acres of cultivated land and 11,800 acres of unimproved land. The levee will reduce this to 585 acres of cultivated land and 6,039 acres of unimproved land. (See Figure 2 and Plate 5.)

Reach 1 of Centennial Levee will protect 3.7 miles of

the proposed irrigation water distribution canal for Harquahala Valley Irrigation District. Without the levee, the District would either have to accept damages to this canal or incorporate flood protection features in the design. Protection features equal to that afforded by Centennial Levee would cost an estimated $335,000 in increased canal costs (1974 prices).

Harquahala F.R.S. will protect a 10½ mile reach of the authorized Central Arizona Project Granite Reef Aqueduct for greater than the 100-year frequency event. Protective features equal to that afforded to the aqueduct by Harquahala F.R.S. would cost an estimated $5,300,000 in increased costs (1974 prices).

Harquahala F.R.S. will also reduce possible floodwater and erosion damage to 9.0 miles of Interstate 10.

Flows greater than those expected to occur once in 100-years will pass through the emergency spillway of Harquahala F.R.S. Some damage to Interstate 10 and the Granite Reef Aqueduct could result if an event of such rare magnitude occurred. However, the existing highway cross-drainage culverts are designed for the 50-year event and the dam will protect for the 100-year event before emergency spillway flow occurs.

Harquahala F.R.S. will reduce the occurrence of erosion of the paved Gin Road roadbeds that presently results from discharges through ten 10 foot by 5 foot concrete box culverts on Interstate 10 at the Buckeye-Salome Road interchange. (See Figure P20.)

Saddleback F.R.S. and Saddleback Diversion will prevent damaging floodwaters from entering a subdivision in the west one-half of section 4, T1N, R8W. Damages expected to occur from the 100-year event would be reduced by approximately 92 percent. This subdivision has only minor development at present.

Saddleback F.R.S. and Saddleback Diversion will also protect 10.8 miles of a Harquahala Valley Irrigation District proposed irrigation water distribution main canal. Without the project structures, the District would either have to accept damages or incorporate flood protection in the design. Costs of protective features equivalent to those afforded by Saddleback F.R.S. and Saddleback Diversion have not been determined.

The project will protect a proposed $5,595,000 (1974 prices) irrigation water distribution system for Harquahala Valley, including the main canals.

All of the project structural measures will reduce floodwater, sediment, and erosion damages sustained by crops, channels, dikes, irrigation ditches, sumps, farm equipment, livestock, and utilities.

Flooding of residential and commercial establishments will be virtually eliminated. Reoccurring road damage to Buckeye-Salome Road, Courthouse Road, Gin Road, and other roads will be greatly reduced.

2. Vegetation 44

a. General

The project will impact native vegetation in three ways: 1) Distruction from construction or prolonged inundation; 2) stress and loss on downstream vegetation from reduced water supply; 3) induced growth from increased water supply.

Destruction from construction will affect all types of vegetation. The estimated minimum area necessary for orderly and economical construction of the structural measures is 780 acres. Of this, approximately 36 acres are trees which are valuable to wildlife. Vegetative destruction will only be temporary over most of the area, however. Growth will return, although the distribution of species may change. Destroyed areas and the structures themselves will be seeded with indigenous species. Adverse impact will be short term. The long term change should show no net decrease in vegetative cover.

Impacts on vegetation from reduced water supply will occur downstream from each structure. The existence of mesquite, ironwood, paloverde and acacia trees predominantly along washes indicates their pseudoriparian nature and partial dependence on periodic flows to provide moisture. Losses can be expected to these tree species as well as to the dominant creosotebush. In some areas, trees may be completely lost whereas others will be only slightly stressed. (See Figures P21 and P22.) Areas with coarse grained soils will probably not be affected as much as those with fine grained soils. Creosotebush loss has occurred downstream from both Interstate 10 and Allison Tank. Similar losses will probably occur downstream from the project structures. It is estimated that 1,530 acres of land dominated by creosotebush will be affected. Losses will approach 100 percent immediately below the structures with some effects occurring up to 1/4 mile downstream. (See Figures P23 and P24.)

Impacts in the flood pool areas will primarily be beneficial. Vegetative growth will be induced where frequent

Figure P21. Looking east along Indian School Road showing live trees immediately downstrea of Caterpillar Co. Proving Grounds diversion dike.

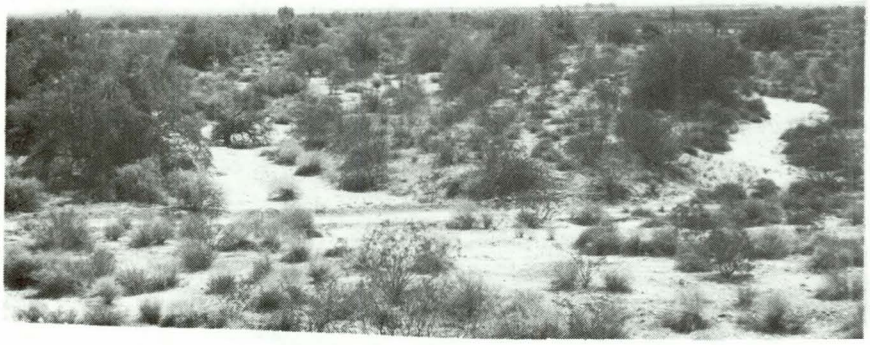


Figure P22. Looking east from top of McMicke Dam showing live trees along washes downstrea of the dam.

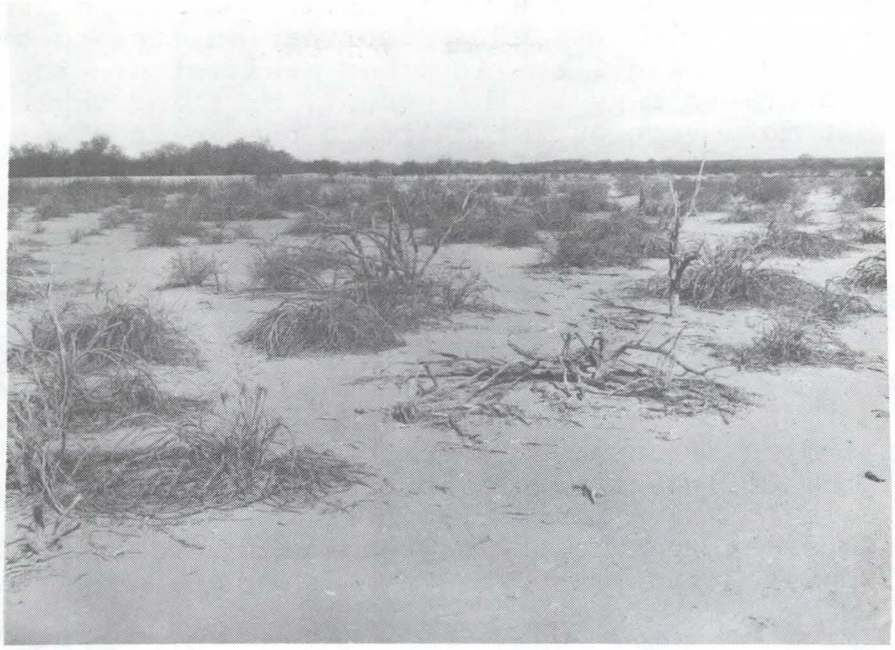


Figure P23. Dead creosote bush downstream of Allison Tank. Area is heavily used by cattle.

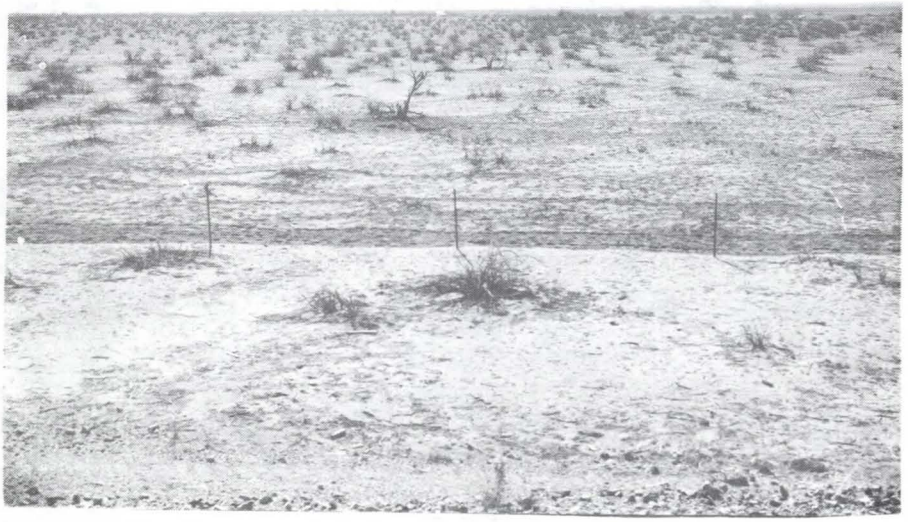


Figure P24. Dead creosote bush downstream of Interstate 10 in Harquahala Valley.

temporary storage increases availability of soil moisture. This will be particularly true of pseudoriparian tree species which are important to wildlife. At other areas within the flood pool where temporary storage is infrequent, existing vegetation will be somewhat more vigorous with little change in plant species composition. Siltation and prolonged inundation of some areas may periodically destroy, retard growth, or cause a change in plant species. It is not anticipated that any reduction will be significant or frequent. Evaluation of other flood control structures in southern Arizona shows a general increase in woody growth in reservoir and diversion areas. (See Figures P25 and P26.)

A study to determine the net overall impact of flood retarding structures in southern Arizona is being undertaken by the Office of Arid Land Studies, University of Arizona, for the Soil Conservation Service, Arizona Water Commission, and other interested agencies. The results should indicate the impacts on vegetation, and give a measure of the parameters involved.

Specific anticipated impacts of each structure are as follows:

Saddleback F.R.S.

Clearing for construction will destroy 160 acres of native vegetation. This includes 60 acres for the embankment and 100 acres for the borrow areas and low flow channel. Approximately 12 acres of trees will be removed. Creosotebush immediately downstream of the structure will either be lost or heavily stressed. Most pseudoriparian trees along washes below the structure will receive a continued water supply from pipes through the embankment. An estimated 150 acres within the reservoir will have increased vegetation induced by the extra moisture from temporary storage.

Harquahala F.R.S.

Construction of Harquahala F.R.S. will require complete removal of native vegetation from an estimated 250 acres. This includes 191 acres for the embankment and upstream berms; 29 acres for the upstream low flow channel; 28 acres for cuts through ridges; and 2 acres for the emergency spillway.

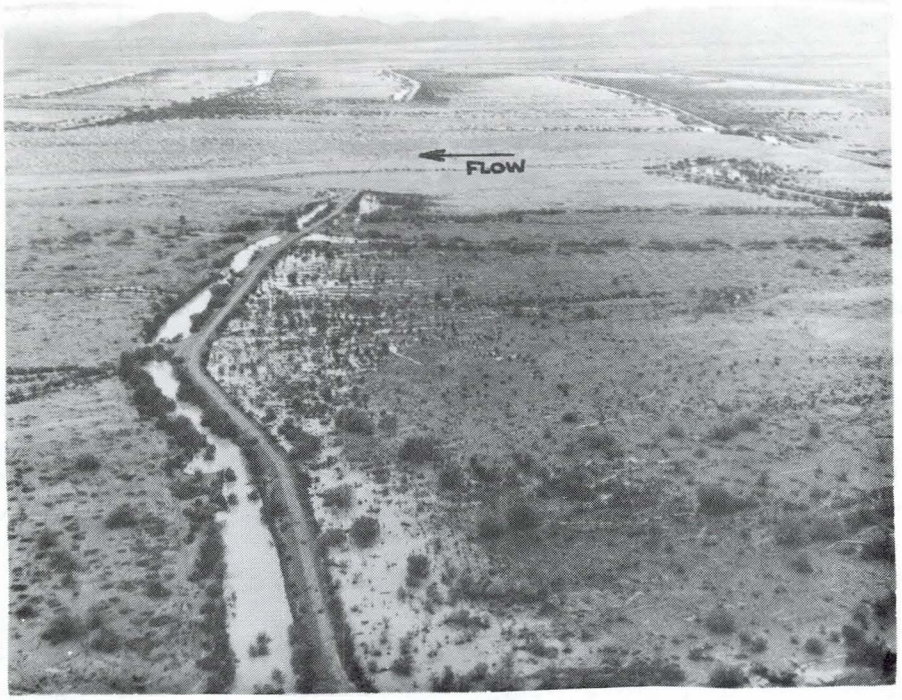


Figure P25. Looking west across Centennial Wash showing heavy growth induced upstream of water-spreaders constructed in the 1950's by the U.S. Bureau of Land Management.

Figure P26. Growth in the flood pool of McMicken Dam. Looking north from top of dam.

Approximately 3 acres of trees will be removed. No reservoir clearing will be done on the remaining 2,024 acres in the flood pool area.

Soil textures found below the Granite Reef Aqueduct vary from fine grained along Reach 2 on the west, to coarse grained along Reach 1 on the east. Loss and stress are expected to occur to vegetation downstream of the structure primarily along Reach 2. Affected will be both creosotebush and about 50 acres of pseudoriparian trees along washes.

Induced growth, primarily tree species, will occur within the flood pool area at locations where approximately 95 washes will not completely free drain, and around the perimeter of the 34 acre nondraining area. The estimated area of induced growth is 300 acres.

Flows from Harquahala F.R.S. are diverted through Saddleback F.R.S. and Saddleback Diversion. Increased growth along the alignment of these structures should also be aided particularly at the existing stock pond between the Saddleback Diversion outlet and Centennial Wash.

Harquahala Floodway

The construction of Harquahala Floodway will require the removal of native vegetation from about 17.5 acres of land. This includes 1.8 acres at the upstream end of Reach 1; 0.4 acres in Reach 2; and 15.3 acres in Reach 4. Approximately 2.0 acres have pseudoriparian species. An unquantified amount of increased growth will occur along the wash section of the floodway as a result of increased flow.

Saddleback Diversion

Construction of Saddleback Diversion will require the complete removal of vegetation on an estimated 150 acres. This includes 56 acres for the embankment and berm, 86 acres for the low flow channel, and 8 acres for a maintenance road. About

9 acres of trees will be removed. Revegetation efforts plus increased flow of water will restore vegetation and should result in a net increase in cover.

Centennial Levee

Construction of Centennial Levee will require the complete removal of vegetation, primarily creosotebush, on an estimated 200 acres. This includes the area for the embankment and borrow areas. Approximately 1 to 2 acres have trees.

The slope of Centennial Levee Reach 1 at 0.00024 foot per foot is so flat that siltation and increased water infiltration will occur upstream from the levee embankment. These conditions are conducive to vegetative growth. Some temporary loss of mesquite will result if Allison Tank is utilized as a source of borrow material for the construction of Centennial Levee (see Figure P28).

b. Rare and Endangered Plants

Two species of rare and endangered plants on the state list will be affected by construction. They are the Saguaro Cacti (Cereus gigantius) and Night Blooming Cereus (Cereus greggii). Harquahala F.R.S. is the only proposed structure where construction activities will disturb these plants. An estimated 60 saguaro cacti within the construction area will be removed for construction of the dam. An additional 275 are within the 100-year flood pool. The disposal or protection of the cacti will be done in a manner acceptable to the Arizona Commission of Agriculture and Horticulture and also with the U.S. Bureau of Land Management for those cacti on federal land. The amount of night blooming cereus to be disturbed is unknown due to difficult detection and identification. Only one plant was located during the vegetative inventories. The endangered and threatened plants on the federal list that may be affected by construction, are listed in the Environmental Setting Section, page 57.

During surveys, layout, and construction, particular vigilance will be employed in locating plant species on both the state and federal listings and insuring that proper salvage procedures are followed.

c. Intrusion by Exotic Vegetation

The project could induce some salt cedar (Tamarix pentandra L.) intrusion. Most vulnerable will be the borrow pit areas of Saddleback F.R.S. To date, the watershed is relatively free of salt cedar, however, small to medium sized trees are growing in the Interstate 10 borrow pits (section 3, T3N, R9W. See Figure P27).

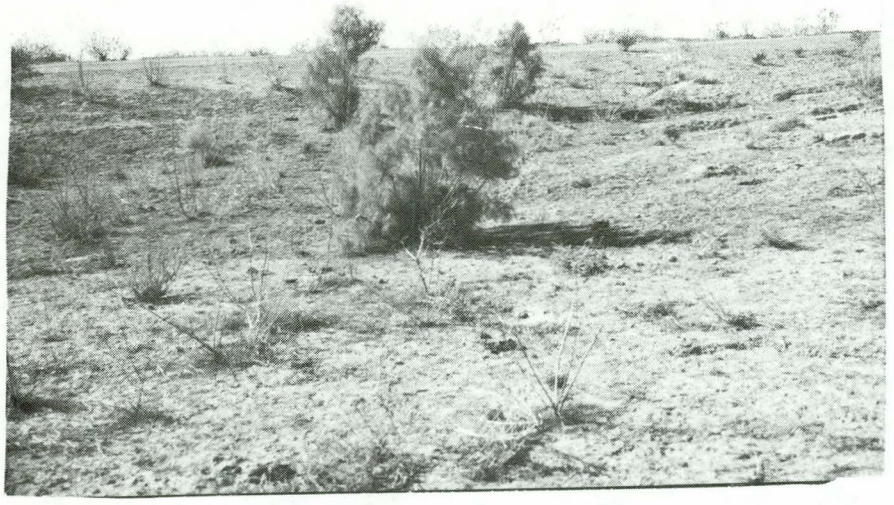


Figure P27. Salt Cedar Intrusion into Interstate 10 borrow pit.

Figure P28. Allison Tank, Section 25, T2N, R10W.

3. Wildlife

a. General

The proposed structural measures of the Harquahala Valley Watershed project will have both adverse and beneficial impacts on wildlife in the watershed. The major adverse impact will result from the destruction of vegetation which serves as basic habitat for the native wildlife. The significant beneficial impacts will be from the creation of semipermanent pools behind structures to provide additional water supply to vegetation and water surface area for wildlife. Impacts will result from construction activities, structural placement, and change in water runoff characteristics.

Appendix F lists the various species of terrestrial vertebrates which may be found in the watershed either as permanent residents, seasonal visitors, or transients. It is not anticipated that installation of the proposed project features will have significant impact on the total watershed population of these species.

Impacts from construction activities will be immediate. Heavy equipment, vehicles, and earth movement may kill or displace many animals. Bird nesting areas and other habitat will be disturbed resulting in reduced populations. Disturbed areas away from the structures, and not serving as corridors necessary for operation and maintenance will slowly return to their natural state.

Impact on wildlife may result from the restriction on big game movement from the combined CAP aqueduct and Harquahala F.R.S. Without the flood control provided by the proposed dam, cross-drainage facilities would be constructed over the canal thus providing a crossing for wildlife. The proposed project therefore has an effect. Current plans by the Bureau of Reclamation provide for one road crossing, two cattle crossings, and three game crossings over the aqueduct along Harquahala F.R.S. At each of these locations, fencing of the dam will be interrupted to allow movement of big game. Additional crossing facilities will be provided should the need be demonstrated in the future.

Long-term impacts on wildlife from structural placement are generally unquantifiable. Approximately 780 acres are directly affected. Wildlife habitat will be reduced at each structural location which in turn will result in reduced wildlife populations in the immediate area. An additional 4,014 acres will be subject to inundation either as reservoir area or area within diversions. Within these areas the impact on wildlife is difficult to determine. If no major flooding occurs there will be a significant increase in vegetation which in turn will increase wildlife populations. However, if vegetation is destroyed through inundation from a major

flood then wildlife populations of some species will suffer. The proposed semipermanent ponds behind flood retarding structures will create habitat. In general, wildlife upstream from structural measures will increase in numbers and species represented.

The loss of woody pseudoriparian vegetation from change in surface water runoff characteristics may be noticeable downstream from Harquahala F.R.S. Reach 2. This will probably have an adverse effect on wildlife and result in reduced populations of certain species dependent upon such growth. Such reduction would not be immediate but rather would occur over several years.

Creosotebush is the dominant vegetation in the project area. Two species of terrestrial vertebrates, the desert iguana and chuckwalla, feed upon creosotebush. This vegetative type also provides ground cover where no other cover of significance occurs. Because of the vast amounts of creosotebush throughout the project area, any creosotebush losses occurring from the project should not adversely affect wildlife to any significant degree.

b. Endangered and Threatened Wildlife

The federal and state listing of endangered and threatened wildlife in the watershed is shown on page 61. Most of these species are limited in numbers or range and will not be greatly affected by the project. Most are large mammals or birds which are not permanent residents of the project area, only periodically migrating through.

Two species on the state list, the desert tortoise and the gila monster, could potentially be affected by construction of the project. The desert tortoise is a grazing species, feeding primarily on grasses. Populations can generally be expected to be very low in the desert where livestock grazing is permitted. Construction activities may destroy a few, however, revegetation and fencing of project features is expected to improve habitat conditions and increase populations.

The gila monster also inhabits the construction site and some may be destroyed by construction activities. This species is more numerous where it has access to water or damp soil. Gila monster habitat conditions will be improved because of the semipermanent pools behind the structures.

The two species on the federal endangered list (Southern Bald Eagle and Peregrine Falcon) will not be adversely affected by the project. The Bald Eagle feeds on fish. There are no fish in the watershed. Only a few pairs of eagles are found in Arizona. The falcon is uncommon in Arizona. It migrates through the state and winters along the Colorado River

and the Santa Cruz Valley. Peregrine falcons rarely nest in Arizona, but when they do, they nest in cliffs. There is no indication that either species nests in the area.

4. Water Resources

a. Surface Water Quality

The project will reduce high sediment concentration and improve the quality of the few surface water impoundments in the watershed. Quality of the runoff to the tanks in sections 20 and 29, T1N, R8W, will be greatly improved as the upstream Harquahala F.R.S. and Saddleback F.R.S. will settle out high sediment loads. Sediment concentrations in the water supplying these tanks will improve from 3,200 parts per million to 2,000 parts per million. The project will reduce flooding of irrigation tailwater sumps by 72 percent with a corresponding decrease in sediment disposition in these sumps.

Harquahala F.R.S., Saddleback F.R.S., and Centennial Levee Reach 1 will trap an estimated 28,270 tons of sediment per year, or 1,413,500 tons in a 50-year period. The sediment delivered by the watershed to Centennial Wash will be reduced from 30,000 tons per year to 10,000 tons per year.

b. Groundwater Quality

The project will reduce flooding of cesspools, domestic water wells and irrigation wells by 72 percent and thereby reduce local contamination of groundwater.

c. Surface Water Quantity

Both Harquahala F.R.S. and Saddleback F.R.S. are designed to have a limited amount of surface water storage. This storage is contingent upon the securing of any required water rights by the sponsors.

Planned storage behind Harquahala F.R.S. is 242 acre-feet. This includes 100-acre-feet where intercepted washes will not be completely drained and 142 acre-feet where a low area in the dam alignment occurs. Surface area of this pool will be 34 acres.

Planned storage behind Saddleback F.R.S. is 186 acre-feet. This includes 101 acre-feet in the 50-year sediment pools of Basins No. 1 and No. 2 and an estimated 85 acre-feet in the borrow pits.

The quantity of runoff yield to two stock tanks located in sections 20 and 29, T1N, R8W, will be increased approximately 45,300 percent from 1.6 acre-feet per year to

725 acre-feet per year. Runoff from approximately 140.6 square miles of drainage area will be diverted through these tanks. Existing water storage will be greatly enhanced.

Existing storage in Allison Tank will be increased if borrow material is obtained from this source. Storage capacity could be increased by an estimated 120 acre-feet. (See Figure P28.)

d. Use of Temporarily Impounded Floodwater for Irrigation

The Harquahala Valley Irrigation District has requested that gated outlets be provided through Harquahala F.R.S. and Saddleback F.R.S. so that impounded floodwater can be used for irrigation. The planned project as presented in this statement does not include provisions for this purpose. The logical vehicle for transportation of impounded floodwaters will be the main canals of the proposed irrigation water distribution system. Central Arizona Project water allocations have not been set and engineering studies conducted to date by the district are of too general a nature to serve as a basis for designing turnout features in the dams. Also water rights have not been secured.

Costs for gated outlets and associated features would be a nonproject cost ineligible for Public Law 566 fund assistance.

e. Water Supply for Construction

There is no dependable surface water supply within reasonable haul distances of the project. Groundwater is available from existing high-capacity irrigation wells within 1/4 to 5 miles of the proposed structures. Groundwater use for compaction and dust control will consume an estimated 484 acre-feet of water. Transportation will be by temporary pipelines or tank trucks. Upon completion of construction, pipelines, sumps, and other equipment will be removed. Natural conditions will be retained or restored as much as possible.

f. Groundwater Recharge

Temporary impoundment of floodwaters behind Saddleback F.R.S. and Harquahala F.R.S. will contribute an estimated 350 acre-feet per year of recharge to the Harquahala Plains Groundwater Basin.

g. Turbidity of Streams and Lakes during Construction

Turbidity resulting from construction of the structure will be insignificant. There are no perennial streams in the watershed.

5. Visual and Audio Aesthetics

a. Landscape Disturbance

Harquahala F.R.S. will be at a distance of 1.5 to 3 miles north of Interstate 10. The structure will blend with the horizon and should not present an unpleasing vista for highway travelers. Saddleback F.R.S. will be visable from both Interstate 10 and Courthouse Road. The low height of the dike will minimize impacts but it will still present a departure from the natural desert setting. The northern end of Centennial Levee will be visable from the eastbound land of Interstate 10.

Until vegetation is re-established following construction, the work areas of all structural measures will present an unpleasing departure from the natural environment. (See Figures P29 and P30 for appearance of similar type structures.)

b. Traffic, Litter, Noise

Traffic and the possibilities of accidents will increase during the construction period. Safety provisions will be included in construction specifications. Contractors will be required to provide flagmen or guards to control public traffic and construction equipment with a minimum of delay and inconvenience to the public.

Construction activities generate waste products such as wasted concrete, wooden forms, oil and grease spillage, packing boxes, etc. All waste products will be collected and disposed of. Work sites will be maintained and left clean.

Large construction equipment produces a relatively high level of noise. Construction specifications will set minimum allowable noise emission. Due to the remoteness of the project, no great disturbances are expected.

c. Lighting and Blasting

The project is in an area of extreme desert heat. To provide tolerable working conditions and utilize equipment in an economical manner, it is a common practice to work at night. Due to the remote setting, the lighting will not affect populated areas but nocturnal wildlife will be temporarily disturbed.

Blasting may be required to excavate the emergency spillway for Harquahala F.R.S. The closest residence is about 2 miles south of the site. Disturbance of the public should not be a problem; however wildlife will be temporarily disturbed.

d. Borrow Areas

Borrow for the construction of Harquahala F.R.S.

Figure P29. Typical floodwater retarding dam (McMicken Dam - Corps of Engineers).

Figure P30. Typical floodwater retarding dam showing canal on the downstream side of embankment. (McMicken Dam - Corps of Engineers.)

will come from excavation of the Granite Reef Aqueduct. Borrow for the construction of the dikes of Saddleback Diversion and Centennial Levee Reach 1 will come from low flow channels upstream of the dike. Borrow for Saddleback F.R.S. and Centennial Levee Reach 2 will come from borrow pits. Excavation will be located so as to minimize vegetative disturbances. Pits will be shaped and contoured to blend as much as possible with the surrounding terrain. Banks will have gradual slopes to prevent erosion. The area will be scarified or ripped to entrap moisture and seeded or treated to induce revegetation.

e. Construction Access Roads and Work Sites

Roads and storage areas will be located within the right-of-way wherever possible and closed to the general public. After completion of construction, disturbed areas will be restored as nearly as possible to the original condition. Roads will be scarified and seeded. As the project is in an area of extremely low rainfall and revegetation is a slow process, the roads and work sites may be devoid of vegetative cover for a number of years.

All roads constructed will be unsurfaced and of a temporary nature to be used primarily for large earthmoving equipment. There will be no access roads constructed on the downstream side of the structures except for those required immediately adjacent to the embankments. None are needed. The borrow for Saddleback F.R.S., Saddleback Diversion and Centennial Levee Reach 1 will come from the upstream side within the flowage areas. The borrow for Harquahala F.R.S. will come from excavation of the Granite Reef Aqueduct. There is a slight possibility that borrow for Centennial Levee may come from offsite downstream areas, however, a more feasible source will probably be from an enlargement of the borrow areas for Reach 1 or from Allison Tank.

f. Open Space

The project will retain 9,060 acres as open space, including 3,120 acres occupied by the flood pools and 5,940 acres on Centennial Wash associated with the land rights requirement for the 100-year frequency event.

6. Air Quality

Public health agencies in the State responsible for air quality standards do not maintain a monitoring system in the project area.

Dust levels at, and adjacent to, the construction sites is the only air quality parameter that will be affected by construction. Construction specifications will call for appropriate measures to control dust arising from construction

operations. Dust levels may rise in rare instances. Discomfort to people will be insignificant due to the remoteness of the area.

7. Vector Control

Information on the presence of mosquitoes in the project area is contained in the letter of June 30, 1976, from the Vector Control Specialist, Arizona Department of Health Services. This letter is shown in Appendix C.

The Vector Control Specialist advises that the retention of floodwaters for a week or more may result in ideal mosquito breeding habitat and that stagnant water may be well suited to development of Culex tarsalis, the primary vector of arbovirus encephalitis.

There are three ways that the project will have an impact in regard to vectors. First, the land treatment program will reduce the ponding of irrigation waters in which mosquitoes may breed. Specific practices that will assist in this include land leveling, irrigation ditch lining, and proper application of irrigation water. Second, the planned structural measures will reduce ponding of floodwaters in low areas, along field borders, and in other areas where floodwaters remain and stagnate after floods. Third, the project will create areas integral to the structures where floodwater will be stored until depleted by evaporation, seepage, or wildlife and livestock use. These areas include Basins No. 1 and No. 2 in Saddleback F.R.S. (both basins can be drained); the borrow pit areas for Saddleback F.R.S. (provisions for drainage will be decided in final design); a pool area for Harquahala F.R.S. (can be drained); and possible nondraining borrow pit areas for Centennial Levee. The total storage capacity in all of these areas is approximately 550 acre-feet. Their construction is contingent upon securing water rights. The areas will eventually fill with sediment, however, in the interim they will allow possible stagnation of water and potential mosquito breeding.

The relative degree of impact between these three sources cannot be ascertained with any degree of accuracy. The prevention of ponding will be beneficial. The planned storage may be adverse. The resulting problem however does not measurably detract from the desirability of creating a limited amount of storage in a desert area critically deficient in surface water.

Vector problems should not be significant. No mosquito problems are evident at the existing impoundments in or adjacent to the watershed. There are only 275 permanent residents in the watershed. Maricopa County Planning and Zoning does not project any urbanization in the watershed at least up to the year 2000.

Most of the present population is concentrated in the Harquahala Valley community, which is 5½ air miles from Saddleback F.R.S. Basin No. 1, 6½ air miles from Saddleback F.R.S. Basin No. 2, 10 air miles from Harquahala F.R.S., and 6½ air miles from Centennial Levee.

There is limited subdivision activity in Harquahala Valley. The most active at present is probably Harquahala Valley Ranches, located south of Centennial Wash. This subdivision is 11 air miles from Saddleback F.R.S. Basin No. 1, 16 air miles from Harquahala F.R.S., and 9 air miles from Centennial Levee.

There are three areas zoned for subdivision in close proximity to Saddleback F.R.S. There are no residences in one. The other two consist of 3 or 4 homes or trailers, the nearest being 3/4 mile from Saddleback F.R.S.

Isolated development could occur anywhere in the valley, however, past trends indicate very limited future development. Any probable areas of projected development have not been evaluated.

Responsibility for vector control lies with the Maricopa County Department of Health Services. The Flood Control District of Maricopa County will monitor the storage areas on a regular basis and notify the County Department of Health Services if vector control is needed. The Operation and Maintenance Agreement between the Soil Conservation Service and the Flood Control District will contain appropriate provisions for vector control.

8. Modification of Places of Archaeological, Historical, or Scientific Value

Information on cultural resources and the surveys conducted by Arizona State University has previously been presented. (See pages 28 and 62.) Arizona State University located several archaeological and historical sites. Appropriate investigation and recording of the sites was accomplished by the survey team. The archaeologist's opinion is that none of the sites are of significant value to warrant inclusion in either the Arizona or National Register of Historic Places. If any more sites are located, the procedures in Public Law 93-291 will be followed.

The National Register Property, Harquahala Peak Observatory, is located in the extreme northwest corner of the upper watershed approximately 16 air miles over severe terrain from the nearest point of proposed construction. The State Historical Preservation Officer has stated that the project will have no impact on this property.

The influx of construction personnel will mean greater human activity in the watershed. An increase in activity will also be evident after completion of construction. People invariably tend to want to "inspect" structures after completion. This increased human activity could result in disturbance of some archaeological or historical values in other parts of the watershed or adjacent area. The degree of disturbance cannot be quantified.

9. Watershed Access

a. General

All of the structures will limit access. The degree will vary by structure. The major restriction will be by Harquahala F.R.S. The dam extends 11.5 miles. A road crossing over the dam will be provided to match a crossing over the Granite Reef Aqueduct at the only intersection with a recognized road (in section 21, T3N, R9W). This road will be closed during periods of flood detention. Rerouted traffic will have to come in from Eagle Eye Road. A traveler desiring to reach the abandoned mine in section 15, T3N, R9W, from Harquahala Valley would have to detour in from the north and travel an extra 22 miles. (See Project Map.)

Saddleback F.R.S. will not significantly restrict access. There will be two road crossings over the dam.

Saddleback Diversion will intersect several unimproved roads located in an idle subdivision in section 4, T1N, R8W. The sponsors will provide road crossings as needed. The diversion will also limit access to the west slopes of Saddleback Mountain. The majority of this land is U.S. Bureau of Land Management administered land. There also are about 350 acres of State Trust land on the east, or upstream side of the diversion. No private lands are involved. There are no existing roads in the area. Providing road crossings over the diversion would not be a major undertaking. The dike is low. The U.S. Bureau of Land Management has been consulted about the location and number of possible crossings. Their plans are not firm at this time. The number of road crossings to be provided, if any, will be negotiated between the project sponsors and the U.S. Bureau of Land Management prior to construction.

Centennial Levee will limit free access on the western side of Harquahala Valley. One individual has expressed concern about access in this area. (Refer to Appendix C, letter of June 4, 1976, from E. Billie Bennett). The number and location of any road crossings to be provided over Centennial Levee will be negotiated between the project sponsors and interested parties. Some shifts in existing policy or other

adjustments may be required. Present Maricopa County policy is to provide road crossings only on dedicated rights-of-way. The Harquahala Valley Irrigation District has plans for an irrigation main canal to transport water from the Granite Reef Aqueduct. This canal is to be located immediately downstream of Centennial Levee Reach 1. This canal, which will also limit access, will be a factor in the final determination of road crossings over Centennial Levee.

b. Livestock and Wildlife Movement

Harquahala F.R.S. will extend 11.5 miles across a single range allotment. The dam proper would not restrict animal movement. However, as the Granite Reef Aqueduct will be immediately downstream an effective barrier does exist. Crossings are planned over the aqueduct. These crossings will match corridors in the fencing in Harquahala F.R.S.

The fencing to protect vegetation will also limit uncontrolled free movement, however, corridors will be placed in this fencing to allow movement of big game and livestock.

c. Road Modification and Closure

Harquahala F.R.S. will intercept and obstruct movement on numerous roads and trails created by off-road vehicles.

The unpaved Buckeye-Salome Road lies within the flood pool area of Saddleback Dam. It is estimated that impounded floodwaters will close this road an average of one day per year. The light use of this road consists primarily of travel by local residents. A detour of about 5.8 miles would be possible either on Courthouse Road or Interstate 10. (See Project Map.)

Approximately 440 feet of Courthouse Road is lower than the top of Saddleback F.R.S., however, the road is higher than the elevation attained by the 100-year frequency flood event. It would take a rare event greatly in excess of the 100-year storm before floodwaters behind the dam would close the road. If this event were to occur, the road would probably be closed by storm runoff at other nonrelated wash crossings.

Courthouse Road will also cross Centennial Levee on the west side of Harquahala Valley. The road is unpaved through this reach. It provides access to Centennial Farm. An earth ramp crossing is planned. Frequency of road closure will be essentially unchanged from present conditions.

Written permission to flood these roads will be obtained before installing the structures.

10. Social and Economic

a. Land Requirement and Tax Base

The securing of required right-of-way for the proposed structures will remove a minimum of 1,560 acres of private land from the tax rolls and possibly 6,677 acres, depending upon the type of land rights obtained for the 100-year flowage easement on Centennial Wash. Minimum net tax loss will be $13,000 per year. The project will also require 1,681 acres of State Trust lands and 2,107 acres of public lands administered by the U.S. Bureau of Land Management.

b. Health and Safety of Watershed Residents

Threat of loss of life will be greatly reduced. Health problems due to flooding of cesspools and domestic wells will be virtually eliminated. Another benefit, unmeasurable in monetary terms, will be the peace of mind of the residents.

c. Local Sociological Impact

The influx of construction personnel into Harquahala Valley will tax local facilities. At least some construction personnel will be expected to find local housing and related community services. Few of the necessary services are available in Harquahala Valley. Additional school facilities are not anticipated. Impacts will be felt in Buckeye and Salome.

d. Land Use Changes

The project is not expected to stimulate any land use changes in the irrigated lands of Harquahala Valley. However, the structures will provide flood protection to 27,300 acres of unimproved land that is presently subject to flooding, primarily from sheet flows. This includes 10,480 acres of private, 5,300 acres of State, and 11,520 acres of public lands administered by the U.S. Bureau of Land Management. A change in ownership and/or land use should not occur on the protected State or Federal public lands for many years - if ever. However, the private lands will be more suited for development than at present. Some subdividing of these lands could occur. It is possible that by reducing losses, marginal lands will stay in production longer if water supply becomes scarce.

11. Reoccurring Operation and Maintenance

No significant impact is expected from these activities. Maintenance personnel will be in the area on an infrequent basis. Some temporary dust problem and wildlife disturbances could be caused by travel at the sites. Minor expenditures may be made locally in renting backhoes or trucks to remove debris.

12. Downstream Impacts

Downstream is defined as being that area from the mouth of the watershed to Gillespie Dam on the Gila River. It includes a 23 mile length of Centennial Wash from the watershed mouth to junction with the Gila River and another 2 miles along the Gila River to the dam.

Impacts include flooding on downstream improvements, underground water supplies, surface water supplies, and sedimentation, and other environmental considerations. Discussion includes both the effects of the project on peak discharges and watershed yield and long duration flows from the project dams.

a. Downstream Flooding

The first improvement is about 13 miles downstream of the watershed mouth in section 24, T1S, R7W, where an 80 acre field has been cleared for irrigated agriculture within the Centennial Wash floodplain. The wash has been channelized to the south around this development. Flow from Winters Wash enters Centennial Wash 15½ miles downstream on about a 2 mile front. Southern Pacific Railroad tracks cross where the washes comingle. There are two 300 feet long wooden trestles where the railroad crosses Centennial Wash proper and another two 300 feet long trestles about 1½ miles to the northeast.

The major downstream development occurs in the Arlington Valley area. The Arlington Canal crosses Centennial Wash about 2 miles above the Gila River. The entire Centennial Wash floodplain in this reach has been completely developed into agriculture. There are no defined channels. Large flows spread out through the irrigated lands seeking a course to the Gila River.

The project dams will control 132 square miles of the total 1,810 square miles above the Arlington Canal. U.S. Bureau of Reclamation Tiger Wash Detention Basin will control an additional 166 square miles.

The evaluation of downstream flooding potential is a study of probabilities. The project will not have any measurable downstream impact if a 100-year storm should occur for the total Centennial Wash drainage area. The floodwater retarding effect of the project dams is offset by the fact that Centennial Levee will prevent floods from spreading out over Harquahala Valley and thus decrease downstream peak discharges.

Peak discharges at the downstream railroad crossing resulting from a 100-year storm occurring only above Harquahala F.R.S., Saddleback F.R.S., Saddleback Diversion and Centennial Levee Reach 1 will be reduced by 84 percent - from 17,190 cfs to 2,700 cfs. Flood damages will be reduced accordingly.

Peak discharges at the Arlington Canal, resulting from a 50-year storm occurring only above Saddleback Diversion will be increased by one third - from 3,000 cfs to 4,000 cfs. This is because the diversion prevents flows from spreading out over the irrigated lands of Harquahala Valley. Centennial Wash can easily handle this flow without damage to improvements for the entire reach except through Arlington Valley, where there are no channels.

Centennial Levee will modify flow conditions on Centennial Wash. Flood flows presently spread out through Harquahala Valley and peaks are reduced. The peak discharge at the downstream railroad resulting from a 100-year storm occurring only over the drainage area controlled by Centennial Levee will be increased by one third - from 15,000 cfs to 20,000 cfs. This is assuming the Tiger Wash Detention Basin is in place. Railroad drainage facilities are adequate to convey this flow; however the irrigated lands in Arlington Valley will be adversely affected.

An attempt has been made here to reflect the worst possible conditions in regard to the potential of flooding in the Arlington Valley area. It should be borne in mind, however, that all of the irrigated lands that are subject to flooding from the Centennial Wash drainage area lie within the flood prone area of the Gila River as determined by the U.S. Geological Survey.

b. Downstream Groundwater Supplies

Runoff from high frequency rainfall events occurring in the drainage areas above the floodwater retarding structures will be effectively contained by the structures. The highest percentage of recharge occurring from project impoundment will occur within the Harquahala Plains Basin. Downstream recharge will be greatest when larger storms occur. High flows will be slowed, routed around the water absorbing agricultural lands of Harquahala Valley, and released into Centennial Wash at a nondamaging rate for a longer duration than would occur under pre-project conditions. As the duration of flow is increased, more time is available for water to infiltrate through the bottom of Centennial Wash into the underground system. This amount will not be large. No attempt has been made to quantify the average annual increase in downstream recharge as there will be many years in which no flow at all will occur. It is estimated, however, that for a 100-year event over the project structures, downstream recharge will be increased by about 100 percent over pre-project conditions.

c. Downstream Surface Water Supply

Gillespie Dam serves as a diversion point for

two canal systems, the Gila Bend Canal on the east and the Enterprise Canal on the west. Neither are dependent upon flow from Centennial Wash.

U.S. Geological Survey gage records at a measuring station on Centennial Wash about 1 mile upstream from the Gila River show that for the 12 year period between 1962 and 1973 there was no flow recorded for 123 months out of the total 144 months of record.

The impact of the project on downstream surface water supplies is minimal. Of the total 1,810 square miles of drainage area at the gaging station, the project dams will slow runoff rates from about 132 square miles or less than 8 percent of the total drainage area.

d. Other Downstream Environmental Considerations

The 100-year storm event would be released from the project dams in about 10 days. Over this period, project flow rates would decrease from a high of 500 cfs to no flow. This flow should aid the growth of vegetation along the course of Centennial Wash and make water available for a longer period for use by wildlife. The flow should all infiltrate before reaching downstream irrigated lands in the Arlington Valley area and the Gila River.

13. Land Subsidence and Earth Cracks

Irrigation pumpage in the project agricultural areas has resulted in substantial lowering of the water table. Similar situations throughout the State have been accompanied by land subsidence and earth cracks.

The Soil Conservation Service and the Arizona Water Commission have examined the basin searching for any land disturbances. In 1966, an earth crack was discovered in the SW¼ section 36, T2N, R9W. This location is approximately 3½ miles west of Saddleback F.R.S. The earth crack was backfilled with 5 to 6 feet of compacted soil and to date no settlement has been noted. The land subsidence appears to have been an isolated case, and there have not been any reported occurrences since that time. Its location is not in the vicinity of any proposed structures, however, it does underscore the potential for subsidence within the project area.

Aware of the subsidence potential, the U.S. Bureau of Reclamation has conducted precise leveling surveys along the Granite Reef Aqueduct alignment. The surveys were started in 1971 and to date no appreciable subsidence has been recorded.

Earth cracking can occur in an erratic pattern and cannot always be predicted even with detailed studies. None

of the structures are located over known zones of subsidence and earth cracks. Known zones will be avoided. High hazard dams will not be constructed in zones that are susceptible to earth cracking.

C. Economic and Social Impacts

Project construction will provide jobs for about 150 skilled and 45 unskilled laborers. Locally, monetary impacts from construction are expected to be slight since there are no significant retail or service establishments in the watershed. Most impacts will occur on a regional basis primarily in the Salome, Buckeye, and Phoenix areas. The most significant economic impact will be from reduction of flood damages. The estimated average annual reduction of $433,900 will result in an equal amount of economic improvement. Reduction of flooding to farmland and the interstate highway will provide a more stable economic base to agriculture in the watershed and relieve travelers of the inconvenience of long and costly detours off the interstate system.

The future land use plan for Maricopa County indicates that the major activity in the watershed area will continue to be agriculture well into the future. Project construction will span a four-year period but will probably not spawn the development of substantial nonagricultural activity.

D. International Impacts

The only known international impact from the project is in regard to the employment of Mexican nationals. Many are employed on the irrigated farms in Harquahala Valley. They will benefit from a more stable agricultural base free from floodwater, erosion, and sediment damages. Construction of the structural measures may provide some direct or spin-off employment.

E. Favorable Environmental Impacts

The land treatment measures will reduce floodwater, erosion and sediment damages, reduce irrigation water seepage losses, provide for more efficient use of applied irrigation water, reduce farm labor inputs, provide some aquatic habitat, reduce air pollution from blowing dust and stubble burning, and reduce ponding of waters where mosquitoes can breed. Proper grazing use on the upstream watershed will prevent further deterioration of the land.

The proposed structural program will reduce floodwater, erosion and sediment damages to improvements in Harquahala Valley by 59 percent.

Centennial Levee will prevent the uncontrolled sweep of floodwater through the irrigated lands of Harquahala Valley.

The project will protect a proposed $5,595,000 irrigation distribution system, including 14.5 miles of main canal.

The project will protect a 10½ mile reach length of the proposed Granite Reef Aqueduct and reduce damages to a 9 mile length of Interstate 10.

The project will reduce the reoccurring floodwater damages to Gin Road and other roads, utilities, residents, etc.

New vegetative growth will be induced due to temporary impoundment of floodwaters and increased flow along some watercourses.

The quality of the few surface water impoundments in the watershed that are downstream of the structures will be improved due to a reduction in high sediment concentrations.

The project will reduce health hazards arising from floodwater contamination of domestic wells and underground supplies and ponding of water in which mosquitoes breed.

Approximately 430 acre-feet of surface water storage will be created within the flood pool and borrow pit areas of the structures. This does not include any additional storage to be gained if Allison Tank is enlarged as a source of borrow for Centennial Levee or nondraining borrow areas (up to 120 acre-feet) are used for the levee.

The existing quantity of surface water yield available to stock tanks will be increased.

An estimated 350 acre-feet per year will be contributed as recharge to the Harquahala Plains groundwater basin.

The planned vegetative treatment program will create new vegetation for wildlife use.

The project will retain 9,060 acres as open space.

Threat of loss of life from floods will be greatly reduced. Peace of mind of the residents will be enhanced.

During construction it is estimated that the construction and inspection personnel will spend $300,000 in Harquahala Valley, Buckeye and Salome. The project will provide temporary employment for a few local residents.

F. Adverse Environmental Effects

Native desert vegetation will be removed and wildlife lost from about 780 acres of land, including 36 acres of trees

a pseudoriparian nature. Some vegetation will either die or be heavily stressed due to diversion of existing watercourses.

About 1,530 acres of creosotebush below the structures may die or be heavily stressed by the elimination of sheet flooding.

An estimated 335 saguaro cacti and a few night blooming cereus will be affected by construction of the project. Both species are considered rare and endangered.

The project could induce salt cedar intrusion into the borrow pit areas.

Approximately 484 acre-feet of groundwater will be consumed by construction activities.

All of the structures will present a permanent visual departure from the natural setting.

There will be unavoidable noise, dust pollution, visual distractions from the natural setting, increased traffic, and other public inconveniences associated with normal construction activities. Wildlife will be temporarily displaced by noise and lighting.

Semipermanent storage areas created will allow possible stagnation of water and potential mosquito breeding.

All structures will limit accessibility to some sectors of the watershed.

Increased travel time will be required to detour around some structures due to road closure by floods.

Approximately 10,472 acres of land will be removed from possible future development due to construction of the structures. The tax base will incur a minimum loss of an estimated $13,000 per year.

Some local community disruption will result from an influx of construction personnel.

Although no significant archaeological and historical sites have been identified at the structure sites such values as do exist elsewhere in the watershed and adjacent areas will be prone to disturbance and vandalism from increased human activity.

Infrequent maintenance activities may temporarily disrupt wildlife and cause minor dust problems.

SECTION VI

ALTERNATIVES

VI. ALTERNATIVES

A. Alternative of Accelerated Land Treatment Only

The majority of floodwater, erosion, and sediment damages in the watershed occur to improvements in Harquahala Valley. Damaging floodwaters come from 341.8 square miles of watershed drainage area adjacent to the valley and 675 square miles of Centennial Wash drainage area. The control of floodwater by land treatment measure would require a structural and vegetative program on the total 1,016.8 square miles.

Since 1954 the U. S. Bureau of Land Management has conducted an intensive land treatment program on Centennial Wash. The program consists of two large dams that meter floodwater out to approximately fifty downstream waterspreading dikes. This system has been very effective in healing headcuts, preventing gully and sheet erosion, increasing vegetative growth and improving wildlife habitat. However, as shown on Figure 1, Centennial Wash Flood of 1960, flood damages along Centennial Wash have not been reduced to acceptable levels.

In this arid climatic area adequate amounts of vegetative and structural land treatment measures could not be installed and maintained to prevent flooding in Harquahala Valley. Legal restraints imposed by downstream water rights limit the applicability of structural land treatment measures on upstream watersheds in the State of Arizona.

B. Alternative of Nonstructural Measures

The nonstructural measures considered in combination with an accelerated land treatment program included floodplain zoning, floodproofing, flood insurance and outright purchase of improvements subject to damage.

Under the authority of the State Flood Control Act of 1973, Maricopa County has enacted floodplain regulations governing developments in floodplain areas. The county, however, has not delineated the floodplain in Harquahala Valley.

When fully implemented and enforced, county floodplain regulations will prevent flood damage to new nonagricultural developments. They will not prevent damage to new agricultural developments. They will not prevent damages to the existing improvements or to agricultural development in the valley.

Floodproofing is the installation of individual protective devices for existing property. The floodproofing measures

considered included raising of floor levels, protective berms/ channels, watertight closure doors, relocation of structures, and protective structural walls. A limited number of improvements in Harquahala Valley could be effectively floodproofed by employing these measures either singularly or in combination. The structures most receptive are the elementary school and the cotton gin. Protective berms could be placed around these units at an estimated cost of $15,000. To prevent floodwater from entering irrigation wells, protective concrete structural walls could be placed around the pumps and engines/motors at an estimated cost of $1,850 for each well. To prevent floodwaters and sediment from entering the tailwater pumpback sumps, protective dikes could be placed around these sumps at an estimated cost of $3,600 for each sump. Buried gas lines and telephone cables could be lowered to prevent washout.

Floodproofing measures are not applicable to crops, land, farm roads, irrigation ditches, livestock, county roads, Interstate 10, and most of the residential, commercial and industrial buildings. Most buildings are set on concrete slabs and for the most part with less than six inches of elevation between the floor and natural ground. It would be very expensive to attempt to raise these buildings.

The floodproofing alternate was investigated without regard to legal constraints or what impact individual measures would have on adjoining or downstream properties and improvements. Dikes, channels, protective berms, protective walls, etc., cannot be placed so as to protect an individual without the possibility of inducing damages to others. Because most of the improvements in Harquahala Valley cannot be practically floodproofed, the planned structural program would still be required.

Flood insurance would reduce the local adverse economic impact of flooding on owners of existing developments; however, the financial burden would transfer to other sectors of the national economy. No net benefit would be realized.

The outright purchase of all improvements in Harquahala Valley that are subject to floodwater damages would require an expenditure in excess of an estimated $50,000,000 (1974 costs). Approximately 16,000 acres of developed and highly productive irrigated cropland would be removed from the national economy.

C. Alternative of Installing the Approved 1967 Plan with Revisions [2]

Details of the approved 1967 Plan are contained in the publication, "Watershed Work Plan - Harquahala Valley Watershed - U.S.D.A. - Soil Conservation Service." Proposed structural

measures included two floodwater retarding structures (Burnt Mountain F.R.S. and Big Horn F.R.S.); two floodways (Burnt Mountain and Big Horn); three diversions (Saddleback, Burnt Well, and Little Horn); and one levee (Centennial Levee).

The plan was completed prior to the construction of Interstate 10. The highway has now been completed and it crosses the alignment of two of the proposed structures, Saddleback Diversion and Big Horn Floodway. No crossings were provided through the highway for these units.

The extremely high expense and requirement for traffic control involved in crossing Interstate 10 eliminates the installation of the 1967 Plan without some revision. During the investigations for this statement, studies were conducted to revise the 1967 Plan.

The installation of the Revised 1967 Plan would cost an estimated $10,540,530 in installation cost of which $9,122,570 would be Public Law 566 costs and $1,417,960 from other funds. Costs reflect updating to current design criteria and 1975 costs. This plan would provide an 8 percent higher level of protection to existing development but would be more costly than the recommended plan.

The environmental impacts would not be appreciably different from those of the recommended plan as presented in the "Environmental Impacts" section except in two major instances. The Revised 1967 Plan would not protect the Granite Reef Aqueduct or the proposed western main canal of the Harquahala Valley irrigation water distribution system. Protection features for these facilities would still have to be constructed with resulting dual adverse environmental impacts. Burnt Mountain F.R.S. would be located one-half to one mile above Interstate 10, creating aesthetic distraction.

D. Major Alternatives in the Selection and Design of Components of the Recommended Plan

1. Alternative of Dam across Main Watercourse of Centennial Wash

The project sponsors and other interested parties have suggested that a dam be constructed across the main watercourse of Centennial Wash as a substitute for the proposed Centennial Levee.

The total drainage area of Centennial Wash at a point

immediately above Harquahala Valley is approximately 652 square miles or 417,280 acres. This exceeds the authorization limit of 250,000 acres maximum under Public Law 566 and consequently is beyond the jurisdiction of the Soil Conservation Service. Although a dam could conceivably be constructed by other agencies or groups, there is not a good efficient damsite anywhere on Centennial Wash that is close to Harquahala Valley. The most efficient site is 23 miles upstream at the location of the existing Narrows Dam. This dam could possibly be enlarged, however, the site is geologically suspect. There appears to be a fault on the left abutment and sinkholes have appeared in past instances in the flood pool.

A dam constructed across the wide alluvial floodplain nearer to Harquahala Valley would be expensive. Rough estimates of such a structure are $12,000,000. This greatly exceeds the installation cost of Centennial Levee without a corresponding increase in flood reduction benefits.

2. Alternative of Channelization of Centennial Wash

It has been suggested that the main watercourse of Centennial Wash be restricted and channelized through Harquahala Valley. The proposal would require dikes on the west side of the valley to funnel the existing widespread sheet flow into a confined channel. The channel would extend 13 miles through the valley. This channel system could not be constructed under the authorities of Public Law 566 because of the same restraints on drainage area size as discussed in number 1 above.

A channel of design capacity equivalent to the protection afforded by Centennial Levee would cost an estimated $1,500,000 (1974 prices). Extensive stabilization measures would be required to prevent channel scour and degradation. Level of benefits would remain the same as in the recommended plan.

3. Alternative of Installing a Channel System in Place of Saddleback F.R.S.

This alternative would replace Saddleback F.R.S. with a channel system constructed through the developed areas of Harquahala Valley.

Channels would be constructed along the east section lines of sections 20 and 29, T2N, R8W; along the north and east section lines of section 33, T2N, R8W; along the north section line of section 32, T2N, R8W; and a channel would extend 4 miles due south from the northwest corner of section 32 outletting

into a natural low area on the east side of Harquahala Valley in the northeast quarter of section 19, T1N, R8W. The system would involve 6.5 miles of channel construction with flowage easement on an additional 4 miles. A total of 4.3 miles of dikes would be required at the beginning to funnel overland sheet flooding into the system.

Installation cost of the plan is estimated at $7,499,190 of which $5,456,030 would be Public Law 566 funds and $2,043,160 would be from other funds. This compares to $1,041,970 for Saddleback F.R.S. The system would be designed for the 25-year frequency event. Due to excessive slopes, channel stabilization measures would be required on 6.3 miles of the system. Right-of-way requirements would be 324 acres of which 182 acres are irrigated land. Three miles of concrete irrigation ditch, about 2½ miles of field ditch, and an unpaved landing strip would require relocation. A concrete box culvert crossing would be installed at the Courthouse Road crossing. Dip crossings would be installed at six farm road crossings.

This system would be free draining with no surface water storage. Vegetative disturbances would be insignificant.

The plan would cause some conflicts with the proposed irrigation water distribution system for Harquahala Valley. The eastern main canal would not be protected and at least one channel crossing would be required. Final design and layout of the laterals has not been attempted. There are apparent conflicts between the channel plan and preliminary lateral layout. The channel system would cause inconveniences in day-to-day farming operations.

4. Alternate of Multi-Purpose Storage in the Proposed Dams

This plan was investigated at the request of the Harquahala Valley Irrigation District. Extra storage capacity would be added so floodwater impoundments could be used for irrigation.

The lack of a dependable and predictable rainfall in this watershed prevents irrigation storage as a project purpose.

5. Alternate of Substituting a Floodwater Retarding Dam for Reach 1 of Centennial Levee

This plan would replace Reach 1 of Centennial Levee with a dam. The dam would be an earthfill embankment, 19,405 feet in length, with a maximum height of 24.7 feet. The dam would provide protection from the 100-year flood event with floodwater storage of 7,500 acre-feet plus 360 acre-feet of

storage for the 50-year sediment accumulation. Maximum floodwater release of 480 cfs from the principal spillway would be conveyed to Centennial Levee Reach 2 through a stabilized floodway. An 800 foot wide earth emergency spillway would be placed around the right end of the dam outletting into Centennial Wash. The dam and flood pool would require 1,240 acres of land. Approximately 200 acres of vegetation, primarily creosotebush, would be cleared by construction activities. The total cost of the dam would be an estimated $2,509,000 of which $2,116,330 would be Public Law 566 funds and $393,370 would be other funds. The cost of this dam greatly exceeds the estimated $335,690 cost of Centennial Levee Reach 1 without increasing flood protection benefits.

6. Alternate of Extending Centennial Levee [2]

This plan would extend Centennial Levee a distance of 34,700 feet. An analysis was made to determine the feasibility of this alternative which would provide additional protection to about 1,080 acres of land within the floodplain of Centennial Wash. The levee would consist of an earthen embankment ranging in height from 3.0 feet to 10.4 feet. The height where the levee would cross Gin Road would be about 7.5 feet. The levee would protect against the 100-year flood event. Velocity of flow at the base of the levee would range from 3.1 to 7.5 feet per second. The levee would have conduits through the embankment at approximately 1 mile intervals to allow for interior drainage from adjacent lands. Flapgates on the Centennial Wash side of the levee would prevent Centennial Wash flows from flowing backward through the conduits and onto adjacent properties. A bridge would be required at Gin Road and approximately 1,000 feet of the road would have to be raised to provide for smooth traffic over the embankment. With the extension, the floodplain easement area of Centennial Levee would be decreased from 2,305 acres to 1,575 acres and the cultivated land subject to flooding would be decreased from 1,080 acres to 730 acres. The levee extension would provide an average annual flood prevention benefit of $7,994 at an increase in average annual costs of $26,210. The ratio of average annual benefit to average annual cost is 0.3:1.

E. Alternative of No Project

The alternative of no project action has been considered. No project action is defined as there being no action under any authority and none of the structural measures or alternatives as described in this statement would be constructed.

It must be recognized, however, that some form of floodwater protection for the authorized Granite Reef Aqueduct is required. The proposed Harquahala F.R.S. would provide this

protection under Public Law 566. It must be assumed that if this dam is not undertaken as a part of the planned project, it will be constructed by the U.S. Bureau of Reclamation in conjunction with construction of the aqueduct. The Bureau of Reclamation has so stated this intent.

Regardless of what authority is used to construct Harquahala F.R.S., the conditions and impacts as described in this statement will apply. No construction of flood prevention measures is foreseen in this watershed except for those features herein described. Local people do not have the financial resources to install measures equivalent to those described in this statement without assistance.

The on-going land treatment program would continue, however, the objectives of the project would not be accomplished nor would any of the impacts occur, beneficial or adverse. The problems as described early in this statement would continue.

If no project is installed there will be continued floodwater, erosion, and sediment damage to existing improvements and future agricultural improvements. Existing State and county floodplain regulations would prevent floodwater damage to future residential developments. There will be some lag time before these regulations will become fully effective. Economic growth in the area below the proposed structures will be inhibited and there will be further health and sediment problems.

The alternative of no project will not prevent the existing widespread sweep of Centennial Wash flood flows through the heart of Harquahala Valley. Development of this floodplain area, particularly to urban types of lands will be severely inhibited.

Interstate 10 will continue to be subject to the same kind of damages as occurred in 1971 and 1972 and described in the "Problems" section of this statement. Erosion of Gin Road will continue. Major damages will be sustained to the proposed irrigation water distribution system.

The dire shortage of surface water impoundments in the watershed will not be improved.

Disturbance to aesthetics and wildlife by construction activities will not occur. There will be no landscape scarring or unpleasing visual effects to detract from the natural desert setting. Land required for the proposed structures can remain in current ownership and use.

Without the project it is estimated that $67,800 average annual net benefits will be forgone. This does not include the unevaluated net benefits to be realized from protection of the Granite Reef Aqueduct, Interstate 10, the proposed irrigation distribution system mains and laterals, and future agricultural and any urban type developments.

SECTION VII

SHORT-TERM vs. LONG-TERM USE OF RESOURCES

VII. SHORT-TERM vs. LONG-TERM USE OF RESOURCES

A. Project Compatibility with Land Use Trends

The project is compatible with both short-term and projected long-term land use trends. There are three areas to consider: (1) land above the structures; (2) land physically occupied by the structures; (3) land below and protected by the structures.

The land above the proposed structures is 100 percent rural, uninhabited, rangeland primarily under State or federal administration. The only known incompatibility with present or future use is that Harquahala F.R.S. will restrict free vehicular access to some of this land. No developments or change in land use is foreseen for any of the land.

The land to be occupied or directly affected by the proposed structures is presently about 60 percent privately owned and 40 percent State Trust or federal. Development could conceivably occur on the private lands occupied by Saddleback F.R.S. or Centennial Levee although such development would be severely restricted by present flooding conditions and high expense required to obtain water from the underground. Whether short-term incompatibility exists or does not exist relative to the 585 acres of presently irrigated lands within the flood easement right-of-way line of Centennial Wash is dependent upon the type of easement to be secured by the project sponsors. If the land is secured by fee simple title, the land may go out of irrigation.

The land below and protected by the proposed structures is approximately 41 percent agricultural and 59 percent undeveloped rangeland. Of the rangeland, about 19.4 percent is State Trust or federal and 38.4 percent is privately held. The agricultural land should remain in current use for the life of the project. Any development here or on the private rangeland will be aided by the flood protection afforded by the project. The project is fully compatible with the goals of the Harquahala Valley Irrigation District to protect not only existing improvements but also a proposed irrigation water distribution system.

B. Solution of Short-Term and Long-Term Problems

The proposed structures will supply an immediate partial solution to flooding problems in Harquahala Valley. Continued application of land treatment measures will provide long-term solutions to the irrigated lands and upstream rangeland before the designed life of the structures is over.

For purposes of economic justification and costing, the proposed structures reflect a 50-year design life. However, the structures will remain effective in protecting land and resource investments for a much longer period.

C. Environmental Considerations

Aesthetically, the area will be permanently altered. Lessening of long-term effects on aesthetic values will be accomplished through strict construction control to minimize vegetative disturbance, restoration of areas temporarily used for constructions, and vegetative plantings or seeding when feasible.

The structures will occupy areas of generally poor habitat. Short-term displacement of wildlife will occur. Construction activities may result in further decreasing use of the Big Horn Mountains and Saddleback Mountain by the desert bighorn sheep. There could be a short-term decline in mule deer or other animals that are presently dependent upon unrestricted access to water or feed in the irrigated lands.

D. Regional and Cumulative Effects [33]

The watershed area is drained by Centennial Wash, a tributary to the Gila River and lies within the Gila Subregion of the Lower Colorado River Region. Within the subregion there are 34 Watershed Project areas that have applied for assistance under Public Law 566 since its enactment in 1954. As of January 1975, four projects have been completed; nine are approved for construction; construction is currently in progress on two; and construction should begin in the near future on four more. Fourteen projects are either inactive or deemed infeasible by the Soil Conservation Service.

No Public Law 566 projects have been completed on the Centennial Wash drainage, however, four applications for assistance have been received; Harquahala Valley, Wenden-Salome, Eagletail Mountains, and Tonopah.

The Wenden-Salome Watershed touches Harquahala Valley Watershed on the west. It is not in an active planning stage. Eagletail Mountain Watershed lies immediately south and west of the Harquahala Valley Watershed. Centennial Wash forms the dividing line between the two. Planning is proposed for this watershed in the near future. Preliminary structural proposals call for the construction of one dam above the irrigated lands that lie south of Centennial Wash.

Tonopah Watershed is east of and borders Harquahala Valley Watershed. The U. S. Bureau of Reclamation is currently investigating a dike in this watershed to be located immediately above and following the alignment of the Granite Reef Aqueduct through the watershed. This dike would be essentially identical in purpose and appearance to Harquahala F.R.S. and the U. S. Bureau of Reclamation's Tiger Wash Detention Basin. It is

doubtful that any Public Law 566 structures will be installed in this area.

Of all projects either authorized or planned for construction in the Gila Subregion, those that are authorized as features of the Central Arizona Project will have the greatest impact on Arizona. U. S. Bureau of Reclamation projects in the near vicinity of the Harquahala Valley Project include the Granite Reef Aqueduct, Tiger Wash Detention Basin, a possible dike in the Tonopah Watershed, and all of the other protective dikes, drainage structures, etc., associated with construction of the aqueduct. In this total scheme the impact of the proposed project structural measures as presented in this statement are considered relatively insignificant.

Other than the small amount of surface water storage proposed in the Harquahala Valley Project and described in this statement, none of the Public Law 566 projects constructed or envisioned in the Gila Subregion have permanent surface water storage. Their cumulative effect on water yield to the Gila River is minimal.

All existing or proposed construction, either Public Law 566 projects or projects of other agencies, will have a cumulative adverse effect on vegetation, wildlife, and aesthetics. The summation of these effects is beyond the realm of this statement.

SECTION VIII

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

VIII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Resource commitments for the construction of the project will take several forms. Resources lost include land, water, vegetation, and wildlife. Fuel, labor, construction materials, and public and private funds will also be required.

A. Land and Water Resources

Land resources committed by this project include the land physically occupied by the structures and flood pools and the additional lands needed for flood easements. It involves federal, State, private, and county lands. About 4,406 acres will be committed to the structures with an additional 5,940 acres in Centennial Wash committed to flood easements. All of the land is only partially committed as it is available for range, wildlife, open space, and perhaps agriculture for the Centennial Wash flood easement.

Construction activities will commit about 484 acre-feet of water for compaction and dust control purposes. About 550 acre-feet will be committed to the proposed surface water storage areas.

All of the land commitments could conceivably be retrieved. If ever required, the structure could be removed and the land allowed to revert to present conditions.

B. Vegetative and Wildlife Resources

The project will require clearing of 780 acres of native desert vegetation. This includes 36 acres of woody vegetation. An additional 1,530 acres of creosotebush downstream of the structures may die or be heavily stressed.

Losses of wildlife due to construction will be minor in terms of total population.

C. Archaeological Resources

Archaeological surveys conducted by Arizona State University identify no significant sites to be affected by construction. More studies may be conducted prior to construction.

D. Economic and Material Resources

The project will require expenditures of both public and private funds. The estimated 1975 cost of the proposed structural program is $9,877,150, of which $8,555,810 are Public

Law 566 funds and $1,321,340 are other funds. Installation of the land treatment measures will require an additional $1,936,000 in other funds.

Material and fuel resources expended will be:

Item	Quantity
Earthwork	9,427,000 cubic yards
Concrete	2,164 cubic yards
(cement)	983,000 pounds
(aggregate)	73,610 cubic yards
Reinforcing Steel	415,000 pounds
Diesel and Gasoline	1,448,000 gallons

Commitments of other resources such as manpower, equipment wear and depreciation, and minor construction items have not been quantified.

SECTION IX

CONSULTATION AND REVIEW WITH APPROPRIATE AGENCIES AND OTHERS

IX. CONSULTATION AND REVIEW WITH APPROPRIATE AGENCIES AND OTHERS

A. General

Studies and investigations in preparation of the original 1967 Watershed Work Plan extended over a period of several years. Numerous agencies, groups, and individuals were consulted and had input into plan development. This coordination and consultation was maintained and expanded upon during the supplemental studies as reflected in this statement.

The statement was developed in consultation with the federal, State and local agencies, groups and individuals expressing interest. Numerous coordination and discussion meetings were held. Open public meetings were held in Harquahala Valley on January 17, 1973, February 7, 1973, September 9, 1974, and May 12, 1976. These meetings were publicly advertised by community postings, notices in newspapers, and verbal invitation to attend. Federal, State and local agencies, environmental groups and other interested parties were given special written notice. For the September 9, 1974, meeting a written notice was mailed to all owners of land required for construction of the structural measures. The May 12, 1976, meeting was held during the interagency review period for the Draft Environmental Impact Statement. Copies of the Draft were available at the meeting.

Continuous coordination has been maintained with the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, Arizona State Land Department, Arizona Game and Fish Department, Buckeye-Roosevelt Natural Resource Conservation District, Harquahala Valley Irrigation District, Flood Control District of Maricopa County, Harquahala Valley Watershed Steering Committee, several concerned individual landowners, and other agencies, groups and individuals.

Consultation on historical and archaeological resources has been made with the Arizona State Historical Preservation Officer, Arizona State Museum, Department of Anthropology of Arizona State University, National Park Service, and the U.S. Bureau of Land Management. Additional archaeological studies may be conducted in the watershed before construction and continuous coordination will be maintained with these agencies. The National Register of Historic Places has been reviewed.

B. Discussion and Disposition of Each Comment on Draft Environmental Statement

The following agencies, groups, and individuals were requested to comment on the Draft Environmental Statement.

Federal Government. (The official distribution of the Draft Environmental Statement to most of the federal agencies was done by the departments at the Washington, D.C., level and not by the Soil Conservation Service. Response is from the department level. The individual agencies shown below are those agencies provided with a copy by the Soil Conservation Service. The list may not be all-inclusive, depending upon the internal distribution policies of each department.)

	Responded
Department of Agriculture	
Director, Office of Equal Opportunity Washington, D.C.	Yes
State Director, Agricultural Stabilization and Conservation Service Phoenix, Arizona	
Regional Forester, Forest Service Albuquerque, New Mexico	
Department of the Army	
Office of Chief of Engineers Washington, D.C.	Yes
Chief, Engineering Division, Corps of Engineers, Los Angeles, California	
Special Assistant to the District Engineer, Corps of Engineers, Phoenix, Arizona	
Department of Commerce	No
Deputy Assistant for Environmental Affairs Washington, D.C.	
Department of Health, Education and Welfare	
Director, Office of Environmental Affairs Washington, D.C.	Yes
Regional Environmental Officer San Francisco, California	
Department of Housing and Urban Development	No
Director, Area Office Los Angeles, California	
Director, Federal Housing Administration Phoenix, Arizona	
Department of the Interior	
Office of the Secretary Washington, D.C.	Yes
Director, Office of Environmental Project Review Washington, D.C.	
Regional Director, Fish & Wildlife Service Albuquerque, New Mexico	
Field Supervisor, Fish & Wildlife Service Phoenix, Arizona	

	Responded
Department of Interior (continued)	
District Chief, Water Resource Division, U.S. Geological Survey, Tucson, Arizona	
Area Director, Bureau of Indian Affairs Phoenix, Arizona	
State Director, Bureau of Land Management Phoenix, Arizona	
SOHIO Project, Bureau of Land Management Los Alamitos, California	
District Manager, Bureau of Land Management Phoenix, Arizona	
Acting Chief, Intermountain Field Operation Center, Bureau of Mines, Denver, Colorado	
Regional Director, Bureau of Outdoor Recreation San Francisco, California	
Regional Director, Bureau of Reclamation Boulder City, Nevada	
Project Manager, Arizona Project Office, Bureau of Reclamation, Phoenix, Arizona	
General Superintendent, Southern Arizona Group, National Park Service, Phoenix, Arizona	
Acting Associate Regional Director, Professional Services, National Park Service, San Francisco, California	
Arizona Archaeological Center, National Park Service, Tucson, Arizona	
Department of Transportation	
Office of Marine Environment and Systems, U.S. Coast Guard, Washington, D.C.	Yes
Division Engineer, Federal Highway Administration, Phoenix, Arizona	
Environmental Protection Agency	
Regional Administrator, Region IX San Francisco, California	Yes
Federal Power Commission Chairman Washington, D.C.	No
Council on Environmental Quality Chairman Washington, D.C.	No
State and Local Agencies	
Governor of Arizona	Yes
Arizona Department of Transportation	Yes
Arizona Game and Fish Department	Yes
Arizona State Land Department	Yes
Arizona State Museum	Yes

State and Local Agencies (continued)	Responded
Arizona Water Commission	Yes
Arizona Commission on Agriculture and Horticulture	No
Arizona Department of Health Services	No
Arizona State Parks Board	No
University of Arizona	
Office of Arid Land Studies	No
College of Agriculture, School of Renewable Natural Resources	No
Arizona State Historical Preservation Officer	No
Office of Economic Planning and Development	No[1]
Arizona Department of Economic Security	No[1]
Arizona Outdoor Recreation Coordinating Commission	No[1]
Indian Affairs Commission	No[1]
University of Arizona, Arizona Bureau of Mines	No[1]
Arizona State University, Center for Environmental Studies	No[1]
Maricopa Association of Governments	No[1]
District IV Council of Governments	No[1]
Maricopa County Board of Supervisors	Yes
Maricopa County Parks and Recreation Department	Yes[2]
Maricopa County Highway Department	Yes[2]
Other Groups	
Buckeye-Roosevelt Natural Resource Conservation District	Yes
El Paso Natural Gas Company	Yes
Sierra Club, Grand Canyon Chapter	Yes
Wickenburg Natural Resource Conservation District	No
Natural Resource Defense Council	No
Friends of the Earth	
Washington, D.C.	No
Phoenix, Arizona	No
Environmental Defense Fund	No
National Wildlife Federation	No
Arizona Wildlife Federation	No
Maricopa Audubon Society	No
Governor's Commission on Arizona Environment	No
Arizona Mining Association	No
Southwestern Mineral Exploration Association	No[1]

[1] Responded with "no comment on this project" through A-95 Clearinghouse.

[2] Comments included with letter from Maricopa County Board of Supervisors.

Other Groups (continued)	Responded
Archaeological Research Services	No
Museum of Northern Arizona	No
Arizona Historical Society	No
Archaeological Society	No
Arizona Conservation Council	No
American Telephone and Telegraph Company	No
Southern Pacific Transportation Company	
San Francisco, California	No
Tucson, Arizona	No
Enterprise Ranch, Inc.	No
Painted Rock Development Corporation	No
John Carollo Engineers	No
W. S. Gookin & Associates	No
Center for Urban Affairs, Northwestern University	No
Ecology and Environment, Inc., Billings, Montana	No
Herner and Company, Washington, D.C.	No
NUS Corporation, Pittsburg, Pennsylvania	No
Document Librarian, Colorado State University	No
Individuals	
E. Billie Bennett	Yes
Barto Price	Yes
Bert Cavanagh	No
Dr. Jack Z. Elias	No
Laurence R. Foerster	No
Randy Harper and Emery Harper	No
Frank Mills	No
Steven Pavich	No
Harry Porterfield	No
Franklin W. Rogers	No
Philip von Bretzel	No

The following are replies to comments received on the interagency Draft Environmental Impact Statement, March 1976.

Departments and Agencies of the Federal Government

United States Department of Agriculture - Office of Equal Opportunity (Letter of May 25, 1976)

No reply necessary.

Department of the Army - Office of the Chief of Engineers (Letter of 28 May 1976)

Comment: The Corps of Engineers has the responsibility to regulate the discharge of dredge and fill material under Section 404 of the Federal Water Pollution Control Act of 1972. The possible need for a permit for any of the proposed activities should be explored and information related to the Section 404 program's impact included in the final environmental statement if appropriate.

Response: The Phoenix, Arizona, Office of the Corps of Engineers has been contacted in regard to the applicability of Section 404. A Corps of Engineers' permit would not be required for the project under existing policy because none of the affected watercourses in the watershed has a flow of 5 cubic feet per second or more for six months or more per year. The Corps of Engineers also advises that there are several bills pending in Congress to amend Section 404.

Because a permit is not required and the statute may be changed it was felt that further discussion of Section 404 in the final statement would not be particularly beneficial, therefore, the final statement does not include this subject. The discussion in this section should suffice.

Department of Health, Education & Welfare - Office of Environmental Affairs (Letters of June 4, 1976 and May 21, 1976)

1. Comment: As we understand the plans, the two proposed floodwater retarding structures are designed to prevent floodwater damages resulting from heavy rainfall. Under normal conditions the impoundment basins will be dry and are not intended to store water for agricultural irrigation,

recreation, etc. However, we cannot ascertain from the illustrations if the basins are provided with a means of draining. Provisions for complete drainage should be included because floodwaters in these reservoirs require a long time to evaporate. This span of time is sufficient to produce mosquitoes, and vector species (e.g. Culex tarsalis, the encephalitis mosquito) could easily breed in the evaporating waters.

Response: Information on provisions for drainage has been added. See the Planned Project Section, beginning on page 3, and the Impact Section, page 90. The drain outlets for the basin areas of Saddleback F.R.S. are shown on Plate 1. Also, the plans have been changed to allow for drainage of the pool area behind Harquahala F.R.S. See Plate 2.

2. Comment: We have been advised that a housing development is being constructed in the Harquahala Valley, and therefore could be at risk of a potential vector-borne disease impact produced by the floodwater retention structures. As you may know, the State of Arizona experienced four human cases of mosquito-borne encephalitis in 1975, and additional vector-producing habitats should not be created.

Response: There are no significant housing developments under construction in Harquahala Valley. The only activity of that nature consists of a few isolated dwellings constructed in speculative subdivisions. Further information on this subject has been added in the Impacts Section. See page 90.

3. Comment: Several questions should be answered to insure that vector-borne diseases do not impact upon residents of the Harquahala Valley. Which species of vector mosquitoes are found there, and how numerous are they?

Response: Species could include Culex tarsalis. The number of mosquitoes is unknown, however, no problems are evident at the existing impoundments in or adjacent to the watershed.

4. Comment: With floodwaters impounded within the structures, what is their capacity to produce mosquitoes, particularly vectors?

Response: Vectors could be produced by the impounded floodwaters.

5. Comment: Is complete drainage feasible?

Response: Complete drainage is possible, however, this is in conflict with the desires of the sponsors, livestock interests, and wildlife interests.

6. Comment: If mosquito problems are caused by nondraining floodwaters, what steps will the Soil Conservation Service take to control them?

Response: The responsibility for mosquito control in Maricopa County lies with the Maricopa County Department of Health Services. The Operation and Maintenance Agreement will contain appropriate provisions for vector control. Further information on this subject has been added. See page 91.

7. Comment: We believe these questions should be considered in the E.I.S. and perhaps some questions on vectors in the area can be obtained from Dr. John M. Doll, Vector Control Specialist, Division of Environmental Health Services, Arizona Department of Health Services, 1740 West Adams Street, Phoenix, Arizona 85007. He should be contacted in this regard.

Response: Dr. Doll was contacted as suggested. A letter from Dr. Doll is shown in Appendix C. The Impacts Section has been expanded to include information on vectors supplied by Dr. Doll and also a further discussion on impacts. See pages 90-91.

United States Department of the Interior - Office of the Secretary
(Letter of June 16, 1976)

1. Comment: Our Bureau of Land Management had requested additional information (memorandum, July 24, 1975) on the preliminary draft EIS. Specifically, they asked that more detail and description be provided toward treatment measures, including fence construction surrounding reseeded areas. That information has not been provided in the draft statement.

Response: Information on treatment measures and fencings has been added. See pages 23-24. The U.S. Bureau of Land Management, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, Arizona Game and Fish Department and others will be consulted with on these and other environmental features.

2. Comment: Clarification of the predicted decrease of traffic is desired. It would appear that the restricted access along I-10 will continue to necessitate a large volume of traffic along the subject roads.

Response: (The subject roads are Courthouse Road and Buckeye-Salome Road.) After reconsideration, the sentence referring to a predicted decrease in traffic on these roads after construction of I-10 was deleted.

3. Comment: Mention is made of utilizing existing box culverts under I-10 for floodwater release. The capacity of those culverts should be stated along with the predicted spillway discharge from a 50 and a 100-year flood.

Response: This information is shown on pages 11 and 16.

4. Comment: Is there an inconsistency in considering a 50-year peak discharge with the Harquahala Floodway and a 100-year flood on the Harquahala F.R.S.?

Response: No. The Interstate system uses a 50-year design frequency for cross-drainage structures. U.S.D.A. Soil Conservation Service policy requires a 100-year flood design for dams such as Harquahala F.R.S. Neither the Arizona Department of Transportation nor the Federal Highway Administration have expressed concerns about these design features.

5. Comment: The reader should be provided a date, as to when the embankment slope treatment studies will be completed.

Response: These are open-ended studies under continuous evaluation. As such, an exact date for completion is inappropriate. Preliminary results are available now. Additional knowledge will be gained prior to construction. Appropriate changes have been made. See page 23.

6. Comment: Although a suitable crossing will be provided over the Granite Reef Aqueduct, no mention is made of complementary crossings on the Harquahala F.R.S. Will crossings over the two structures coincide?

Response: (Comment is in reference to New Tank, mentioned on page 25.) The crossing is for movement of livestock and wildlife. No structural crossing

is required over the embankment. The animals can walk over. Further information about this crossing has been added to the above mentioned section of the statement.

7. Comment: The land ownership and control of the watering tanks should be specified.

Response: (Comment is in reference to two tanks near Saddleback Diversion plus Allison Tank.) The statement has been changed to specify the land ownership and control as suggested. See page 26.

8. Comment: Specific details of mitigating measures is lacking. For example, the methods used to protect new growth from livestock and vehicles should be stated. Stockproof fencing of those areas upstream of the flood-retarding structures should be considered. This measure would improve conditions for wildlife in those green-up areas and help compensate for anticipated vegetative losses downstream of the protective dikes. Even with fencing, those areas discussed in the statement to be seeded and treated may require more than three years to permit adequate reestablishment of vegetation.

Response: Additional information on environmental features and mitigation has been added. See pages 23 and 28. All fencing will be stockproof.

Direct reference to a three-year establishment period has been deleted. The normal U.S.D.A. Soil Conservation Service Policy is to terminate the establishment period for vegetative work associated with a structural measure when any of the following conditions are met:

a. Adequate vegetative cover is obtained.

b. Two growing seasons have elapsed since the initial installation of vegetative work.

c. The establishment period for the associated structural measure has terminated (three years after the structural measure is accepted).

This policy is not rigid. It is intended more for the humid areas of the nation rather than a desert setting like Harquahala Valley. During the establishment period, the S.C.S. State

Conservationist can approve additional work if required to obtain an adequate vegetative cover. Also, the Administrator, S.C.S., can grant an extension if the need is determined during the establishment period.

The program will be closely monitored. If it is apparent that an adequate cover cannot be established in the initial establishment period, then additional work will be done and/or an extension requested. Both of these avenues have been used in the past in Arizona.

9. Comment: Page III-28, Paragraph 6 - The discussion on historical and archaeological resources does not agree with the material provided on page III-62.

Response: (The page number refers to the draft statement.) The narrative on historical and archaeological resources has been completely rewritten. Information on these resources is contained in three sections of the final statement. See pages 28, 62 and 91.

10. Comment: Page III-34, Paragraph 1 - "Land treatment measures on Federal lands will be maintained by the Bureau of Land Management or the leasees." BLM's supporting role should proceed with the close cooperation of the SCS and sponsoring agencies. This will help to alleviate problems which may occur without preliminary on-the-ground input from the BLM.

Response: (The page number refers to the draft statement.) Full contact and cooperation will be maintained with the U.S. Bureau of Land Management.

11. Comment: Page III-34, paragraph 3 - "A specific operation and maintenance agreement will be entered into between the sponsors and the SCS..." The effect upon other surface owners (private and Federal) should be stated.

Response: (The page number refers to the draft statement.) Appropriate changes have been made. See page 34. The paragraph now reads: "Representatives of the federal, State, and county government shall have free access at all times to the structural works of improvement, including flowage easement areas, for official activities. These activities shall include inspection and necessary operation and maintenance activities."

The operation and maintenance agreement will be discussed with the U.S. Bureau of Land Management as to the possible impact on public land.

12. Comment: The automatic nature of the operation of the conduits for maintaining downstream water flow should be explained more thoroughly.

Response: Additional information on the operation of these conduits has been added. See page 35.

13. Comment: The location of the 17 watering tanks and the five natural springs in the watershed should be specified. Impacts, if any, should be stated in the impact section.

Response: The majority of these are located in the upper portions of the watershed far removed from the proposed structures. As the project will not impact on them, the locations have not been specified as suggested. The tanks and springs are shown on U.S.G.S. 7½' quad maps.

The location of those tanks to be impacted by the project are discussed in the Planned Project Section under the discussions on specific features for each structure. See pages 24-27. Impacts are discussed in the Impacts Section, page 86.

14. Comment: Some estimates of number of acres per crop, in addition to average yields, would be helpful in analyzing the watershed economy.

Response: Cropping patterns in Harquahala Valley change with market conditions. To list the acres per crop at any one point in time would not be truly reflective of past conditions or future trends. Therefore, the information has not been included in the final statement as suggested.

15. Comment: In addition to the reference cited, the 1975 "Smithsonian Institution Report on Endangered and Threatened Plant Species of the United States" (House Document No. 94-51) should also be used to check for rare and endangered plants in the construction area.

Response: The Smithsonian Institution Report has been superseded by a federal listing of endangered and threatened plant species. Refer to reference No. 43 in Appendix G.

The federal listing has been checked. Appropriate changes have been made. See pages 56 and 83.

16. Comment: The Desert Tortoise (Gopherus agassizi) and Gila Monster (Heloderma suspectum) have been placed in Group III of the Arizona Game and Fish Department's "list of Threatened Wildlife of Arizona." This group corresponds closely to the Federal "threatened" category and includes species currently in greatest jeopardy of being eliminated from Arizona.

The current Fish and Wildlife Service Endangered Species Listing was published in the Federal Register, Vol. 40, No. 188, on September 26, 1975, and should be used in lieu of those references listed. This current listing uses only two classifications--Endangered and Threatened.

Response: The State list (Jan. 1976) is unofficial. It has not been approved by the Arizona Game and Fish Commission. Nevertheless, the final statement has been expanded and revised to reflect both the State listing and the federal listing as contained in the Federal Register, Vol. 40, No. 188, on September 26, 1975. This information is shown on page 62.

The Impacts Section has also been revised to include additional information about impacts upon those species on both the State and federal listings. See page 85.

17. Comment: The Archaeology section should provide enough information for the reader to judge impacts. The assurance that no problem exists (although nine sites were found) is not verified. This section should contain, minimally, the following:

1. A brief synopsis of the cultural history (through historic times) of the Harquahala Valley area.

2. Discussion of previous cultural resource work in the area (with references and bibliography).

3. The text should tell how intense the survey was and what areas it involved. The term "reconnaissance" usually means a less than complete survey. In the areas where ground disturbance is expected, this is not satisfactory.

4. The sites themselves should be described in

greater detail and related to the regional synthesis. The sites should also be related to the areas of surface disturbance. If located within them, they should be minimally mapped and collected.

A copy of the archaeological report by the Arizona State University should be made available to the Western Archaeological Center, National Park Service, P.O. Box 94008, Tucson, Arizona 85717, so that a more adequate review of the final environmental impact statement can be made. Also, our BLM is concerned with non-National Register sites and can require mitigation of those on BLM land. Therefore, a copy of the ASU Archaeological Report will be needed by our BLM archaeologist to fully assess and evaluate the nine sites and other information developed.

Response: Copies of the archaeological reports have been sent to the National Park Service, Arizona State Museum and the BLM. Additional surveys may be conducted prior to construction. All concerned agencies will be kept informed of and consulted with on cultural resources that may be affected by the project.

Appropriate changes have been made in sections of the final environmental statement dealing with archaeological resources. All of the information as requested in the above comment has not been included in the final statement. This information, however, is in the archaeological reports sent to the concerned agencies.

Consideration was given to greatly expanding the archaeological sections of the report and/or including the survey reports as an appendix to the final statement. This was decided against because (1) a copy of the reports has been sent to all concerned agencies; (2) the agencies will be kept informed of future developments; (3) the inclusion of more volume in the statement is in conflict with recent statements issued by the Council of Environmental Quality that environmental statements are becoming to voluminous and detailed and go beyond the intent of the National Environmental Policy Act.

18. Comment: The final statement should include a determination of effect from the State Historic Preservation Officer regarding the National Register property, Harquahala Peak Observatory.

Response: The determination of effect has been added. See page 91.

19. Comment: Page III-65, Paragraph 3 - The 19 farms in the watershed does not agree with the 20 farm establishments indicated on page III-49.

Response: (The page number refers to the draft statement.) The correct number is 20. Appropriate changes have been made.

20. Comment: From the local contour, it appears that flooding could extend to the south side of Centennial Wash to a greater degree than depicted.

Response: (Reference is to Figure 2, Centennial Wash Flood Plain Map.) Some degree of detail has been lost because of the small map size. The southern boundary of the floodline on Centennial Wash is shown in greater detail on Plate 5, Centennial Levee.

21. Comment: Minimal consideration has been given to potential access problems involving public land use and the erection of protective structures. These should be examined to resolve conflicts.

Response: Refer to the response for Comment No. 35.

22. Comment: Information should be provided on numbers and distribution of wild horses and burros. "Tolerable levels" is non-definitive and fails to accurately portray the extent or magnitude of use between competing segments of the wildlife population.

Response: (Reference is to a paragraph in the draft statement. The paragraph read: "Horses and burros compete directly with wildlife, primarily bighorn sheep. While burro populations are at tolerable levels at this time there are no provisions for controlling these populations at current levels because the wild horse and burro act was passed providing total protection for these animals.")

The entire paragraph has been deleted from the final statement. This issue is considered nebulous as far as the project is concerned and somewhat political. This approach was discussed with the U.S. Bureau of Land Management. The BLM stated that deletion of the paragraph would be acceptable.

23. Comment: The construction of retarding structures and land treatment measures will have considerable impact on wildlife habitat and native flora. Under the plan, approximately 2,000 acres of national resource land will need to be acquired for easement, and about 11,000 acres of NRL will be directly impacted within the watershed. An additional amount of BLM-administered land surrounding the project and impound area will be impacted to a lesser degree.

Some consideration of BLM's plans, policies, and controls should have been presented in this section. For example, the Phoenix District should be consulted on the Vulture Planning Unit.

Response: The Phoenix District Office of the U.S. Bureau of Land Management has been contacted in regard to this comment. Additional information has been added. See page 76.

24. Comment: Downstream impacts are inadequately addressed. There is a need for specific information on new roads to be constructed, their location, surfacing, and expected use. Without these specifics, it is impossible to assess the total associated adverse impacts.

Response: Additional information on haul roads has been added to the Impacts Section. See page 89.

25. Comment: Additional maps covering vegetation, soils, topography, land use, etc., would be extremely helpful to assess and juxtapose the various project impacts.

Response: The maps have not been included in the final statement as suggested. It is felt that to do so would make the statement too voluminous. However, this data is available at the State office of the U.S.D.A., Soil Conservation Service.

26. Comment: The E 1/2 of Sec. 4, T. 1 N., R. 8 W., is national resource land and not a subdivision as stated in the narrative.

Response: The word "east" has been changed to "west."

27. Comment: General - Impacts associated with a possible increase in erosion as a result of a loss of downstream vegetation have not been addressed.

Response: An increase in erosion downstream of the structures

should not occur. The vegetation in the project area, consisting primarily of creosotebush, is too sparse for the project to cause an increase in erosion rates.

28. Comment: The specific anticipated impacts do not mention haul roads which will be associated with the construction of the structures.

Response: Refer to the response for comment No. 24.

29. Comment: Who will make the determination and when will it be made for the removal or support of Saguaro Cacti?

Response: This information has been added to the Impacts Section. See page 83.

30. Comment: A number of endangered species are listed in Appendix F as being in the Harquahala Watershed. The statement, "The project will have no known impacts on threatened and endangered species," is not substantiated. Some discussion of habitat available and habitat requirements for the endangered species is needed to substantiate the statement.

Response: There are two species on the federal endangered list. These are the Southern Bald Eagle and Peregrine Falcon. The Bald Eagle feeds on fish. There are no fish in the watershed. There is no indication that either species nests or congregates in the area. (Refer also to the response for Comment No. 16.)

31. Comment: We suggest that shaping and contouring of pit walls be maintained at 4:1 or less.

Response: Side slopes of the borrow pit walls will be maintained at 4:1 or less wherever possible.

32. Comment: Although the dam itself may not restrict animal movement, fencing along the boundary will (page V-8). Is this portion of the dam going to be fenced and if so, what provision has been made for complementary crossings from the impoundment across the aqueduct?

Response: (Reference is to the movement of livestock and wildlife over Harquahala F.R.S.) This section has been rewritten. See page 92. More detail on fencing has also been added to the Planned Project Section. See page 23.

33. Comment: A general concern of this and similar projects is that they tend to foster land use changes in growth and development. This can adversely affect many of the environmental impacts which appear to be mitigated in the draft environmental statement.

Response: The project is not expected to stimulate any land use changes. This is discussed in the Impact Section. See page 94. Any land use changes in Harquahala Valley will be fostered by the Central Arizona Project, or possibly by the Palo Verde Nuclear Power Plant.

34. Comment: A map should be included defining the extent of the impacted area.

Response: (Suggestion is to include a map of Centennial Wash downstream of the project, i.e., between Harquahala Valley and the Gila River.) After consideration, it was decided not to include this map because the downstream impacts are adequately described in the Impacts Section beginning on page 95. Another factor leading to this decision is that this is the only comment received suggesting that a map be included. The draft environmental statement was sent to downstream entities, including the Southern Pacific Transportation Company, Painted Rock Development Corporation, Enterprise Ranch, Inc., and individual farmers. Some of the downstream entities were present at the Public Information Meeting on May 12, 1976.

35. Comment: Page V-20, Section F - "Harquahala F.R.S. will limit accessibility to some sectors of the watershed." All other structures will limit access as well, and these impacts should be addressed.

Response: (The page number refers to the draft statement.) The sentence now reads: "All structures will limit accessibility to some sectors of the watershed." Additional information on access has been added to the Impacts Section. See page 92. The title of this section has been changed from "Mineral Exploration and Ranching Operations" to "General."

36. Comment: Maintenance activities should be included as an adverse impact.

Response: The following sentence has been added to the

Adverse Impacts Section: "Infrequent maintenance activities may temporarily disrupt wildlife and cause minor dust problems." See page 100.

Department of Transportation, Office of Marine Environment and Systems (Letter of 3 June 1976)

No reply necessary.

United States Environmental Protection Agency Region IX (Letter of May 25, 1976)

1. Comment: The Environmental Protection Agency has received and reviewed the draft environmental impact statement for the Harquahala Valley Watershed Project, Arizona. EPA's comments on the draft environmental statement have been classified as category LO-1. Definitions of the categories are provided on the enclosure. The classification and date of EPA's comments will be published in the Federal Register, in accordance with our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action, and the adequacy of the environmental statement.

EIS CATEGORY CODE

Environmental Impact of the Action

LO--Lack of Objections

EPA has no objection to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

Adequacy of the Impact Statement

Category 1--Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Response: Noted.

2. Comment: Mitigation measures for any adverse effects occurring during construction phase of this project should be indicated in the final EIS.

Response: Statements as to the actions to be taken in the construction phase are located in several places throughout the statement. For instance, the Planned Project Section, page 29, describes the actions to be taken if archaeological and historical sites are encountered during construction. Planned Project Section, pages 29 to 33, describes the actions to minimize the impacts of numerous construction activities. The Impacts Section, page 83, describes the actions to be taken in regard to rare and endangered plants.

3. Comment: This project should be coordinated with the ongoing Corps of Engineers Urban Study for Phoenix and the Maricopa County Association of Governments, Section 208 of PL 92-500 area-wide waste management plan.

Response: The Phoenix Office of the Corps of Engineers and the Secretary of the Maricopa Association of Governments were contacted to determine the degree of coordination needed.

The Corps of Engineers advises that the Harquahala Valley Watershed is not within the Urban Study area.

The PL 92-500 Section 208 program is in an infancy stage. The agencies involved are fully aware of the Harquahala Valley Project. They have all received a copy of the draft environmental statement. A copy of the final statement will be provided to them.

It is difficult to address the 208 program until planning of the program advances. No conflicts between the planned project and PL 92-500 are evident. Continuous coordination will be maintained.

State and Local Agencies

Office of the Governor (Letter of July 26, 1976)

No reply necessary.

Arizona Department of Transportation - Highways Division (Letter of May 13, 1976)

No reply necessary.

Arizona Game and Fish Department (Letter of May 4, 1976)

1. Comment: We have one question related to treated areas. On page III-24, "Seeded and treated areas will be fenced during the planned three-year establishment period for protection from livestock, wildlife, and off-road vehicles." The question is, what type of fencing will be required to protect these areas from wildlife and what forms of wildlife do the areas need protection from?

   Response: The word "wildlife" has been deleted from the sentence.

2. Comment: It also may be necessary to provide a longer period than three years for vegetation to become reestablished.

   Response: Refer to response to U.S. Bureau of Land Management Comment No. 8.

3. Comment: An additional mitigation feature that has not been discussed, and that would provide some compensation for expected habitat losses downstream would be the fencing, to exclude livestock, of the upstream areas of the protective dikes. This would provide a means for maintaining the expected increase in vegetation resulting from increased water behind the dikes. Small game and non-game mammals and birds would benefit greatly from such a feature.

   Response: This is an excellent suggestion. The proposed plan has been modified to incorporate this feature. The proposed fencing plans are discussed on pages 22 to 24. The Arizona Game and Fish Department will be contacted for recommendations as to how much of the flood pools should be fenced.

Arizona State Land Department (Letter of May 12, 1976)

1. Comment: About 10% of the landfall within the Harquahala Watershed is state trust land. We have checked Appendix B, "Revised Land Status and Resource Unit Map," and would like to call your attention to our findings: Sec. 2, T2N, R8W is not state; Sec. 16, T3N, R9W is not state; Sec. 3, T2N, R9W - S½ only is state; Sec. 15, (W½) T2N, R10W, (W½) only is state; Sec. 16, T2N, R10W, all is state; Sec. 11, T2N, R9W is not state; and Sec. 15, T2N, R9W, NW¼ only is state.

   Response: The map has been changed.

2. Comment: The Department finds no conflict between this watershed management proposal and existing flood plain laws and regulations. However, we would like to raise the thought that the introduction of new CAP water and waterways into the area and the construction of the Palo Verde Nuclear Plant nearby could alter the use pattern of this agricultural system in the future.

Response: A statement to this effect has been added. See page 48.

Arizona State Museum (Reply of May 21, 1976, on A-95 Clearinghouse Form)

Comment: Cultural resources have been considered in this draft EIS. The overall treatment of these resources is average and resources included those associated with prehistoric, historic and modern time periods. The statement only gave a summary of the original reports utilized in compiling the archaeological and historical data for the EIS. However, the summary does indicate that both an inventory of the records pertaining to the area of impact and a survey of site area took place. The field survey (conducted by the Department of Anthropology, Arizona State University) resulted in a full report that is available for further review. The record inventory was conducted by both the Department of Anthropology, Arizona State University and the Arizona State Museum, Tucson. The level of inventory investigation should be considered sufficient for this stage of the EIS. The field survey located 9 sites and 4 isolated artifact depositions. No additional archaeological investigations of those sites were recommended, nor were any of the sites recommended for inclusion in either the Arizona or National Register of Historic Places. Based on the present level of information given in the summary report, this recommendation of mitigative action may be unacceptable. Unless further information clearly indicates that no significant level of anthropological or archaeological knowledge will be derived from further work at these sites, the present mitigation recommendations may be premature.

Response: Copies of the Arizona State University reports have been sent to the Arizona State Museum. The museum will also be kept fully informed of all further developments in regard to cultural resources in the project area. All sections in the environmental statement have been rewritten to reflect

the current status of archaeological studies and actions to be taken. The mitigation recommendations as stated in the draft statement are in full compliance with Soil Conservation Service policy and guidelines, in that the contracted professional archaeologist is to provide the opinion as to the eligibility of any identified cultural properties for inclusion in the National Register of Historic Places. (Federal Register, Vol. 41, No. 112, Wednesday, June 9, 1976, U.S.D.A. Soil Conservation Service, Archaeological and Historical Sites.)

Mineral Resources Department (Reply of April 19, 1976, on A-95 Clearinghouse Form)

1. Comment: According to USBM I.C. 8236 there are 16 secs. (10,240 acres) in T4N, R9W that contain a placer deposit of potential iron ore. Magnetite makes up 3-7% of the total alluvium to a depth of 15'; in places the content is as much as 10%. The southern part of this area is within 3 miles of the Harquahala F.R.S., however, due to the differences in elevation it is doubtful the placer iron area would be flooded as a consequence of the levee.

   Response: Geologic investigations indicate that the Harquahala Project will have a minimal effect on potential mining operations in the watershed. The 10,240 acres of placer deposits described in the comments are located outside of the proposed reservoir area of Harquahala F.R.S. and will not be affected.

2. Comment: On the USGS topographic sheet Bighorn Mtns. is shown a mine shaft near the SW corner of sec. 15 T3N R9W. No specific information can be found on this property; however, access to it should be provided.

   Response: This is an abandoned mine. Access will be provided. See Response to Comment No. 3 below.

3. Comment: Beginning near the north-central part of sec 30 T4N R9W and extending south easterly to the SE corner of sec. e T2N R9W is a road that will be seriously affected by construction of the Harquahala F.R.S. The explanation of the alternative to this road given on page III-13 is unacceptable.

Response: (The page number refers to the draft statement) Access to this property is currently provided by an unimproved road passable only under favorable weather conditions. This road is actually a fork off another unimproved road located to the west. The fork occurs approximately 3/4 mile south of Harquahala F.R.S. The two roads proceed north independently and essentially parallel of each other. At the point of intersection with the dam, the roads are approximately 1/2 mile apart. The dam and Granite Reef Aqueduct will intersect both roads. A crossing over the dam will be provided for the west fork in Section 21, T3N, R9W, to match a bridge over the aqueduct. The east road will be severed. An approximately 1/2 mile long detour road, to be located through the flood pool area or other suitable location, will connect the two roads.

The environmental statement has been changed to reflect the above response. See page 13. This issue was discussed with the Mineral Resources Department. They have given verbal acceptance to the explanation as presented here.

Arizona Water Commission (Reply of April 16, 1976, on A-95 Clearinghouse Form)

No reply necessary.

Maricopa County Board of Supervisors (Letter of May 20, 1976)

1. Comment: The Maricopa County Parks Department again emphasize their comments of August 6, 1975, wherein they indicated their concern for maintaining horse trails and bicycle and foot paths along the Central Arizona Project right-of-way. Continuity of trails should be a consideration if any of the area will be fenced.

Response: Additional information on fencing has been added. See page 23. It is difficult to be specific on design features for maintaining trails along the aqueduct because the location and type of these trails has not been determined. The parallel fencing on the project should not interfere with proposed trails and paths along the Central Arizona Project right-of-way. The parallel fencing on the upstream side of Harquahala F.R.S. will be placed within the flood pool at some distance from the aqueduct. There

will be corridors at widely spaced intervals to allow for movement of livestock and wildlife over the aqueduct and dam. These corridors could present some hindrance. The details will have to be fully coordinated with any future plans for trails and paths. This will be accomplished during the design state. Hopefully, any plans for trails and paths will be firmed up by that time.

1. Comment: They also reiterate their concern for revegetation and the long range possibility of use of the area for park purposes. Your attention should also be directed to Board of Supervisor's Resolution of May 10, 1976, regarding embankment slopes for the Spook Hill structure. It is requested that the same consideration be given this project.

Response: The project has provisions for revegetation. This is outlined in the Environmental Features Section of the statement. The long range possibility of use of the area for park purposes has been known for several years. The proposed area is north of Harquahala F.R.S. in the Big Horn Mountains. Unfortunately, plans for this park have not advanced beyond the conceptual stage.

A copy of the Board of Supervisors' Resolution is included in Appendix C. Reference has also been made to the resolution in the Planned Project Section. See page 24. The Parks and Recreation Department has been contacted as to how many of these items should be incorporated into the Harquahala Project. They state that the resolution is only a form of guidelines of items to consider, however, they want the opportunity to review the design.

It is recognized that the Harquahala Project is in an isolated area and decidedly different than the urban area setting of the Spook Hill structure. Many of the resolution items are already incorporated in the preliminary plans as reflected in this statement. Several items do not appear feasible and are not included in the present plan. The design of the structures will be fully coordinated with the project sponsors, the County Parks Department, the U.S. Bureau of Land Management and other interested parties. Any conflicts will be resolved prior to construction. The results of ongoing studies of existing

structures will provide valuable information as to which, if any, courses of action over and above those presented in this statement are environmentally and economically justifiable.

3. Comment: The Maricopa County Highway Department has pointed out in their letter of April 15, 1976, that a minimum 50' roadway should be provided over the proposed box culvert on Courthouse Road.

Response: See response to letter from Maricopa County Highway Department.

Maricopa County Highway Department (Letter of April 15, 1976)

Comment: Although the pavement on Courthouse Road is only 28 feet wide, our minimum cross section for any County highway provides a 10-foot wide shoulder on each side of the pavement for safety and emergency parking. Any structure on the roadway must be at least as wide as the pavement and shoulders combined. This accounts for the necessity of a 50-foot roadway over the proposed box culvert.

If, as you indicate, this provision is the responsibility of the Flood Control District, we are, by copy of this letter, requesting them to make arrangements for you to include such in the construction plans.

Response: (Comment refers to the road crossing over Saddleback Diversion. See Plate 4) The width of the box will be decided by negotiation between the Flood Control District and Maricopa County Highway Department. The plans (see Plate 4) still show a width of 28 feet. This may be increased to 50 feet in final design. In any event, a change from 28 feet to 50 feet is not viewed as a significant action requiring that the issue be resolved for the purpose of the final environmental statement.

Other Groups

Buckeye-Roosevelt Natural Resource Conservation District (Letter of May 14, 1976)

Comment: The Supervisors of this board have reviewed the Draft Environmental Impact Statement for the PL-566 Project, Harquahala Watershed, and

have one comment. When the final decision on the size of the deadwater areas above the flood water retarding structures is made, we recommend that the size of the area be held as large as possible for wildlife and livestock use even though it might require purchasing water rights from the downstream water users.

Response: As presented in the environmental statement, the pools will contain a combined total storage of approximately 550 acre-feet. This value may be less if nondraining borrow areas are used for Centennial Levee and/or Saddleback F.R.S. The value was arrived at by a consideration of Public Law 566 policy constraints combined with the amount of borrow needed for construction of the embankments.

It is not anticipated that the final storage will exceed 550 acre-feet. A major increase would undoubtedly require a supplement to the Final Environmental Statement to insure that all impacts are fully recognized. This is particularly true in view of the concern expressed by the U.S. Department of Health, Education and Welfare about vector problems. (See letter of June 4, 1976.)

The final storage may actually be less than 550 acre-feet depending upon the success in acquiring any needed water rights. The Flood Control District of Maricopa County has stated that they will initiate the necessary action to secure necessary surface water rights.

El Paso Natural Gas Company (Letter of April 28, 1976)

Comment: From pages III-17, III-18 and Plate 4 of the study we note that floodwater will be released from the Saddleback Diversion into a drainage way leading to Centennial Wash. Four El Paso Natural Gas Company pipelines cross the drainage-way between the diversion outlet and Centennial Wash and will be subject to the concentrated water flow.

According to the Impact Statement, excess scouring is not expected to occur. However, El Paso Natural Gas Company would hope that you would monitor this area and take such corrective measures as are necessary should excess scouring occur.

Response: (The page numbers refer to the draft statement.)

The statements in regard to the potential for scour are based upon preliminary investigations. Detailed geologic investigations and scour analysis will be conducted in the final design stage. The design will be such so as to insure that the project will not present any threat to the pipelines. The area will be monitored. Corrective action will be taken if required.

Sierra Club (Letter of April 19, 1976)

1. Comment: It seems to me that the most serious impact this project would have if implemented is the loss of over 10,000 acres of creosotebush on the downstream side of project structures and the resultant wildlife death that would undoubtedly follow. It seems doubtful whether the benefits incurred on the upstream side of the project structures would offset those on the downstream end.

Response: The draft environmental statement contained statements to the effect that "10,100 acres of creosotebush downstream of the structures may die or be heavily stressed." This value was arrived at by assuming a 1/2 mile width to be affected downstream for the entire lengths of all structures. Quite frankly, minimal consideration was given to this issue in the draft statement because all of the wildlife biologists involved in the planning of this project discounted the value of creosotebush. Their emphasis is upon tree loss. After receiving this letter, the issue was reconsidered. S.C.S. plant scientists have completed a detailed study of downstream creosotebush loss on four existing structures in western Pinal County. These structures are Powerline, Vineyard Road, Rittenhouse, and Magma. The study shows, for the most part, that plant communities to be adversely affected are those whose existence is dependent in large on runoff or run-in water from adjacent areas. The communities on the higher, drier sites on coarse grained soils will not be affected as they are in fact existing on the rainfall which falls on site. These highly permeable soils soak up nearly all the rainfall that lands on them and makes nearly all of it available to creosotebush, whereas the fine-grained soils with poor infiltration need extra water to be ponded on them so that the water can enter the soil and become available

to plants. Also, this study shows that the downstream strip to be affected is about 1/4 mile wide, and not 1/2 mile as used in the draft statement.

In view of this new information, substantial changes have been made in the final statement. The reference to downstream impact now reads, "1,530 acres of creosotebush downstream of the structures may die or be heavily stressed." The losses per structure are:

Structure	Length (miles)	Area Affected (acres)
Harquahala FRS	5.4(use 2.7)	430
Saddleback FRS	3.18	510
Harquahala Floodway	N/A	
Saddleback Diversion	N/A Coarse-grained soils, steep terrain	
Centennial Levee	3.7	590
Totals	12.28	1,530

Note that only 50 percent of the total 5.4 miles of Harquahala F.R.S. on fine-grained soils has been used. The proposed Granite Reef aqueduct lies immediately downstream of the dam. This aqueduct will cause losses with or without the project dam. It is unreasonable to charge all of this to the dam, therefore, only 50 percent was used.

Wildlife biologists have identified two species of terrestrial vertebrates, the desert iguana and chuckwalla, that feed upon creosotebush. The vegetative type also provide ground cover when no other cover of significance occurs. Because of the vast amounts of creosotebush throughout the area, wildlife will not be adversely affected to any significant degree. The final environmental statement includes information on this subject.

2. Comment: One problem area overlooked in the discussion of the project was the possible effect of subsidence cracks caused by continued groundwater pumping. The ASU Geology dept. has done a detailed study of subsidence caused by pumping of groundwater and its effects on surface structures these cracks always occur in the

transition zone between playas and alluvial slopes coming off mountain ranges. The could create zones of weakness in retarding structures.

Response: We are aware that the Arizona State University Geology Department and in particular the geophysics section under Dr. W. A. Sauck, has conducted specific studies on land subsidence and earth cracks. Unfortunately, none of their studies are for the Harquahala area and no general methodology has been derived that would allow specific application to the project.

A new section, titled "Land Subsidence and Earth Cracks" has been added to the Impacts Section. See page 97.

3. Comment: A cumulative climatic effect from various flood control projects over the whole state may have a tendency to create more humid weather conditions. The ponding and slow release of floodwaters would certainly be 2 factors to consider in this possible impact.

Response: The effect on the climate was not discussed in the draft environmental statement because it is assumed that the impact will be insignificant. The cumulative effect of all the flood control projects in the State is not positively known, however, it can reasonably be assumed that this impact is also minimal.

Individuals

E. Billie Bennett (Letter of June 15, 1976)

1. Comment: First our request. We object to the route the Flood Control is taking through our land, but if there is no other way, we request the dikes be moved west of the dividing line of 9 & 10 west along section 30, R2N9W and R2N10W, Section 25.

Response: (The subject dike is Centennial Levee) Unfortunately, this request cannot be fulfilled. Modifications as suggested would require a north-south dogleg in the levee to follow property lines, placing the levee essentially perpendicular to the main thrust of flows down Centennial Wash. The only way that this levee can be constructed is parallel to Centennial Wash.

2. Comment: Move closer to the Allison tank so the dikes will not interfer with our well sites.

Response: This request could possibly be accomodated. The final location of Centennial levee in the vicinity of Allison Tank will depend in part upon the location of the Harquahala Valley Irrigation District's proposed main irrigation canal. In any event, the levee should not interfere with potential well sites. A closed piping system can be installed through the levee to transport water from wells, regardless of their location.

3. Comment: We request the top of dike be 14 feet in width to serve as a road when flooding forces us and our cattle and other livestock out.

Response: (The subject dike is Centennial Levee) The present design calls for 10 feet top width. This was based upon preliminary soils testing and design. Detailed studies will be conducted in the final design stage. If these studies indicate that soil conditions are such as to require a 14 feet width, then the request can be met. If not, then a wider top width would constitute a nonproject item, ineligible for Public Law 566 funds, and the project sponsors would have to bear the increased cost. There are alternatives available. A maintenance access road will be required on the downstream side of the levee. This road, protected from floods, would be ideally suited for the purposes suggested.

4. Comment: We request road crossings over C.A.P. and dikes on South of Section 30, 29, 28, 27 through to Gin Road. T2NR9W, also Section 25, 26, 27, 28 through to Gasline Road, T2NR10W.

We request road crossings on dividing line of 9 & 10 West over all dikes, C.A.P. and flood from Courthouse Road to Interstate 10 to the Aguila overpass.

Our request for the above roads and crossings were granted us by the Board of Supervisors on April 30, 1919. Enclosed is a copy of the Grant.

We request road crossing over C.A.P. and flood dikes on North line of Section 24 and Section 23 R2N10W. This is for the convenience of range cattle and prevent complete severence of Section 23.

We would like some type of passage over dikes between Section 30 and 25 to accommodate live stock and farm impliments. You may use borrow material from the Allison tank.

Response: Road crossings are requested in several locations over Centennial Levee, some of which are on nondedicated rights-of-way. All road crossings are the responsibility of the project sponsors. The Flood Control District of Maricopa County is aware of these specific requests. Negotiations on road crossings should be conducted directly with the Flood Control District.

5. Comment: The non-draining borrow areas, also non-draining areas, which will store storm runoff, and wild life and recharge the aquifers. I believe a cattle tank should be placed beside every turn in the Centennial Wash, which would serve to inhibit the rushing waters, also aid wild life. These various features will serve as a soft plug in a boiler. We are dealing with explosives when we group many waters in one or two spots.

Response: Policy restraints prevent such features on Centennial Wash as a part of this Public Law 566 project. The drainage area of Centennial Wash greatly exceeds the maximum drainage area applicable (250,000 acres) under this program.

Barto B. Price (Letter of June 5, 1976, and discussions on June 8, 1976. The comments are from SCS letter of June 17, 1976, from Thomas G. Rockenbaugh to Mr. Price.)

1. Comment: You would like to see low flow releases put into the floodwater retarding structures at points where the structures cross existing dry washes.

Response: Saddleback F.R.S. and Saddleback Diversion have outlets for this purpose. They will be located to serve those downstream areas where valuable wildlife habitat exists. Obviously, it would be economically impossible to provide an outlet for every wash intercepted. No outlets are provided at washes intercepted by Harquahala F.R.S. and Centennial Levee because there are large canal features proposed to be located immediately downstream of these structures.

2. Comment: You would like to see the project sponsors physically relocate people on other land rather than just purchasing necessary land rights.

Response: The project will not result in the relocation of any people. There are no dwellings within the required right-of-way. Negotiations on possible land exchanges should be conducted with the Flood Control District of Maricopa County.

3. Comment: You question the wisdom of designing small pools for water for wildlife behind the structures, when it is recognized these pools will go dry in some years. You would apparently prefer that any wildlife water be taken from Central Arizona Project allocations.

Response: The design concepts for storage of water is based upon the recommendations of wildlife biologists from several wildlife oriented agencies. In the past, all flood control structures constructed under the Public Law 566 program in Arizona have been free-draining "dry" structures. Past procedures have been modified for the Harquahala Valley Project in an attempt to comply with the desires of these interests. The taking of water from the Central Arizona Project for wildlife would undoubtedly be a desired feature. The Soil Conservation Service has no control over these allocations or any other part of the Central Arizona Project. It is our understanding, however, that the Central Arizona Project will have some wildlife watering features.

SECTION X

LIST OF APPENDIXES

X. LIST OF APPENDIXES

Appendix A - Comparison of Benefits and Costs for Structural Measures

Appendix B - Project Map - Revised
Land Status and Resource Unit Map

Appendix C - Letters of Comment Received on the Draft Environmental Statement

Appendix D - Glossary of Terms

Appendix E - Representative Plant List

Appendix F - Terrestrial Vertebrates of the Harquahala Valley Watershed

Appendix G - References Cited

SECTION XI

APPROVAL

XI. APPROVAL

Approved by Thomas G. Rockenbaugh

Thomas G. Rockenbaugh
State Conservationist

4-4-77

Date

APPENDIX A

COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

APPENDIX A

COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES - REVISED

HARQUAHALA WATERSHED, ARIZONA

Dollars 1/

Evaluation Unit	AVERAGE ANNUAL BENEFITS: Flood Prevention Damage Reduction	Secondary	Total	Average Annual Cost	Benefit Cost Ratio
Floodwater Retarding Structures, Diversions Floodways and Levees	433,900 2/	63,600	497,500 3/	398,100	
Project Administration				31,600	
TOTAL	433,900	63,600	497,500	429,700	1.16:1.0

1/ Price Base-Benefits: Current Normalized Prices

Costs: 1975 Prices

2/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $36,400.

3/ Does not include unevaluated benefits accruing to the Granite Reef Aqueduct, Interstate 10, Gin Road, or to the proposed irrigation water distribution system main canals, laterals, or associated improvements.

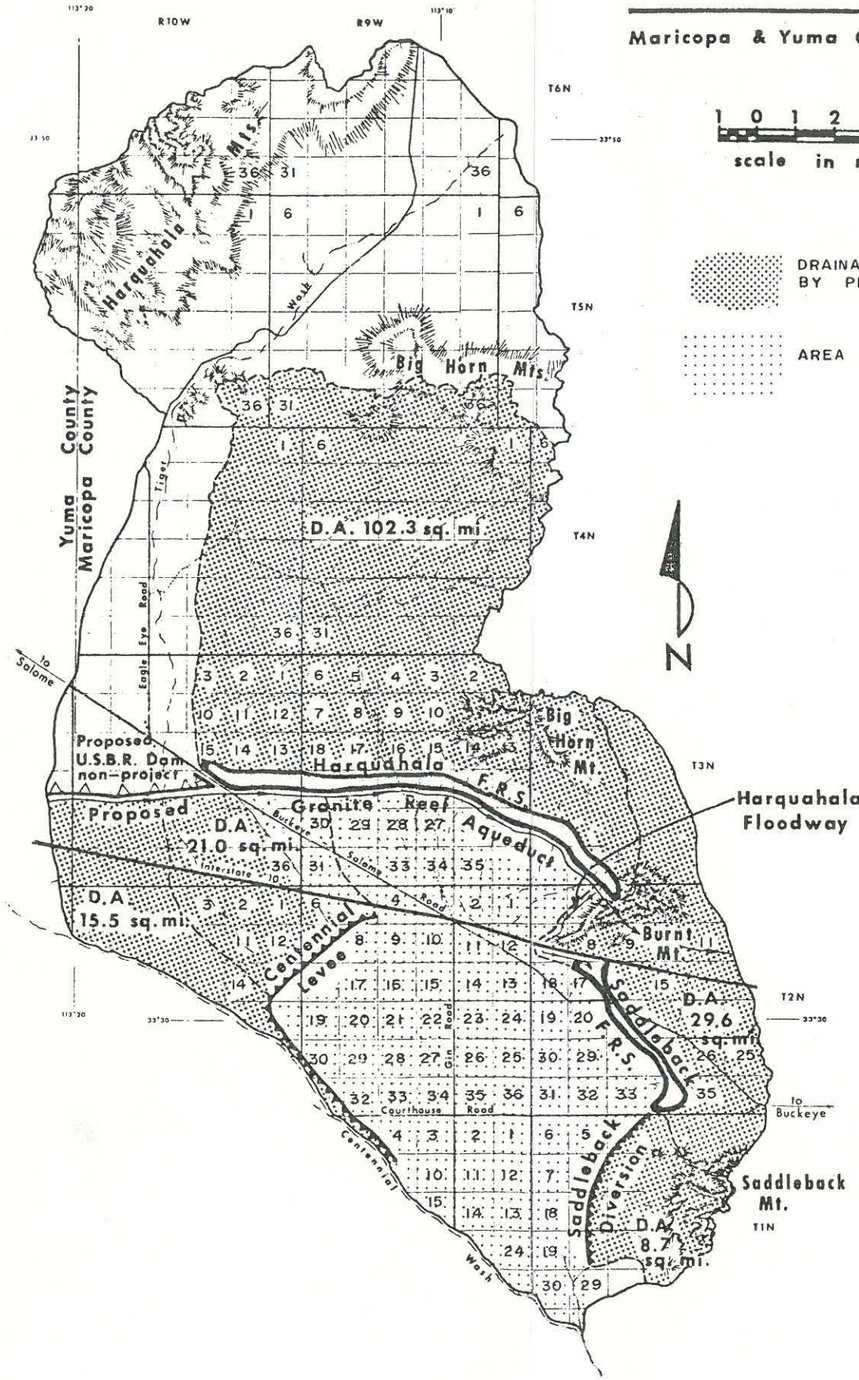
March 1977

APPENDIX B

PROJECT MAP - REVISED
LAND STATUS & RESOURCE UNIT MAP

PROJECT MAP
Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona



1 0 1 2 3 4 5

scale in miles

DRAINAGE AREA CONTROLLED BY PROJECT STRUCTURES

AREA BENEFITED

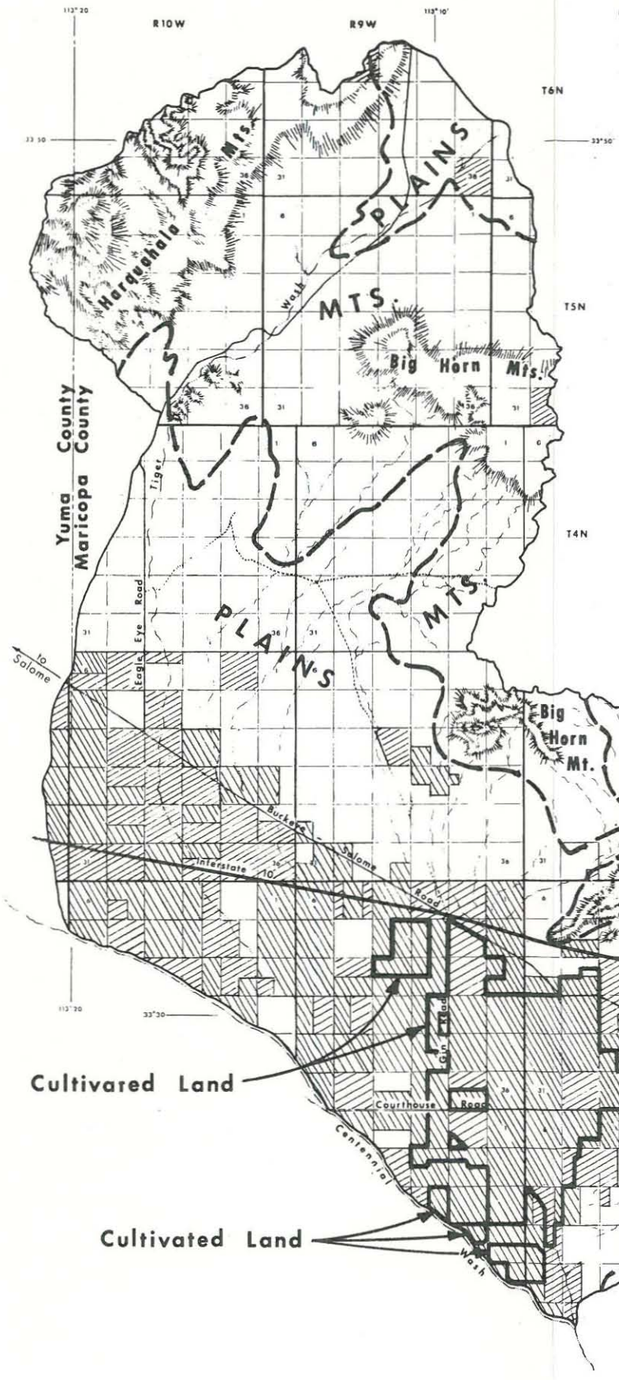
N

LOCATION MAP

LAND STATUS & RESOURCE UNIT MAP

Harquahala Valley Watershed

Maricopa & Yuma Counties, Arizona



1 0 1 2 3 4 5

scale in miles

LEGEND

- PRIVATE LAND
- STATE LAND
- NATIONAL RESOURCE LAND
- RESOURCE UNIT BOUNDARY

LOCATION MAP

APPENDIX C

LETTERS OF COMMENT RECEIVED ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF EQUAL OPPORTUNITY
WASHINGTON, D.C. 20250

MAY 25 1976

IN REPLY
REFER TO: 8140 Supplement 7

SUBJECT: Draft Environmental Impact Statement on the Supplemental Plan for the Harquahala Valley Watershed, Arizona, Phoenix, Arizona

TO: Thomas G. Rockenbaugh
State Conservationist

THRU: Verne M. Bathurst, Deputy
Administrator for Management, SCS

The Draft Environmental Impact Statement on the Supplemental Plan for the Harquahala Valley Watershed has been reviewed by this office to assess the civil rights impact for the socio-economic effects on minority groups.

The plan appears to have no significant adverse impact on the minority population.

J. Fred King

for MILES S. WASHINGTON, JR.
Acting Director

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-CWP-W

28 MAY 1976

03 4940-D
SCS

Honorable Robert W. Long
Assistant Secretary of Agriculture
Washington, D. C. 20250

Dear Mr. Long:

In accordance with the provisions of the National Environmental Policy Act of 1969, we have reviewed the draft environmental statement for the Harquahala Valley Watershed in Maricopa and Yuma Counties, Arizona.

We do not foresee any conflict between the proposed project and any existing or authorized projects of the Corps of Engineers. The environmental statement adequately discusses the proposed project and its significant impacts as they relate to our responsibilities with one exception. The Corps of Engineers has the responsibility to regulate the discharge of dredge and fill material under Section 404 of the Federal Water Pollution Control Act of 1972. The possible need for a permit for any of the proposed activities should be explored and information related to the Section 404 program's impact included in the final environmental statement if appropriate.

We appreciate the opportunity to review this environmental statement.

Sincerely yours,

Marvin W. Rees

MARVIN W. REES
Colonel, Corps of Engineers
Executive Director of Civil Works

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

JUN 4 1976

Mr. Thomas G. Rockenbaugh
State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
3008 Federal Building
Phoenix, Arizona 85025

Dear Mr. Rockenbaugh:

We have reviewed the draft Environmental Impact Statement concerning the Harquahala Valley Watershed, Arizona. We would like to retract the April 16, 1976 letter from Mr. James D. Knochenhauer, Regional Environmental Officer, DHEW, and offer the enclosed letter as the official Departmental response.

Thank you for the opportunity to review the document.

Sincerely,

Charles Custard

Charles Custard
Director
Office of Environmental Affairs

Enclosure

cc: Boris Osheroff
Jim Knochenhauer
Warren Muir (2)
Richard Hayes

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

BUREAU OF LABORATORIES
VECTOR-BORNE DISEASES DIVISION
POST OFFICE BOX 2087
FORT COLLINS, COLORADO 80522

May 21, 1976

Mr. Charles Custard
Director, Office of Environmental
Affairs
Department of Health, Education
and Welfare
Room 542F2, South Portal
200 Independence Avenue, SW.
Washington, D.C. 20201

Dear Mr. Custard:

Re: Control No. 679

In response to your letter, we have reviewed the draft environmental impact statement on the Harquahala Valley Watershed, Maricopa and Yuma Counties, Arizona and we are submitting our comments on vector-borne disease impacts which might result from the project.

As we understand the plans, the two proposed floodwater retarding structures are designed to prevent floodwater damages resulting from heavy rainfall. Under normal conditions the impoundment basins will be dry and are not intended to store water for agricultural irrigation, recreation, etc. However, we cannot ascertain from the illustrations if the basins are provided with a means of draining. Provisions for complete drainage should be included because floodwaters in these reservoirs require a long time to evaporate. This span of time is sufficient to produce mosquitoes, and vector species (e.g. Culex tarsalis, the encephalitis mosquito) could easily breed in the evaporating waters. We have been advised that a housing development is being constructed in the Harquahala Valley, and therefore could be at risk of a potential vector-borne disease impact produced by the floodwater retention structures. As you may know, the state of Arizona experienced 4 human cases of mosquito-borne encephalitis in 1975, and additional vector-producing habitats should not be created.

Several questions should be answered to insure that vector-borne diseases do not impact upon residents of the Harquahala Valley. Which species of vector mosquitoes are found there, and how numerous are they? With floodwaters impounded within the structures, what is their capacity to produce mosquitoes, particularly vectors? Is complete drainage feasible?

If mosquito problems are caused by nondraining floodwaters, what steps will the Soil Conservation Service take to control them? We believe these questions should be considered in the E.I.S. and perhaps some questions on vectors in the area can be obtained from Dr. John M. Doll, Vector Control Specialist, Division of Environmental Health Services, Arizona Department of Health Services, 1740 West Adams Street, Phoenix, Arizona 85007. He should be contacted in this regard.

We are pleased to cooperate with your office in this review. If we can furnish any additional information, please let us know.

Sincerely yours,

Richard O. Hayes

Richard O. Hayes, Ph.D., M.P.H.
Chief, Water Resources Branch

cc: Dr. John M. Doll
Mr. William J. McCurry

ARIZONA DEPARTMENT OF HEALTH SERVICES

Division of Environmental Health Services

RAUL H. CASTRO, Governor
SUZANNE DANDOY, M.D., M.P.H., Director

June 30, 1976

WDM		WES	
✓ FMB		TCC	
S		RE	
SGE		CLL	
BJF		PCB	
ALR		BGS	

Mr. Frank M. Barrios, Chief
Watershed Planning Unit
Arizona Water Commission
222 North Central Avenue, Suite 800
Phoenix, Arizona 85004

Dear Mr. Barrios:

The following comments are in response to your telephone request of June 25, regarding possible vector related problems associated with the Harquahala Valley Watershed and Maricopa and Yuma Counties. I have read the letter dated May 21, 1976, written by Dr. Richard O. Hayes, and basically share the same concerns.

Past experience has shown that retention of floodwater for a week or more may result in ideal mosquito breeding habitat. Stagnant water, especially if developed in conjunction with emergent vegetation or organic debris, may be well suited to development of Culex tarsalis, the primary vector of arbovirus encephalitis.

The presence of these arboviruses, St. Louis Encephalitis and Western Equine Encephalitis, has been demonstrated in the general area and there is little doubt that transmission to humans in the area could occur.

The remaining factor in the epidemiological chain is the presence of a human population near enough to be bitten by mosquitoes from the area. Present population in the area seems to be fairly remote from the project, but consideration should be given to future population growth.

Mosquitoes breeding in impounded water could either be controlled biologically, by means of mosquito fish, or by application of mosquito larvicides. The first option may be objectionable since the pools will probably dry up between rains, sacrificing the fish. The second option, mosquito larviciding with chemicals, may be impractical because of environmental concerns, i.e. you mentioned that ranchers plan to use the water for cattle, and conservationists are interested in wildlife usage of the impounded water. An additional complication would be that application of pesticides would be required of some agency whose vector control capacity may already be stressed to the limit.

Sincerely,

Barry Abbott, Manager
Solid Waste Section
Bureau of Sanitation

John M. Doll, Ph.D.
Vector Control Specialist

JMD:jar

cc: Dr. Richard Hayes

State Health Building 1740 West Adams Street Phoenix, Arizona 85007

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/350

JUN 16 1976

Dear Mr. Rockenbaugh:

Thank you for the letter of April 9, 1976, requesting our views and comments on the draft environmental statement for Harquahala Valley Watershed, Maricopa and Yuma Counties, Arizona. In reviewing the document, we have noticed several areas of discussion which we feel merit re-examination.

Planned Project

Our Bureau of Land Management had requested additional information (memorandum, July 24, 1975) on the preliminary draft EIS. Specifically, they asked that more detail and description be provided toward treatment measures, including fence construction surrounding reseeded areas. That information has not been provided in the draft statement.

Page III-8, Paragraph 2 - Clarification of the predicted decrease of traffic is desired. It would appear that the restricted access along I-10 will continue to necessitate a large volume of traffic along the subject roads.

Page III-11, Paragraph 4 - Mention is made of utilizing existing box culverts under I-10 for floodwater release. The capacity of those culverts should be stated along with the predicted spillway discharge from a 50 and a 100-year flood.

Page III-16, Paragraph 3 - Is there an inconsistency in considering a 50-year peak discharge with the Harquahala Floodway and a 100-year flood on the Harquahala F.R.S.?

Page III-24, Paragraph 3 - The reader should be provided a date, as to when the embankment slope treatment studies will be completed.

Page III-26, Paragraph 2b - Although a suitable crossing will be provided over the Granite Reef Aqueduct, no mention is made

of complementary crossings on the Harquahala F.R.S. Will crossings over the two structures coincide?

Page III-27 - The land ownership and control of the watering tanks should be specified.

Page III-28, Paragraph 5, Mitigation - Specific details of mitigating measures is lacking. For example, the methods used to protect new growth from livestock and vehicles should be stated. Stockproof fencing of those areas upstream of the flood-retarding structures should be considered. This measure would improve conditions for wildlife in those green-up areas and help compensate for anticipated vegetative losses downstream of the protective dikes. Even with fencing, those areas discussed in the statement to be seeded and treated may require more than three years to permit adequate reestablishment of vegetation.

Page III-28, Paragraph 6 - The discussion on historical and archeological resources does not agree with the material provided on page III-62.

Page III-34, Paragraph 1 - "Land treatment measures on Federal lands will be maintained by the Bureau of Land Management or the leasees." BLM's supporting role should proceed with the close cooperation of the SCS and sponsoring agencies. This will help to alleviate problems which may occur without preliminary on-the-ground input from the BLM.

Page III-34, Paragraph 3 - "A specific operation and maintenance agreement will be entered into between the sponsors and the SCS...." The effect upon other surface owners (private and Federal) should be stated.

Page III-35, Paragraph 2 - The automatic nature of the operation of the conduits for maintaining downstream water flow should be explained more thoroughly.

Environmental Setting

Page III-44 - The location of the 17 watering tanks and the five natural springs in the watershed should be specified. Impacts, if any, should be stated in the impact section.

Page III-49 - Some estimates of number of acres per crop, in addition to average yields, would be helpful in analyzing the watershed economy.

Page III-56, Paragraph d - In addition to the reference cited, the 1975 "Smithsonian Institution Report on Endangered and Threatened Plant Species of the United States" (House Document No. 94-51) should also be used to check for rare and endangered plants in the construction area.

Page III-61, Paragraph b - The Desert Tortoise (Gopherus agassizi) and Gila Monster (Heloderma suspectum) have been placed in Group III of the Arizona Game and Fish Department's "List of Threatened Wildlife of Arizona." This group corresponds closely to the Federal "threatened" category and includes species currently in greatest jeopardy of being eliminated from Arizona.

The current Fish and Wildlife Service Endangered Species Listing was published in the Federal Register, Vol. 40, No. 188, on September 26, 1975, and should be used in lieu of those references listed. This current listing uses only two classifications--Endangered and Threatened.

Pages III-62 - III-63, Paragraph a - The Archeology section should provide enough information for the reader to judge impacts. The assurance that no problem exists (although nine sites were found) is not verified. This section should contain, minimally, the following:

1. A brief synopsis of the cultural history (through historic times) of the Harquahala Valley area.

2. Discussion of previous cultural resource work in the area (with references and bibliography).

3. The text should tell how intense the survey was and what areas it involved. The term "reconnaissance" usually means a less than complete survey. In the areas where ground disturbance is expected, this is not satisfactory.

4. The sites themselves should be described in greater detail and related to the regional synthesis. The sites should also be related to the areas of surface disturbance. If located within them, they should be minimally mapped and collected.

The final statement should include a determination of effect from the State Historic Preservation Officer regarding the National Register property, Harquahala Peak Observatory (page III-63).

A copy of the archeological report by the Arizona State University should be made available to the Western Archeological Center, National Park Service, P.O. Box 49008, Tucson, Arizona 85717, so that a more adequate review of the final environmental impact statement can be made. Also, our BLM is concerned with non-National Register sites and can require mitigation of those on BLM land. Therefore, a copy of the ASU Archeological Report will be needed by our BLM archeologist to fully assess and evaluate the nine sites and other information developed.

Page III-65, Paragraph 3 - The 19 farms in the watershed does not agree with the 20 farm establishments indicated on page III-49.

Page III-72, Figure 2 - From the local contour, it appears that flooding could extend to the south side of Centennial Wash to a greater degree than depicted.

Page III-75, Paragraph 1 - Minimal consideration has been given to potential access problems involving public land use and the erection of protective structures. These should be examined to resolve conflicts.

Page III-76, Paragraph 1 - Information should be provided on numbers and distribution of wild horses and burros. "Tolerable levels" is non-definitive and fails to accurately portray the extent or magnitude of use between competing segments of the wildlife population.

Relationahip to Land Use Plans, Policies, and Controls

Page IV-1 - The construction of retarding structures and land treatment measures will have considerable impact on wildlife habitat and native flora. Under the plan, approximately 2000 acres of national resource land will need to be acquired for easement, and about 11,000 acres of NRL will be directly impacted within the watershed. An additional amount of BLM-administered land surrounding the project and impound area will be impacted to a lesser degree.

Some consideration of BLM's plans, policies, and controls should have been presented in this section. For example, the Phoenix District should be consulted on the Vulture Planning Unit.

Environmental Impacts

Downstream impacts are inadequately addressed. There is a need for specific information on new roads to be constructed, their

location, surfacing, and expected use. Without these specifics, it is impossible to assess the total associated adverse impacts.

Additional maps covering vegetation, soils, topography, land use, etc., would be extremely helpful to assess and juxtapose the various project impacts.

Page V-3, Paragraph 5 - The E 1/2 of Sec. 4, T. 1 N., R. 8 W., is national resource land and not a subdivision as stated in the narrative.

Page V-4, General - Impacts associated with a possible increase in erosion as a result of a loss of downstream vegetation have not been addressed.

Page V-5 - The specific anticipated impacts do not mention haul roads which will be associated with the construction of the structures.

Page V-7, Section b - Who will make the determination and when will it be made for the removal or support of Saguaro Cacti?

Page V-9, Paragraph 1 - A number of endangered species are listed in Appendix F as being in the Harquahala watershed. The statement, "The project will have no known impacts on threatened and endangered species," is not substantiated. Some discussion of habitat available and habitat requirements for the endangered species is needed to substantiate the statement.

Page V-12, Section d - We suggest that shaping and contouring of pit walls be maintained at 4:1 or less.

Page V-14, Section b - Although the dam itself may not restrict animal movement, fencing along the boundary will (page V-8). Is this portion of the dam going to be fenced and if so, what provision has been made for complementary crossings from the impoundment across the aqueduct?

Page V-15, Section d - A general concern of this and similar projects is that they tend to foster land use changes in growth and development. This can adversely affect many of the environmental impacts which appear to be mitigated in the draft environmental statement.

Page V-15, Item 12 - A map should be included defining the extent of the impacted area.

Page V-20, Section F - "Harquahala F.R.S. will limit accessibility to some sectors of the watershed." All other structures will limit access as well, and these impacts should be addressed.

Maintenance activities should be included as an adverse impact.

We hope these comments and suggestions will be of assistance to you.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. Thomas G. Rockenbaugh
State Conservationist
Soil Conservation Service
Department of Agriculture
3008 Federal Building
Phoenix, Arizona 85025

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

• 3 JUN 1976

Mr. Thomas G. Rockenbaugh
State Conservationist
Soil Conservation Service
3008 Federal Building
Phoenix, Arizona 85025

Dear Mr. Rockenbaugh:

This is in response to your letter of 9 April 1976 addressed to the DOT Coordinator for Water Resources concerning a draft environmental impact statement on the supplemental plan for the Harquahala Valley Watershed, Maricopa and Yuma Counties, Arizona.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

D. J. DELEY
Captain, U. S. Coast Guard
Acting Chief, Office of Marine
Environment and Systems

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
100 CALIFORNIA STREET
SAN FRANCISCO, CALIFORNIA 94111

Mr. Thomas G. Rockenbaugh
State Conservationist
United States Department of Agriculture
Soil Conservation Service
3008 Federal Building
230 North First Avenue
Phoenix, AZ 85025

MAY 25 1976

Dear Mr. Rockenbaugh:

The Environmental Protection Agency has received and reviewed the draft environmental impact statement for the Harquahala Valley Watershed Project, Arizona. EPA's comments on the draft environmental statement have been classified as category LO-1. Definitions of the categories are provided on the enclosure. The classification and date of EPA's comments will be published in the Federal Register, in accordance with our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act. Our procedure is to categorize our comments on both the environmental consequences of the proposed action, and the adequacy of the environmental statement.

Mitigation measures for any adverse effects occurring during the construction phase of this project should be indicated in the final EIS. This project should be coordinated with the ongoing Corps of Engineers Urban Study for Phoenix and the Maricopa County Association of Governments, Section 208 of PL 92-500 area-wide waste management plan.

EPA appreciates the opportunity to review this draft environmental statement, and looks forward to receiving two copies of the final statement when available.

Sincerely,

Paul De Falco, Jr.
Regional Administrator

cc: Council on Environmental Quality

EIS CATEGORY CODES

Environmental Impact of the Action

LO--Lack of Objections

EPA has no objection to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER--Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to reassess these aspects.

EU--Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

Adequacy of the Impact Statement

Category 1--Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2--Insufficient Information

EPA believes that the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3--Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement.

If a draft impact statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

RAUL H. CASTRO
GOVERNOR

OFFICE OF THE GOVERNOR
STATE HOUSE
PHOENIX, ARIZONA 85007

IN REPLY
REFER TO:

July 26, 1976

U. S. Department of Agriculture
SOIL CONSERVATION SERVICE
3008 Federal Building
Phoenix, Arizona 85025

Attention: Mr. Thomas G. Rockenbaugh, State Conservationist

Dear Mr. Rockenbaugh:

At my request, the environmental impact statement, HARQUAHALA VALLEY WATERSHED has been reviewed by members of my staff. Their findings have been submitted to me. Based on the information before me, I would like to comment that the overall proposal should bring new benefit to the people and resources within the region of the watershed.

I realized that the control of flooding and sheet flooding problems and the treatment of the land through levy controls has long been an ideal of the agricultural community of the Valley. From the information before me, it would appear that the construction of the Harquahala and Saddleback flood retention structures and the system of levies associated with them will satisfy both the control and the quality goals of the planners.

It is assumed that further field analysis of the soils and geology will assure the safety of the structures. The fact that both of these are 100-year flood structures offers excellent latitude to the project.

The use of our state lands and the requirements of our state law on appropriable water, including change of use, are areas for future consideration in which we should all be prepared to participate cooperatively.

Please consider this letter an endorsement of this preliminary plan for the Harquahala Valley Watershed project.

Sincerely,

Raul H. Castro
Governor

RHC:pbh

Do not type to the left of dotted line.

COVER SHEET for FEDERAL GRANT APPLICATION/AWARD NOTIFICATION

ARIZONA Related To 75-80-0027

1 APPLICATION DATE yr mo day 19 ___ ___ ___

3. APPLICANT – Organizational Unit: Soil Conservation Service

4. ADDRESS – Street or P. O. Box: 3022 Federal Building, 230 North First Avenue

2 FEDERAL EMPLOYER ID NO.

5. CITY: Phoenix

6. COUNTY: Maricopa

7. STATE: Az.

8. ZIP CODE: 85025

9. PROG NO./FEDERAL AGENCY: 10.999 Dept. of Agriculture Soil Conservation Service

10. TYPE OF ACTION: a ☐ New c ☐ Modification b ☐ Continuation

TYPE OF CHANGE (Complete if 10b or 10c was checked)
11. a ☐ Increased Dollars b ☐ Decreased Dollars
12. a ☐ Increased Duration b ☐ Decreased Duration
13. a ☐ Other Scope Change b ☐ Cancellation

14a. EXISTING FED GRANT ID

14b. EXISTING CLEARINGHOUSE: 75-80-0027

15. REQUESTED FUND START yr mo 19___ ___

16. FUNDS DURATION ___(Months)

17. EST. PROJECT START yr mo 19___ ___

18. EST. PROJECT DURATION ___(Months)

19. APPLICANT TYPE — Enter Letter [J]

A. State; B. Interstate; C. COG; D. County; E. City; F. School District; G. Community Action Agency; H. Sponsored Organization; I. Indian; J. Other

FUNDS REQUESTED (For Changes Show Only Amt. of Inc.(+) or Dec.(-))

20a. FEDERAL GRANT	( )$	.00
20b. FEDERAL LOAN	( )$	.00
21. STATE	( )$	.00
22. LOCAL	( )$	.00
23. OTHER	( )$ 1	.00
24. TOTAL (20,21,22,23)	( )$ 1	.00

25. BRIEF TITLE OF APPLICANT'S PROJECT: Harquahala Valley Watershed - Draft Environmental Impact Statement

26. PROJECT ABSTRACT (60 Characters Per Line – 5 Lines). Attach 1–2 Page Project Summary For Review.

Proposed works of improvement for watershed protection and flood prevention include both conservation land treatment and structural measures. Conservation land treatment program is proposed for 13,000 acres of irrigated cropland and about 200,000 acres of rangeland.

27. AREA OF PROJECT IMPACT (Indicate City, County, State, etc.)

Maricopa, Yuma Counties, Arizona

28. CONGRESSIONAL DISTRICT Of Applicant [01] Districts Impacted By Project [03]

29. Environmental Assessment Required By State/Federal Agency? If Yes, Attach. ☒ Yes ☐ No

30. CLEARINGHOUSE(S) TO WHICH SUBMITTED: a ☒ State b ☒ Area Wide

31. a NAME OF CONTACT PERSON: Thomas G. Rockenbaugh, State Conservationist

b ADDRESS – Street or P. O. Box: 3008 Federal Bldg. 230 N. 1st Ave., Phx., Az. 85025

c TELEPHONE NO.: 261-6711 Ext 22

31. d STATE AGENCIES ONLY — WILL PROJECT, REQUIRE NEW POSITION ☐ YES ☐ NO; WILL PROJECT, SUPPORT EXISTING POSITIONS ☐ YES ☐ NO

31. e MATCHING RATIO | FEDERAL | STATE | LOCAL

TO BE COMPLETED BY CLEARINGHOUSE

32. CLEARINGHOUSE ID NO. | ☒ MULTIPLE CLEARINGHOUSE | 201 | 204

33. a ACTION BASED ON REVIEW OF: a ☐ Notification b ☒ Application

33. b ACTION TAKEN: a ☒ With Comment b ☐ Without Comment c ☐ Waived d ☐ Unfavorable

34. STATE APPLICATION IDENTIFIER (SAI): A Z 76800022 (State / Number)

35. CLEARINGHOUSE IMPACT CODE	STATE WIDE	County/City Plng Area	County/City Plng Area	County/City Plng Area	County/City Plng Area	County/City Plng Area	County/City Plng Area
	☐ Yes ☒ No	013	027				

36. STATE PLAN REQUIRED: ☒ Yes ☐ No

CLEARINGHOUSE DATE AT CLEARINGHOUSE: yr mo day 19 76 04 13

38. FINAL CLEARINGHOUSE ACTION DATE: yr mo day 19 76 05 28 By Ralph Kingery

TO BE COMPLETED BY APPLICANT BEFORE SENDING FORM TO FEDERAL AGENCY

39. CERTIFICATION – The applicant certifies that to the best of his knowledge and belief the above data are true and correct and filing of this form has been duly authorized by the governing body of the applicant.

40. a NAME (Print or Type)	b TITLE	c SIGNATURE of Authorized Representative	d TELEPHONE NUMBER

41. DATE MAILED TO FEDERAL/STATE AGENCY yr mo day 19___ ___ ___

42. NAME OF FEDERAL / STATE AGENCY TO WHICH THIS APPLICATION SUBMITTED

TO BE COMPLETED BY FEDERAL AGENCY AND CLEARINGHOUSE IF REQUIRED

43. GRANT APPLICATION ID (Assigned by Federal Agency)

52. Application Rec'd. yr mo day 19 ___ ___ ___

53. a Extension Date

53. b OR

44. GRANTOR AGENCY

45. ORGANIZATIONAL UNIT

46. ADMINISTERING OFFICE

REVISIONS	Amended Applic. Received yr mo day	REVISIONS	Extension Auth. Date	54. Exp. Action Revised As Of yr mo day	REVISIONS	
	C-18					
	19 ___ ___ ___		19	19 ___ ___ ___		19
	19 ___ ___ ___		19	19 ___ ___ ___		19
	19 ___ ___ ___		19	19 ___ ___ ___		19

ARIZONA DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION

206 South Seventeenth Avenue Phoenix, Arizona 85007

RAUL H. CASTRO
Governor

WILLIAM A. ORDWAY
Director

WILLIAM N. PRICE
State Engineer

May 13, 1976

Mr. Ralph Kingery
Arizona State Clearinghouse
Office of Economic Planning
and Development
1624 West Adams, Room 300
Phoenix, AZ 85007

Re: Draft Environmental Impact Statement
Harquahala Valley Watershed, Arizona

Dear Mr. Kingery:

Environmental Planning Services, in coordination with the Structures Section, Highways Division, Arizona Department of Transportation, have reviewed the Draft Environmental Impact Statement for the referenced project submitted by the U.S. Department of Agriculture, Soil Conservation Service.

We remarked on the preliminary Draft Environmental Impact Statement by letter of July 30, 1975 to George C. Marks, State Conservationist, Soil Conservation Service. At that time we suggested that liaison be maintained with the Structures Section and District I of the Arizona Department of Transportation during the development of the project's design and construction stages. The Draft Environmental Impact Statement gives assurances to that effect.

We appreciate the opportunity to examine and comment on this plan.

Yours very truly,

WM. N. PRICE
State Engineer

Mason J. Toles

MASON J. TOLES, Manager
Environmental Planning Services

MJT/ELW/cm

cc: Thomas G. Rockenbaugh ✓
Soil Conservation Service

ADOT, Structures Section
ADOT, District I

ARIZONA GAME & FISH DEPARTMENT

2222 West Greenway Road Phoenix, Arizona 85023 942-3000

May 4, 1976

Mr. Ralph Kingery
Arizona State Clearinghouse
1624 W. Adams, Suite 317
Phoenix, Arizona 85007

Re: SAI 76-80-0022

Dear Mr. Kingery:

The Arizona Game and Fish Department has reviewed the draft environmental statement "Harquahala Valley Watershed" prepared by the Soil Conservation Service. We feel the impacts to wildlife that will result from the project are well documented. The proposed features to allow water to pass through the protective dikes to provide water for downstream vegetation is an excellent plan and receives our full support. The plans to reseed and plant areas affected during construction is also highly desirable.

We have one question related to treated areas. On page III-24, "Seeded and treated areas will be fenced during the planned three-year establishment period for protection from livestock, wildlife, and off-road vehicles." The question is, what type of fencing will be required to protect these areas from wildlife and what forms of wildlife do the areas need protection from? It also may be necessary to provide a longer period than three years for vegetation to become reestablished.

An additional mitigation feature that has not been discussed, and that would provide some compensation for expected habitat losses downstream would be the fencing, to exclude livestock, of the upstream areas of the protective dikes. This would provide a means for maintaining the expected increase in vegetation resulting from increased water behind the dikes. Small game and non-game mammals and birds would benefit greatly from such a feature.

The Department appreciates the opportunities we have had in working with SCS on this project and opportunity to comment. If we can assist or be of help, we are available.

Sincerely,

Robert A. Jantzen, Director

By: John N. Carr, Supervisor
Planning & Evaluation Branch

JNC:dd

cc: Thomas Rockenbaugh

RAUL H CASTRO
GOVERNOR

Arizona
State Land Department
1624 WEST ADAMS
PHOENIX, ARIZONA 85007
602 - 271-4634

OFFICE OF
STATE LAND COMMISSIONER

May 12, 1976

TO: U. S. Department of Agriculture
Soil Conservation Service
3008 Federal Building
Phoenix, Arizona 85025

FROM: The Arizona State Land Department

We have reviewed the draft environmental statement "Harquahala Valley Watershed", published by the U. S. Soil Conservation Service, March, 1976.

This project is basically a watershed protection and land treatment plan, and an examination of the proposed deployment of the control structures would indicate that the purposes and goals of the Harquahala Watershed Project will be accomplished.

According to this document, the anticipated train of environmental effects accompanying and following the five-year construction plan of Saddleback and Harquahala dams and their associated floodways and levees are anticipated and provided for. We have particularly noted the plans for reseeding and soil restoration in and around the areas of disturbed earth, and the rules and regulations by which on -site construction will be carried out.

About 10% of the landfall within the Harquahala Watershed is state trust land. We have checked Appendix B, "Revised Land Status and Resource Unit Map", and would like to call your attention to our findings: Sec. 2, T2N, R8W is not state; Sec. 16, T3N, R9W is not state; Sec. 3, T2N, R9W - S½ only is state; Sec. 15, (W½) T2N, R10W, (W½) only is state; Sec. 16, T2N, R10W, all is state; Sec. 11, T2N, R9W is not state; and Sec. 15, T2N, R9W, NW¼ only is state.

The State Land Department is the designated coordinator for the National Flood Insurance Program in Arizona and under ARS 45-2341 administers its responsibilities related to PL 566 and other flood plain programs for Arizona. The Department finds no conflict between this watershed management proposal and existing flood plain laws and regulations. However, we would like to raise the thought that the introduction of new CAP water and waterways into the area and the construction of the Palo Verde Nuclear Plant nearby could alter the use pattern of this agricultural system in the future.

The alternatives to the Harquahala Valley Watershed proposal are clearly discussed in this document. We reviewed these and the "Short-Term vs Long-Term Use of Resources", Section VII, and conclude that the Harquahala Valley Watershed as described in this draft environmental impact statement is the desirable management application for this region.

Thank you for the opportunity to review this statement.

Sincerely,

Andrew L. Bettwy
State Land Commissioner

Peggy Spaw

By:
Peggy Spaw
Natural Resource Conservation Division

ALB:PS:fmr

CC: Buckeye-Roosevelt Natural Resource Conservation District
Wickenburg Natural Resource Conservation District
Thomas G. Rockenbaugh, State Conservationist
Clearinghouse

BALANCE OF FORM TO BE COMPLETED BY REVIEWING AGENCY

TO:

Dr. R. Gwinn Vivian
Arizona State Archaeologist
Arizona State Museum
Tucson, AZ 85721

State Application Identifier (SAI)

April 13, 1976 State AZ Number 76-80-0022

From: Ralph Kingery

This project is referred to you for review and comment. Please evaluate as to:

(1) the program's effect upon the plans and programs of your agency
(2) the importance of its contribution to State and/or areawide goals and objectives
(3) its accord with any applicable law, order or regulation with which you are familiar
(4) additional considerations

Economic Sec.	Archaeological
Indian Affairs	AORCC
Game & Fish	Museum of No. A
Agri. & Hort.	Renewable Nat'l
Mineral Res.	Resources
Health	Az. Hist. Soc.
Land	Transportation
Water	OEPAD
Parks	
Bureau of Mines	
Az. Mining Ass'n	Region I
Arid Lands	Region IV
Environmental Stud.	
SW Minerals Explor.	

Please return this form to the clearinghouse no later than 15 working days from the date noted above. Please contact the clearinghouse if you need further information or additional time for review.

☐ No comment on this project
☐ Proposal is supported as written
☐ Comments as indicated below

Comments: (Use additional sheets if necessary)

Cultural resources have been considered in this draft EIS. The overall treatment of these resources is average and resources included those associated with prehistoric, historic and modern time periods. The statement only gave a summary of the original reports utilized in compiling the archaeological and historical data for the EIS. However, the summary does indicate that both an inventory of the records pertaining to the area of impact and a survey of the site area took place. The field survey (conducted by the Department of Anthropology, Arizona State University) resulted in a full report that is available for further review. The records inventory was conducted by both the Department of Anthropology, Arizona State University and the Arizona State Museum, Tucson. The level of inventory investigation should be considered sufficient for this stage of the EIS. The field survey located 9 sites and 4 isolated artifact depositions. No additional archaeological investigations of those sites were recommended, nor were any of the site recommended for inclusion in either the Arizona or National Register of Historic Places. Based on the present level of information given in the summary report, this recommendation of mitigative action may be unacceptable. Unless further information clearly indicates that no significant level of anthropological or archaeological knowledge will be derived from further work at these sites, the present mitigation recommendations may be premature.

Reviewer's Signature R. Gwinn Vivian Date May 21, 1976

Archaeologist Telephone 884-2445

Title

BALANCE OF FORM TO BE COMPLETED BY REVIEWING AGENCY

TO:

Mr. John Jett, Director
Mineral Resources Departmen
Fairgrounds, Mineral Building
1826 West McDowell Road
Phoenix, Arizona 85007

State Application Identifier (SAI)

April 13, 1976 State AZ Number 76-80-0022

From: Ralph Kingery

This project is referred to you for review and comment. Please evaluate as to:

(1) the program's effect upon the plans and programs of your agency
(2) the importance of its contribution to State and/or areawide goals and objectives
(3) its accord with any applicable law, order or regulation with which you are familiar
(4) additional considerations

Economic Sec.	Archaeological
Indian Affairs	AORCC
Game & Fish	Museum of No. A
Agri. & Hort.	Renewable Nat'l
Mineral Res.	Resources
Health	Az. Hist. Soc.
Land	Transportation
Water	OEPAD
Parks	
Bureau of Mines	Region I
Az. Mining Ass'n	Region IV
Arid Lands	
Environmental Stud.	
SW Minerals Explor.	

Please return this form to the clearinghouse no later than 15 working days from the date noted above. Please contact the clearinghouse if you need further information or additional time for review.

☐ No comment on this project
☐ Proposal is supported as written
☐ Comments as indicated below

Comments: (Use additional sheets if necessary)

According to USBM I.C. 8236 there are 16 secs. (10,240 Acres) in T4N R9W that contain a placer deposit of potential iron ore. Magnetite makes up 3-7% of the total alluvium to a depth of 15'; in places the content is as much as 10%. The southern part of this area is within 3 miles of the Harquahala F.R.S., however, due to the differences in elevation it is doubtful the placer iron area would be flooded as a consequence of the levee.

On the USGS topographic sheet Bighorn Mtns. is shown a mine shaft near the SW corner of sec. 15 T3N R9W. No specific information can be found on this property; however, access to it should be provided.

Beginning hear the north-central part of sec. 30 T4N R9W and extending south easterly to the SE corner of sec. e T2N R9W is a road that will be seriously affected by construction of the Harquahala F.R.S. The explanation of the alternative to this road given on page III-13 is unacceptable.

Reviewer's Signature Glen Walker Date 4/19/76

Title Field engineer D.M.R. Telephone 271-3791

BALANCE OF FORM TO BE COMPLETED BY REVIEWING AGENCY

O:

Mr. Wesley E. Steiner, Eng.
State Water Commission
222 N. Central Ave., Suite 800
Phoenix, Arizona 85004

State Application Identifier (SAI)

April 13, 1976 State AZ Number 76-80-0022

From: Ralph Kingery

This project is referred to you for review and comment. Please evaluate as to:

(1) the program's effect upon the plans and programs of your agency
(2) the importance of its contribution to State and/or areawide goals and objectives
(3) its accord with any applicable law, order or regulation with which you are familiar
(4) additional considerations

Economic Sec.	Archaeological
Indian Affairs	AORCC
Game & Fish	Museum of No.
Agri. & Hort.	Renewable Nat'l. Resources
Mineral Res.	
Health	Az. Hist. Soc.
Land	Transportation
Water	OEPAD
Parks	
Bureau of Mines	
Az. Mining Ass'n	Region I
Arid Lands	Region IV
Environmental Stud.	
SW Minerals Explor.	

Please return this form to the clearinghouse no later than 15 working days from the date noted above. Please contact the clearinghouse if you need further information or additional time for review.

☐ No comment on this project
☑ Proposal is supported as written
☐ Comments as indicated below

Comments: (Use additional sheets if necessary)

The Arizona Water Commission assisted in the preparation of this report

Reviewer's Signature Bob Farrer Date 4-16-76

Title Staff Engr. Telephone

OFFICE OF THE BOARD OF SUPERVISORS

MARICOPA COUNTY
602 County Administration Bldg. 111 S. 3rd Avenue, Phoenix, Arizona 85003

HENRY H. HAWS District 1 | ELDON RUDD District 2 | BOB CORBIN District 3 | BOB STARK District 4 | JOE EDDIE LOPEZ District 5

May 20, 1976

U. S. Department of Agriculture
Soil Conservation Service
3008 Federal Building
Phoenix, Arizona 85025

Attention Mr. Thomas Rockenbaugh

Re: Harquahala Valley Watershed- Environmental Impact Statement

Gentlemen:

The environmental impact statement for Harquahala Valley Watershed, Arizona received with your letter of April 9, 1976, has been reviewed by the various County departments to which you furnished copies. Their individual reviews reflect the following comments:

The Flood Control District of Maricopa County advises that their comments from previous reviews have already been incorporated in this draft of the statement.

The Maricopa County Parks Department again emphasize their comments of August 6, 1975, wherein they indicated their concern for maintaining horse trails and bicycle & foot paths along the Central Arizona Project right-of-way. Continuity of trails should be a consideration if any of the area will be fenced.

They also reiterate their concern for revegetation and the long range possibility of use of the area for park purposes. Your attention should also be directed to Board of Supervisor's Resolution of May 10, 1976, regarding embankment slopes for the Spook Hill structure. It is requested that the same consideration be given this project.

Maricopa County Park Department staff will be available to work with you on any aspect of the development as it may affect recreational activities.

The Maricopa County Highway Department has pointed out in their letter of April 15, 1976, that a minimum 50' roadway should be provided over the proposed box culvert on Courthouse Road.

Any effort to an early completion of the project will be greatly appreciated.

Cordially,

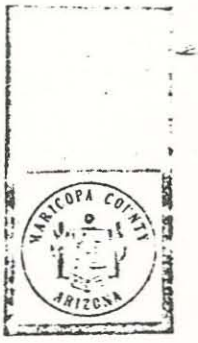
BOARD OF SUPERVISORS

Henry H. Haws
District 1

MARICOPA COUNTY PARKS AND RECREATION DEPARTMENT

4701 EAST WASHINGTON STREET, PHOENIX, ARIZONA 85034

ADMINISTRATION & PARKS 262-3711 RECREATION 262-3716



For several years, Maricopa County Parks Commission and Staff have been concerned with the construction of flood control structures in the County; especially, effecting the visual and utilitarian impact. Recently, our Commission addressed this problem in approving a design presented for the Spook Hill dike. Our Staff and the appropriate Federal officials worked out solutions satisfactory to both parties. The Commission then adopted a resolution which is intended to be a guide for the design and construction of all future flood control structures in the County.

This guide will be used by Staff and the appropriate officials informing the appropriate Federal agencies as to the County's position in these matters. A copy of this resolution is enclosed for your information.

We hope you will use these guidelines should you be involved with like problems.

If you have any questions regarding the position of our Commission or our department, please do not hesitate to contact our office.

Very truly yours,

ROBERT H. MILNE, Director
MARICOPA COUNTY PARKS AND RECREATION DEPARTMENT

By _____
Bill Richwine
Assistant Director

M:s

Enc.

MARICOPA COUNTY

PARKS AND RECREATION COMMISSION

The Maricopa County Parks and Recreation Commission has adopted a Resolution pertaining to floodwater retarding structures and will apply the requirements of this Resolution, as described below, as a standard and guide for the construction of future floodwater retarding structures.

1. The sides and top of the structure will be furrowed to enhance vegetation growth.
2. The structure will meander throughout its length as opposed to the traditional straight line structures, enabling natural islands of vegetation to be left.
3. The top soil will be replaced throughout the structure, preferably with "on site" top soil, rather than mixtures that may be "imported" from other areas.
4. The entire structure will be landscaped in accordance with pre-approved plans with an emphasis on large shrubs or trees where possible, near the top of the structure to break the monotonous straight line effect of the structure.
5. Great care will be taken to assure that the natural flora and fauna be disturbed as little as possible.

6. As much natural vegetation as possible will be left throughout the bounds of the construction project.
7. Irrigation will be installed the entire length of the structure.
8. The Maricopa County Parks and Recreation Department and/or Commission will have the opportunity to review the plans and specifications as required and requested.
9. The grading of the area must be done in cooperation witn the Maricopa County Parks and Recreation Department development plans to facilitate future development and other agencies that may be directly involved with the specific structure.
10. The contractor will make a sincere effort to construct and preserve a service road that may be used as a future pleasure drive along the upstream side of the structure.
11. The side scope ratio shall be a minimum of 2½ : 1.

R:s

MARICOPA COUNTY HIGHWAY DEPARTMENT

3325 WEST DURANGO STREET • PHOENIX, ARIZONA 85009

R. C. ESTERBROOKS, P.E.
COUNTY ENGINEER

F. H. LATHROP, P.E.
DEPUTY COUNTY ENGINEER

April 15, 1976

U. S. Department of Agriculture
Soil Conservation Service
3008 Federal Building
Phoenix, Arizona 85025

Attention Mr. Thomas G. Rockenbaugh

Gentlemen:

Re: Harquahala Valley - Watershed
Environmental Impact Statement

The draft Environmental Impact Statement for Harquahala Valley Watershed, submitted with your letter of April 9, 1976, has been further reviewed by Maricopa County Highway Department.

We still offer the same comments as transmitted in our letter of July 25, 1975, with respect to provisions for County roads crossing the diversion structure.

Although the pavement on Courthouse Road is only 28 feet wide, our minimum cross section for any County highway provides a 10-foot wide shoulder on each side of the pavement for safety and emergency parking. Any structure on the roadway must be at least as wide as the pavement and shoulders combined. This accounts for the necessity of a 50-foot roadway over the proposed box culvert.

If, as you indicate, this provision is the responsibility of the Flood Control District, we are, by copy of this letter, requesting them to make arrangements for you to include such in the construction plans.

Very truly yours,

F. H. Lathrop, P.E.
Acting County Engineer

FHL:mr

cc: Mr. H. Donald

Buckeye-Roosevelt
Natural Resource Conservation District

508 N. 4th Street
Buckeye, AZ 85326

May 14, 1976

Thomas G. Rockenbaugh
State Conservationist
U.S. Department of Agriculture
Soil Conservation Service
3008 Federal Building
230 N. First Avenue
Phoenix, AZ 85025

Dear Sir:

The supervisors of this board have reviewed the Draft Environmental Impact Statement for the PL-566 Project, Harquahala Watershed, and have one comment. When the final decision on the size of the deadwater areas above the flood water retarding structures is made, we recommend that the size of the area be held as large as possible for wildlife and livestock use even though it might require purchasing water rights from the downstream water users.

Sincerely yours,

John E. Fornes
Chairman
Buckeye-Roosevelt NRCD

El Paso NATURAL GAS COMPANY

P. O. BOX 1492
EL PASO, TEXAS 79978

PHONE: 915-543-2600

APR 2 9 1976

April 28, 1976

3	[illegible] Engr.	[illegible]	Engrg
2	D[illegible]		
	P[illegible]		
4	C & O		
	Hydrology		
		5	12.2.1

Flood Control District
of Maricopa County
3325 W. Durango
Phoenix, Arizona 85009

Attention: Mr. Herbert P. Donald
Chief Engineer and General Manager
Flood Control District of Maricopa
County for the Watershed Project Sponsors

Re: R/W 71930 Central
Arizona Project:
Harquahala Valley Watershed
Cal Lines and Waha Ehrenberg
Line, M.P. 648
Maricopa County, Arizona

Gentlemen:

El Paso Natural Gas Company's Engineers have completed their study of the Draft of the Environmental Impact Statement dated March 1976 for the captioned project.

From pages III-17, III-18 and Plate 4 of the study we note that floodwater will be released from the Saddleback Diversion into a drainage way leading to Centennial Wash. Four El Paso Natural Gas Company pipelines cross the drainageway between the diversion outlet and Centennial Wash and will be subject to the concentrated water flow.

According to the Impact Statement, excess scouring is not expected to occur. However, El Paso Natural Gas Company would hope that you would monitor this area and take such corrective measures as are necessary should excess scouring occur.

Your cooperation will be greatly appreciated.

Very truly yours,

Wayne C. Stephens

Wayne C. Stephens
Manager
Controls Division
Right of Way Department

DH/la

4/19/76

SIERRA CLUB

Grand Canyon Chapter · Arizona

Dear Sirs;

I am writing to comment on the Harquahala Valley Watershed EIS.

It seems to me that the most serious impact this project would have if implemented is the loss of over 10,000 acres of creasotebush on the downstream side of project structures & the resultant wildlife death that would undoubtedly follow. It seems doubtful whether the benefits incurred on the upstream side of the project structures would offset those on the downstream end.

One problem area overlooked in the discussion of the project was the possible effect of subsidence cracks caused by continued ground water pumping. The ASU Geology dept. has done a detailed study of subsidence caused by pumping of groundwater and its effects on surface structures. These cracks always occur in the transition zone between playas and alluvial slopes coming off mountain ranges. They could create zones of weakness in retarding structures.

(OVER)

A cumulative climatic effect from various Flood control projects over the whole state may have a tendency to create more humid weather conditions. The ponding and slow release of floodwaters would certainly be 2 factors to consider in this possible impact.

Sincerely,
Jim Vaaler
Membership Chairman

823 N. Brand Blvd.
Glendale, Calif. 91203
Friday - June 4, 1976

United States Department of Agriculture
Soil Conservation Service
3008 Federal Building
Phoenix, Arizona 85025

Gentlemen:

Enclosed is my comments and request on Harquahala Valley water shed.

First our request. We object to the route the Flood Control is taking through our land, but if there is no other way, we request the dikes be moved west of the dividing line of 9 & 10 west along section 30, R2N9W and R2N10W, Section 25.

Move closer to the Allison tank so the dikes will not interfer with our well sites.

We request the top of dike be 14 feet in width to serve as a road when flooding forces us and our cattle and other livestock out.

There is plenty of borrow material around the Allison tank. Hauling cost will be minimum, and control the thrust of the Centennial Wash.

We request road crossings over C. A. P. and dikes on South of Section 30, 29, 28, 27 through to Gin Road. T2NR9W, also Section 25, 26, 27, 28 through to Gasline Road, T2NR10W.

We request road crossings on dividing line of 9 & 10 West over all dikes, C. A. P. and flood/from Courthouse Road to Interstate 10 to the Aquila overpass.

Our request for the above roads and crossings were granted us by the Board of Supervisors on April 30, 1919. Enclosed is a copy of the Grant.

We request road crossing over C. A. P. and flood dikes on North line of Section 24 and Section 23 R2N10W. This is for the convenience of range cattle and prevent complete severence of Section 23.

We would like some type of passage over dikes between Section 30 and 25 to accommodate live stock and farm impliments. You may use borrow material from the Allison tank.

May I compliment the various officials and other organizations on their planning of the C. A. P. and flood control.

The non-draining borrow areas, also non-draining areas, which will store storm runoff, and wild life and recharge the aquifers. I believe a cattle tank should be placed beside every turn in the

United States Dept. of Agriculture
Soil Conservation Service

Centennial Wash, which would serve to inhibit the rushing waters, also aid wild life. These various features will serve as a soft plug in a boiler. We are dealing with explosives when we group many waters in one or two spots.

The Arizona flash floods are similar to California earthquakes. We must prepare. They often come without warning.

Many families have spread their lunch in a beautiful Arroyo only to loose their possessions, and often their lives while the sun yet shines.

My forefathers were engineers and developers. Hanson Dredge Co. in Illinois was my brother-in-law. They drained so much water into Black River in Arkansas, the Government purchased the land and turned it into game reserve. River overflowed everytime there was rain. A body of water is something to be cautious of and to use every available source to impede the water, as soft plugs in a boiler relieves the pressure; controls on a nuclear energy plant; bracing of buildings to withstand earthquakes.

May I compliment your planning on the site of the Palo Verda Nuclear Plant being near the railroads and hidden in the hills.

Our group drained land in the Southern States which was so depleted one could not grow turkeys on it, and that was the days when money was a scarce commodity. If all those improvements could be made in Eastern-Southern and Mid-Western states, surely we should be able to obtain funds to improve the most productive land in the United States our rich soil, warm climate double crop seasons makes it so.

We are thankful to our planning officials for their foresight.

One does not embark on an ocean voyage in a conoe, and curse the big ship which makes the rescue, even though a few mistakes are made in throwing the life line. One does not pitch a camp on a river without getting wet feet.

With all of my defense of wild life of which I am very fond, I yet must refer you to the beginning of our Bible history - Genesis Chapter one, verse 26 - God placed man over all he created. So the birds and bees were not created to subjugate man, but was created for his food, help and pleasure.

Thank you for bearing with me.

Sincerely

C-37 E. Billie Bennett

E. Billie Bennett

SCHEDULE B

Showing defects, liens, encumbrances and other matters against which the Company does not, by this Policy, insure.

Exceptions Nos. 1 to 4, both inclusive, as shown on rider attached hereto and made a part hereof.

5. Rights of way for canals, laterals and ditches.

6. Taxes for the year 1956, a lien, but not yet payable.

7. Roadway over the East and South 33 feet of said Section 25, as established by Order of the Board of Supervisors, on April 30, 1919, and disclosed by Road Map recorded in Book 1 of Road Maps, page 59, and other instruments of record.

NOTE: Unless expressly set forth otherwise in Schedule B hereof, this Policy insures that no restriction upon the sale or occupancy of insured premises on the basis of race, color or creed, has been filed of record at any time subsequent

E. Billie Bennett

3008 Federal Building, Phoenix, Arizona 85025

June 15, 1976

Mr. E. Billie Bennett
823 North Brand Blvd.
Glendale, CA 91203

Dear Mr. Bennett:

I appreciate your candid and specific comments concerning the Harquahala Valley Watershed project. We will certainly consider all your suggestions, and either incorporate them into the final environmental impact statement, or explain why we could not.

I am returning your original insurance policy Schedule B which mentions the roadways granted you by the County Board of Supervisors. We have noted the description. This document could be valuable to you. We do not need an original like this in our files.

Thank you again for your comments. You will receive a copy of the final environmental impact statement when it is published.

Sincerely,

Thomas G. Rockenbaugh
State Conservationist

Attachment

bcc:
R. L. Clark

Big Valley Water Co.

P.O. Box 448
Salome, Arizona 85348

June 5, 1976

Mr. Thomas G. Rockenbaugh
State Conservationist
United States Department of Agriculture
Soil Conservation Service
3008 Federal Building
Phoenix, Arizona 85025

Dear Mr. Rockenbaugh:

We received a copy of the draft Environmental Impact Statement for PL-566 Project, Harquahala Valley Watershed, Arizona, on May 15, 1976.

Speaking for the majority of the landowners that will be affected by this Project, we reject the draft as designed.

Sincerely,

Barto B. Price
Chairman

3008 Federal Building, Phoenix, Arizona 85025

June 17, 1976

Mr. Barto B. Price, Chairman
Big Valley Water Co.
P. O. Box 448
Salome, Arizona 85348

Dear Mr. Price:

Thank you for your June 5, 1976, comments on the draft environmental impact statement for Harquahala Valley Watershed. Your comment, ". . ., we reject the draft as designed." is very general, but our discussion when you visited this office on June 8 was much more specific. That discussion brought out your three main concerns.

1. You would like to see low flow releases put into the flood-water retarding structures at points where the structures cross existing dry washes.

2. You would like to see the project sponsors physically relocate people on other land rather than just purchasing necessary land rights.

3. You question the wisdom of designing small pools for water for wildlife behind the structures, when it is recognized these pools will go dry in some years. You would apparently prefer that any wildlife water be taken from Central Arizona Project allocations.

We will respond to these three comments in the final environmental statement. Please let me know if I have misstated your comments.

Sincerely,

Thomas G. Rockenbaugh

Thomas G. Rockenbaugh
State Conservationist

cc:
H. P. Donald

bcc: (w/copy of Price letter)
W. E. Steiner, AWC
R. L. Clark, RBWS Staff Ldr.
J. L. Knisley, Jr., AC
J. H. Fronske, DC

6/21

APPENDIX D

GLOSSARY OF TERMS

APPENDIX D

Glossary of Terms

acre-foot

The amount of water that will cover one acre to a depth of 1 foot. Equals 43,560 cubic feet. Abbreviated AF.

aesthetics

A branch of philosophy dealing with the nature of the beautiful and with judgments concerning beauty.

AF

Abbreviation for acre-foot or acre-feet.

bosque

A grove or community of trees in a given area.

brush management

Management and manipulation of stands of brush by mechanical, chemical, or biological means, or by controlled burning on rangeland, native pasture, pastureland, recreationland and wildlifeland. (Includes reducing excess brush to restore natural plant community balance and manipulating brush stands through selective and patterned control methods to meet specific needs of the land and objectives of the land user.)

caliche

In the southwest United States, gravel, sand, or desert debris cemented by porous calcium carbonate; also the calcium carbonate itself.

carrying capacity

The number of animals that can be maintained in a given habitat.

cfs

Abbreviation for cubic feet per second. A unit of water flow. Sometimes called "second-feet."

conglomerate

Rounded waterworn fragments of rock or pebbles.

conservation cropping system

Growing crops in combination with needed cultural and management measures. Cropping systems include the use of rotations that contain grasses and legumes, as well as sequences in which the desired benefits are achieved without the use of such crops.

crop residue use

Utilizing plant residues left in cultivated fields by incorporating them into the soil or leaving them on the surface during that part of the year when critical erosion periods usually occur.

desert pavement

A thin, natural, smooth or sheet-like residual concentration of wind polished, closely packed pebbles, boulders, gravel, and other rock fragments, mantling a desert surface where wind action and sheetwash have continually removed all smaller particles (sand and dust) and usually protecting the underlying finer grained material from further deflation. The fragments commonly are cemented by mineralized solutions.

design storm

A given rainfall amount, areal distribution, and time distribution, used to estimate runoff. The rainfall amount is either a given frequency (25, 50-year, etc.) or a special large value.

dike and levee

Earthen embankment constructed across defined watercourse or water overflow area.

direct runoff

The water that enters the stream channels during a storm or soon after, forming a runoff hydrograph. May consist of rainfall on the stream surface, surface runoff, and seepage of infiltrated water (rapid subsurface flow).

diversion

A channel designed to divert water from a body of water for purposes such as prevention of flooding, reduction of erosion, or promotion of infiltration.

emergency spillway

A rock or vegetated earth waterway around a dam, built with its crest above the normally used principal spillway. Used to assist the principal spillway in conveying extreme amounts of runoff safely past the dam.

endangered species

Species or subspecies of vertebrates, mollusks or crustaceans determined to be threatened with extinction.

family

In taxonomy, a category containing one or more genera which have similar characteristics.

fanglomerate

Composed of heterogenous materials which were originally deposited in an alluvial fan but which since deposition have been cemented into rock.

fauna

All animal life associated with a given habitat, country, area, or period.

flood pool

Floodwater storage in a reservoir. In a floodwater retarding reservoir, the temporary storage between the crests of the principal and emergency spillways.

floodwater retarding structure

A dam, usually with an earth fill, having a flood pool where incoming floodwater is temporarily stored and slowly released downstream through a principal spillway. The reservoir contains a sediment pool and sometimes storage for irrigation or other purposes.

floodway

(a) A large capacity channel constructed to divert floodwaters or excess streamflow from populous or damageable areas, such as a bypass route marked by levee. (b) The part of a floodplain kept clear of encumbrances and reserved for emergency diversion of floodwaters.

flora

All plantlife associated with a given habitat, country, or period. Bacteria are considered flora.

forb

Any herb other than grass.

foundation

The lower, manmade, supporting part of an engineering structure in contact with the underlying soil or rock and transmitting the weight of the structure and its included loads to the underlying earth material.

freeboard

(a) The additional height that is above the recorded or design high water mark of a dam associated with a body of water and that represents an allowance against overtopping by transient disturbances. (b) The vertical distance between the water level at a given time and the top of an engineering structure, such as the distance between the normal operating level of a reservoir and the crest of the associated dam.

frequency

An expression or measure of how often a hydrologic event of given size or magnitude should, on an average, be equaled or exceeded. For example, a 50-year frequency flood should be equaled or exceeded in size, on the average, only once in 50 years. In drought or deficiency studies it usually defines how many years will, on the average, be equal to or less than a given size or magnitude.

groundwater

The water in the saturated zone beneath the water table. A source of base flow in streams.

habitat

An area where a plant or animal lives. (Sum total of environmental conditions in the area.)

100-year 10-day storm

The storm of 10-day duration which would produce a discharge volume in any given stream which would be expected to be equaled or exceeded in magnitude only once in 100 years.

100-year 6-hour storm

The storm of 6-hour duration which would produce a discharge

peak which would, on the average, be equaled or exceeded in magnitude only once in 100 years.

hydrologic soil group

A group of soils having the same runoff potential under similar storm and cover conditions.

irrigation ditch and canal lining

A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch or irrigation canal or lateral.

irrigation land leveling

Reshaping the surface of land to be irrigated to planned grades.

irrigation pipeline

A pipe or other closed conduit installed in an irrigation system.

irrigation water management

The use and management of irrigation water, where the quantity of water used for each irrigation is determined by the moisture-holding capacity of the soil and the need of the crop, where the water is applied at a rate and in such a manner that crops can use it efficiently and significant erosion does not occur.

levee

An artificial embankment, usually of random earth fill, built along the bank of a watercourse and designed to protect land from inundation or to confine streamflow to its channel.

percent chance

A name often given to the probability scale on log-normal paper. A 2 percent chance flood is a 50-year frequency flood (see frequency) since $\frac{100}{\text{percent chance}}$ = frequency in years.

peripheral

A peripheral species or subspecies is one whose occurrence in the United States is at the edge of its natural range and which is threatened with extinction within the United States although not in its range as a whole.

principal spillway

A concrete or metal pipe or conduit used with a drop inlet dam or floodwater retarding structure. It conveys, in a safe and non-erosive manner, all ordinary discharges coming into a reservoir and all of an extreme amount that does not pass through the emergency spillway.

proper grazing use

Limiting livestock grazing to an intensity which will maintain enough cover to protect the soil and maintain the quantity and quality of desirable vegetative cover.

pseudoriparian

Woody plants capable of completing their life cycle in relatively xeric or mesic sites, but which achieve maximum size and density when additional subsurface moisture is available. (Example: mesquite, ironwood and paloverde trees.)

range condition

The present state of vegetation of a range site in relation to the climax plant community for that site.

range seeding

Establishing adapted plants by seeding on rangeland.

range site

A distinctive kind of rangeland that differs from other kinds of rangeland in its potential to produce native plants.

retarding pool

The reservoir space allotted to the temporary impoundment of floodwater. Its upper limit is the elevation of the crest of the emergency spillway.

rock

In an engineering sense, the term rock signifies firm and coherent or consolidated substances that cannot normally be excavated by manual methods alone.

sediment pool

The reservoir space allotted to the accumulation of submerged sediment during the life of the structure.

sediment pool elevation

The elevation of the surface of the anticipated sediment accumulation at the dam.

sheetflow

A broad expanse of moving, stormborne water that spreads as a thin, continuous, relatively uniform film over a large area in an arid region and that is not concentrated into well defined channels; its distance of flow is short and its duration is measured in minutes or hours. Sheetflows usually occur before runoff is sufficient to promote channel flow, or after a period of sudden and heavy rainfall.

species

In taxonomy, a subdivision of a genus which (1) has a high degree of similarity; (2) is capable of interbreeding only among themselves; and (3) show persistent differences from members of allied species.

status-undetermined

A species or subspecies that has been suggested as possibly threatened with extinction, but about which there is not enough information to determine its status. More information is needed.

structural measure

For flood prevention work, any form of earthwork (dam, ditch, levee, etc.) or installation of concrete, masonry, metal or other material (drop spillway, jetties, riprap, etc.).

structure for water control

A structure in an irrigation or drainage system for water management that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation in a natural or artificial channel. Also includes any structure for managing water levels for wildlife or other purposes.

surface runoff

Total rainfall minus interception, evaporation, infiltration, and surface storage, and which moves across the ground surface to a stream or depression.

suspended load

Particles moving outside the bed layer. Includes suspended bed material and wash load.

tailwater recovery system

A facility to collect, store, and transport irrigation tailwater for reuse in the farm irrigation distribution system. The most common practice is to construct a dugout pit at the lower end of a field or series of fields and pump collected tailwater back to the head of the field(s) for on-farm reuse.

threatened species

Species or subspecies that are so few in numbers or so threatened by present circumstances, as to be in danger of extinction.

timing and scheduling

A nonstructural management practice used to time and schedule the distribution and application or irrigation water.

water spreading

Diverting runoff from natural watercourses by means of a system of dams, dikes or ditches, and spreading it over relatively flat areas. The objective being to induce increased vegetative growth.

vector

An organism (as an insect) that transmits disease.

xerophyte

Plants which are structurally adapted to growing in dry or desert conditions. The plants often have a greatly reduced leaf surface area to prevent water loss; thick fleshy parts for water storage; and many possess hairs, spines, or thorns. (Examples: cacti, Joshua tree, yucca.)

APPENDIX E

REPRESENTATIVE PLANT LIST

APPENDIX E

Representative Plant List of the Harquahala Valley Watershed

Grasses

big galleta	Hilaria rigida
bush muhly	Muhlenbergia Porteri
fluffgrass	Tridens puchellus
Rothrock grama	Bouteloua Rothrockii
sixweeks grama	Bouteloua barbata
tobosa	Hilaria mutica
threeawn	Aristida spp.

Forbs

California poppy	Eschscholtzia mexicana
desert marigold	Baileya multiradiata
dogweed	Dyssodia acerosa
fiddleneck	Amsinckia intermedia
fiddleneck or purple heliotrope	Phacelia tenacetifolia
filaree	Erodium cicutarium
globemallow	Sphaeralcea spp.
indianwheat	Plantago insularis
mustard	Sisymbrium irio
owl-clover	Orthocarpus purpurascens
peppergrass	Lepidium lasiocarpus
Russian-thistle	Salsola Kali
tansymustard	Descurainia pinnata

Cactus

buckhorn cholla	Opuntia acanthocarpa

Cactus (Cont'd)

chain cholla	Opuntia spinosior
compass barrel cactus	Ferocactus acanthodes
coville barrel cactus	Ferocactus covillei
desert Christmas cholla	Opuntia leptocaulis
desert night-blooming cereus	Cereus Greggii
diamond cholla	Opuntia ramosissima
fishhook barrel cactus	Ferocactus acanthodes
fishhook pincushion	Mammillaria spp.
hedgehog cactus	Echinocereus fasciculatus
jumping cholla	Opuntia fulgida
pricklypear	Opuntia phaeacantha
saguaro	Cereus giganteus
silver cholla	Opuntia echinocarpa
staghorn cholla	Opuntia versicolor
teddy bear cholla	Opuntia Bigelovii

Shrubs and Trees

bitter condalia	Condalia globosa
catclaw	Acacia Greggii
creosotebush	Larrea divaricata
crucifixion thorn	Holocantha Emoryi
desert hackberry	Celtis pallida
desert saltbush	Atriplex polycarpa
desert thorn	Lycium sp.
false mesquite	Calliandra eriophylla
four-wing saltbush	Atriplex canescens
graythorn	Condalia lycioides

Shrubs and Trees (Cont'd)

ironwood	Olneya tesota
joint fir	Ephedra trifurca
ocotillo	Fouquieria spendens
paloverde	
1) littleleaf (foothill)	Cercidium microphyllum
2) blue	Cercidium floridum
quailbush	Atriplex lentiformis
ratany	Krameria parvifolia
salt cedar	Tamarix pentandra
smoketree (smokethorn)	Dalea spinosa
triangle bursage	Franseria deltoidea
velvet mesquite	Prosopis juliflora var. velutina
western honey mesquite	Prosopis juliflora var. torreyana
white brittlebrush	Encelia farinosa
white bursage	Franseria dumosa
whitethorn	Acacia constricta

APPENDIX F

TERRESTRIAL VERTEBRATES

APPENDIX F

Terrestrial Vertebrates of the Harquahala Valley Watershed

Mammals

Desert Shrew	*Natiosorex crawfordi*
Leafnose Bat	*Macrotus californicus*
Yuma Myotis	*Myotis yumanensis*
Cave Myotis	*Myotis velifer*
Long-Eared Myotis	*Myotis evotis*
Fringed Myotis	*Myotis thysanodes*
Long-Legged Myotis	*Myotis volans*
California Myotis	*Myotis californicus*
Small-Footed Myotis	*Myotis subulatus*
Western Pipistrel	*Pipistrellus hesperus*
Big Brown Bat	*Eptesicus fuscus*
Hoary Bat	*Lasiurus cinereus*
Red Bat	*Lasiurus borealis*
Spotted Bat	*Euderma maculata*
Western Big-Eared Bat	*Corynorhinus rafinesquei*
Pallid Bat	*Antrozous pallidus*
Mexican Freetail Bat	*Tadarida cynocephala*
Big Freetail Bat	*Tadarida macrotis*
Western Mastiff Bat	*Eumops perotis*
Raccoon	*Procyon lotor*
Ringtail Cat	*Bassariscus astutus*
Spotted Skunk	*Spilogale putorius*
Striped Skunk	*Mephitis mephitis*
Badger	*Taxidea taxus*

Mountain Lion	Felis concolor
Bobcat	Lynx rufus
Rock Squirrel	Citellus variegatus
Yuma Antelope Squirrel	Cytellus harrisi
Roundtail Ground Squirrel	Cytellus tereticaudus
Valley Pocket Gopher	Thomomys bottae
Silky Pocket Mouse	Perognathus flavus
Arizona Pocket Mouse	Perognathus amplus
Little Pocket Mouse	Perognathus longimembris
Bailey Pocket Mouse	Perognathus baileyi
Desert Pocket Mouse	Perognathus penicillatus
Rock Pocket Mouse	Perognathus intermedius
Merriam Kangaroo Rat	Dipodomys merriami
Ord Kangaroo Rat	Dipodomys ordi
Desert Kangaroo Rat	Dipodomys deserti
House Mouse	Mus musculus
Southern Grasshopper Mouse	Onychomys torridus
Western Harvest Mouse	Reithrodontomys megalotis
Cactus Mouse	Peromyscus eremicus
Deer Mouse	Peromyscus maniculatus
Hispid Cotton Rat	Sigmodon hispidus
Whitethroat Woodrat	Neotoma albigula
Desert Woodrat	Neotoma lepida
Muskrat	Ondatra zibethica
Norway Rat	Rattus norvegicus

Blacktail Jackrabbit	*Lepus californicus*
Desert Cottontail	*Sylvilagus auduboni*
Mule Deer	*Odocoileus hemionus*
Bighorn Sheep	*Ovis canadensis*
Kit Fox	*Vulpes velox*
Gray Fox	*Urocyon cinereoargenteus*
Coyote	*Canis latrans*

Appendix F

Terrestrial Vertebrates of the Harquahala Valley Watershed

Reptiles and Amphibians

Couch's Spadefoot Toad	*Scaphiopus couchi*
Western Spadefoot Toad	*Scaphiopus hammondi*
Colorado River Toad	*Bufo alvarius*
Great Plains Toad	*Bufo cognatus*
Leopard Frog	*Rana pipiens*
Bull Frog	*Rana catesbeiana*
Desert Tortoise	*Gopherus agassizi*
Texas Softshell	*Trionyx spiniferus emoryi*
Desert Banded Gecko	*Coleonyx variegatus variegatus*
Desert Iguana	*Dipsosaurus dorsalis*
Arizona Chuckwalla	*Sauromalis obesus tumidus*
Western Chuckwalla	*Sauromalis obesus obesus*
Zebra-Tailed Lizard	*Callisaurus draconoides*
Collared Lizard	*Crotaphytus collaris*
Long-Nosed Leopard Lizard	*Crotaphytus wislizenii wislizenii*
Desert Spiny Lizard	*Sceloporus magister magister*
Sonora Spiny Lizard	*Sceloporus clarki clarki*
Desert Side-Blotched Lizard	*Uta stansburiana stejnegeri*
Arizona Brush Lizard	*Urosaurus graciosus shannoni*
Tree Lizard	*Urosaurus ornatus*
Southern Desert Horned Lizard	*Phrynosoma platyrhinos calidiarum*
Regal Horned Lizard	*Phrynosoma solare*

Southern Whiptail	Cnemidophorus tigris gracilis
Reticulate Gila Monster	Heloderma suspectum suspectum
Western Blind Snake	Leptotyphlops humilis
Desert Rosy Boa	Lichanura trivirgata gracia
Western Leaf-Nosed Snake	Phyllorhynchus decurtatus perkinsi
Maricopa Leaf-Nosed Snake	Phyllorhynchus browni lucidus
Red Racer (Western Black Racer)	Masticophis flagellum piceus
Desert Patch-Nosed Snake	Salvadora hexalepis hexalepis
Arizona Glossy Snake	Arizona elegans noctivaga
Sonora Gopher Snake	Pituophis melanoleucus affinis
Yuma Kingsnake	Lampropeltis getulus yumensis
Western Long-Nosed Snake	Rhinocheilus lecontei lecontei
Checkered Garter Snake	Thamnophis marcianus
Western Ground Snake	Sonora semiannulata
Colorado Desert Shovel-Nosed Snake	Chionactis occipitalis annulata
Tucson Shovel-Nosed Snake	Chionactis occipitalis klauberi
Banded Sand Snake	Chilomeniscus cinctus
Mexican Black-Headed Snake	Tantilla planiceps articeps
Sonora Lyre Snake	Trimorphodon lambda
Spotted Night Snake	Hypsiglena torquata ochrorhyncha
Arizona Coral Snake	Micruroides euryxanthus
Western Diamondback Rattlesnake	Crotalus atrox
Southwestern Speckled Rattlesnake	Crotalus mitchelli pyrrhus
Sonora Sidewinder	Crotalus cerastes cercobombus
Black-Tailed Rattlesnake	Crotalys molossus
Tiger Rattlesnake	Crotalus tigris
Mojave Rattlesnake	Crotalus scutulatus

Appendix F

Terrestrial Vertebrates of the Harquahala Valley Watershed

Birds

Eared Grebe	*Podiceps caspicus*
Pied-Billed Grebe	*Podilymbus podiceps*
Great Blue Heron	*Ardea herodias*
Green Heron	*Butorides virescens*
Common Egret	*Casmerodius albus*
Snowy Egret	*Leucophoyx thula*
Black-Cr. Night Heron	*Nycticorax nycticorax*
Least Bittern	*Ixobrychus exilis*
American Bittern	*Botaurus lentiginosus*
White-Faced Ibis	*Plegadis chihi*
Canada Goose	*Branta canadensis*
White-Fronted Goose	*Anser albifrons*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Pintail	*Anas acuta*
Green-Winged Teal	*Anas carolinensis*
Blue-Winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
American Wigeon	*Mareca americana*
Shoveler	*Spatula clypeata*
Wood Duck	*Aix sponsa*
Redhead	*Aythya americana*
Ring-Necked Duck	*Aythya collaris*
Canvasback	*Aythya valisineria*

Greater Scaup	Aythya marila
Lesser Scaup	Aythya affinis
Common Goldeneye	Bucephala clangula
Bufflehead	Bucephala albeola
Ruddy Duck	Oxyura jamaicensis
Common Merganser	Mergus merganser
Red-Breasted Merganser	Mergus serrator
Turkey Vulture	Cathartes aura
Goshawk	Accipiter gentilis
Sharp-Shinned Hawk	Accipiter striatus
Cooper's Hawk	Accipiter cooperii
Red-Tailed Hawk	Buteo jamaicensis
Swainson's Hawk	Buteo swainsoni
Ferruginous Hawk	Buteo regalis
Harris' Hawk	Parabuteo unicinctus
Black Hawk	Buteogallus anthracinus
Golden Eagle	Aquila chrysaetos
Bald Eagle	Haliaeetus leucocephalus
Marsh Hawk	Circus cyaneus
Osprey	Pandion haliaetus
Prairie Falcon	Falco mexicanus
Peregrine Falcon	Falco peregrinus
Pigeon Hawk	Falco columbarius
Sparrow Hawk	Falco sparverius
Gambel's Quail	Lophortyx gambelii
Sandhill Crane	Grus canadensis
Virginia Rail	Rallus limicola
Sora	Porzana carolina

Common Gallinule	*Gallinula chloropus*
American Coot	*Fulica americana*
Killdeer	*Charadrius vociferus*
Black-Bellied Plover	*Squatarola squatarola*
Common Snipe	*Capella gallinago*
Spotted Sandpiper	*Actitis macularia*
Solitary Sandpiper	*Tringa solitaria*
Willet	*Catoptrophorus semipalmatus*
Greater Yellowlegs	*Totanus melanoleucus*
Least Sandpiper	*Erolia minutilla*
Long-Billed Dowitcher	*Limnodromus scolopaceus*
Marbled Godwit	*Limosa fedoa*
American Avocet	*Recurvirostra americana*
Black-Necked Stilt	*Himantopus mexicanus*
Wilson's Phalarope	*Steganopus tricolor*
Northern Phalarope	*Lobipes lobatus*
Ring-Billed Gull	*Larus delawarensis*
Caspian Tern	*Hydroprogne caspia*
Black Tern	*Childonias niger*
White-Winged Dove	*Zenaida asiatica*
Mourning Dove	*Zenaidura macroura*
Ground Dove	*Columbigallina passerina*
Inca Dove	*Scardafella inca*
Yellow-Billed Cuckoo	*Coccyzus americanus*
Roadrunner	*Geococcyx californianus*
Barn Owl	*Tyto alba*
Screech Owl	*Otus asio*

Great Horned Owl	Bubo virginianus
Ferruginous Owl	Glaucidium brasilianum
Elf Owl	Micrathene whitneyi
Burrowing Owl	Speotyto cunicularia
Barred Owl	Strix varia
Long-Eared Owl	Asio otus
Short-Eared Owl	Asio flammeus
Saw-Whet Owl	Aegolius acadicus
Whip-Poor-Will	Caprimulgus vociferus
Poor-Will	Phalaenoptilus nuttallii
Common Nighthawk	Chordeiles minor
Lesser Nighthawk	Chordeiles acutipennis
Vaux's Swift	Chaetura vauxi
White-Throated Swift	Aeronautes saxatalis
Black-Ch. Hummingbird	Archilochus alexandri
Costa's Hummingbird	Calypte costae
Anna's Hummingbird	Calypte anna
Broad-T. Hummingbird	Selasphorus platycercus
Rufous Hummingbird	Selasphorus rufus
Belted Kingfisher	Megaceryle alcyon
Yellow-Shafted Flicker	Colaptes auratus
Red-Shafted Flicker	Colaptes cafer
Gilded Flicker	Colaptes chrysoides
Gila Woodpecker	Centurus urophygialis
Lewis' Woodpecker	Asyndesmus lewis
Yellow-B. Sapsucker	Sphyrapicus varius
Hairy Woodpecker	Dendrocopos villosus

Ladder-Back Woodpecker	Dendrocopos scalaris
Tropical Kingbird	Tyrannus melancholicus
Western Kingbird	Tyrannus verticalis
Cassin's Kingbird	Tyrannus vociferans
Ash-Throated Flycatcher	Myiarchus cinerascens
Eastern Phoebe	Sayornis phoebe
Black Phoebe	Sayornis nigricans
Say's Phoebe	Sayornis saya
Traill's Flycatcher	Empidonax traillii
Hammond's Flycatcher	Empidonax hammondii
Gray Flycatcher	Empidonax wrightii
Western Flycatcher	Empidonax difficilis
Western Wood Pewee	Contopus sordidulus
Vermillion Flycatcher	Pyrocephalus rubinus
Horned Lark	Eremophila alpestris
Violet-Green Swallow	Tachycineta thalassina
Tree Swallow	Iridoprocne bicolor
Rough-Winged Swallow	Stelgidopteryx ruficollis
Barn Swallow	Hirundo rustica
Cliff Swallow	Petrochelidon pyrrhonota
Purple Martin	Progne subis
Steller's Jay	Cyanocitta stelleri
Scrub Jay	Aphelocoma coerulescens
Common Bushtit	Psaltriparus minimus
White-Breasted Nuthatch	Sitta carolinensis
Red-Breasted Nuthatch	Sitta canadensis
Pygmy Nuthatch	Sitta pygmaea

Dipper	Cinclus mexicanus
House Wren	Troglodytes aedon
Bewick's Wren	Thryomanes bewickii
Cactus Wren	Campylorhynchus brunneicapillum
Long-Billed Marsh Wren	Telmatodytes palustris
Canyon Wren	Catherpes mexicanus
Rock Wren	Salpinctes obsoletus
Mockingbird	Mimus polyglottos
Bendire's Thrasher	Toxostoma bendirei
Curve-Billed Thrasher	Toxostoma curvirostre
Le Conte's Thrasher	Toxostoma lecontei
Crissal Thrasher	Toxostoma dorsale
Sage Thrasher	Oreoscoptes montanus
Robin	Turdis migratorius
Hermit Thrush	Hylocichla guttata
Swainson's Thrush	Hylocichla ustulata
Western Bluebird	Sialia mexicana
Mountain Bluebird	Sialia currucoides
Townsend's Solitaire	Myadestes townsendi
Blue-Gray Gnatcatcher	Polioptila caerulea
Black-T. Gnatcatcher	Polioptila melanura
Golden-Cr. Kinglet	Regulus satrapa
Ruby-Crowned Kinglet	Regulus calendula
Water Pipit	Anthus spinoletta
Cedar Waxwing	Bombycilla cedrorum
Phainopepla	Phainopepla nitens
Loggerhead Shrike	Lanius ludovicianus

Starling	Sturnus vulgaris
Bell's Vireo	Vireo bellii
Gray Vireo	Vireo vicinior
Solitary Vireo	Vireo solitarius
Warbling Vireo	Vireo gilvus
Orange-Crowned Warbler	Vermivora celata
Nashville Warbler	Vermivora ruficapilla
Lucy's Warbler	Vermivora luciae
Yellow Warbler	Dendroica petechia
Myrtle Warbler	Dendroica coronata
Audubon's Warbler	Dendroica auduboni
B.-Throated Gray Warbler	Dendroica nigrescens
Hermit Warbler	Dendroica occidentalis
MacGillivray's Warbler	Oporornis tolmiei
Yellowthroat	Geothlypis trichas
Yellow-Breasted Chat	Icteria virens
House Sparrow	Passer domesticus
Eastern Meadowlark	Sturnella magna
Western Meadowlark	Sturnella neglecta
Yellow-Headed Blackbird	Xanthocephalus xanthocephalus
Red-Winged Blackbird	Agelaius phoeniceus
Hooded Oriole	Icterus cucullatus
Baltimore Oriole	Icterus galbula
Brewer's Blackbird	Euphagus cyanocephalus
Boat-Tailed Grackle	Cassidix mexicanus
Brown-Headed Cowbird	Molothrus ater
Bronzed Cowbird	Tangavius aeneus

Summer Tanager	Piranga rubra
Cardinal	Richmondena cardinalis
Pyrrhuloxia	Pyrrhuloxia sinuata
Black-Headed Grosbeak	Pheucticus melanocephalus
Blue Grosbeak	Guiraca caerulea
Evening Grosbeak	Hesperiphona vespertina
Cassin's Finch	Carpodacus cassinii
House Finch	Carpodacus mexicanus
Pine Siskin	Spinus pinus
American Goldfinch	Spinus tristis
Lesser Goldfinch	Spinus psaltria
Red Crossbill	Loxia curvirostra
Green-Tailed Towhee	Chlorura chlorura
Rufous-Sided Towhee	Pipilo erythrophthalmus
Brown Towhee	Pipilo fuscus
Abert's Towhee	Pipilo aberti
Lark Bunting	Calamospiza melanocorys
Savannah Sparrow	Passerculus sandwichensis
Grasshopper Sparrow	Ammodramus savannarum
Vesper Sparrow	Pooecetes gramineus
Lark Sparrow	Chondestes grammacus
Rufous-Winged Sparrow	Aimophila carpalis
Black-Throated Sparrow	Amphispiza bilineata
Sage Sparrow	Amphispiza belli
Slate-Colored Junco	Junco hyemalis
Oregon Junco	Junco oreganus
Brewer's Sparrow	Spizella breweri

White-Crowned Sparrow	*Zonotrichia leucophrys*
White-Throated Sparrow	*Zonotrichia albicollis*
Lincoln's Sparrow	*Melospiza lincolnii*
Song Sparrow	*Melospiza melodia*
McCown's Longspur	*Rhynchophanes mccownii*
Chestnut-Collared Longspur	*Calcarius ornatus*

APPENDIX G

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APPENDIX G

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