PRELIMINARY INVESTIGATION REPORT

TONOPAH WATERSHED

MARICOPA COUNTY ARIZONA

SPONSORS

BUCKEYE ROOSEVELT & WICKENBURG NRCD
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
JULY 1974

PRELIMINARY INVESTIGATION REPORT

For

TONOPAH WATERSHED

Maricopa County
Arizona

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 66), as amended.

Sponsors

Flood Control District of Maricopa County
Buckeye-Roosevelt Natural Resource Conservation District
Wickenburg Natural Resource Conservation District

Assisted By

U. S. Department of Agriculture, Soil Conservation Service

July 1974

TABLE OF CONTENTS

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SUMMARY OF INVESTIGAION

A preliminary plan has been formulated by the sponsors that will fulfill their objectives, will be economically feasible and will consider the preservation and enhancement of the environment. Land treatment and wildlife enhancement are a viable part of this plan. Natural scenic areas are proposed. This plan also proposes one dam located upstream of and parallel to the authorized Central Arizona Project Granite Reef Aqueduct. Mitigating measures related to this dam are to be included. The estimated total cost of this project is $7,330,500.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical Data

Tonopah Watershed is within Maricopa County, which is located in the central portion of Arizona. It covers an area of 249,200 acres. Within this area are three small communities - Tonopah, Wintersburg, and Arlington. Tonopah is the fastest growing community in the watershed because of its proximity to Interstate-10 which traverses the watershed in an east-west direction. At present I-10 extends from the California-Arizona border to Tonopah. When the stretch from Tonopah to Phoenix is completed, I-10 will extend across the entire state. The Buckeye-Salome road roughly parallels I-10. There are few roads in the northern half of the watershed, but numerous east-west, north-south roads traverse the southern half. Many of the 1,500 people who reside in this area use these secondary roads daily to get to and from work and school. Also, these roads lead to the Arlington Wildlife Area which is located near the confluence of the Gila River and Centennial Wash. Towns and roads, together with other features, are shown on Figure 3.

The Tonopah Watershed lies within the Desert Region of the Basin and Range Physiographic Province. This is a land of scenic terrain and rugged natural beauty. Broad, gently sloping alluvial valleys are separated by stark, lonely mountain ranges rising sharply out of the desert. Through geologic time, the area has been subjected to a

variety of disturbances, including subsidence, sea invasions, upwarping, erosion, igneous intrusions, volcanism, faulting and metamorphism. Because of the arid climate and resultant sparse vegetation, features in the rocks which bear evidence of past geologic events are easily observed. For instance, volcanic plugs and lava flows are easily recognizable along the route of I-10. The mountains are well suited for educational and recreational activities by those who have an interest in geology.

The Big Horn Mountains, which compose 20 percent of the area, dominate the northwestern portion of the watershed. Directly east of these mountains are the Belmont Mountains which occupy 5 percent of the watershed. To the southeast of the Big Horn Mountains, and in the southern portion of the watershed, are the Palo Verde Hills which occupy 5 percent of the watershed. After torrential rains, floodwaters laden with coarse sediment pour from these hills. This sediment is rapidly deposited in the upper part of the watershed. Fine grained sediment is carried on downstream and deposited as the stream gradient decreases. As a result, a shallowly dissected plain has formed in this desert area with many shifting and interlacing channels and washes.

Cretaceous andesite with some Precambrian schist form the Big Horn Mountains, while in the Belmont Mountains the predominant rocks are Precambrian granite and schist, together with Cretaceous intrusions and Quaternary basalt. Quaternary basalt and Cretaceous andesite constitute the bulk of the Palo Verde Hills.

Downstream from the Big Horn and Belmont mountains, the valley alluvium is of Tertiary and Quaternary age. In general, these valley soils are deep, and range in texture from clay to gravel. Soils are, to some degree, naturally sodic-saline south of Tonopah and east of Winters Wash.

Farmers in this area depend on the valley soils and on the weather. With the mean annual air temperature ranging from 69^{o} to 75^{o} F. and with a frost-free season of 250 to 320 days, they grow cotton, grain, alfalfa, and related agricultural crops.

The average annual rainfall is only 7 to 10 inches and the average annual runoff is less than 5 acre-feet per square mile. Water for agricultural crops and domestic purposes comes primarily from ground water supplies. Most wells produce from 1,000 to 2,000 gallons per minute. The depth to water bearing strata is generally less than 200 feet south of Tonopah, and greater than 200 feet north of Tonopah. Total dissolved solids in the water are generally less than 1,000 milligrams per liter. However, sodium content in some well water does present an irrigation hazard. Farmers cannot get supplemental irrigation water from the authorized Granite Reef Aqueduct.

At present, 7 percent of the watershed is used to grow crops while 86 percent is desert. The other 7 percent of the land is used for roads, homes, and industrial development.

Economic Data

The Tonopah Watershed is located in Maricopa County which is part of the Gila-Salt Water Resource Subarea. Also included in this subarea is the State Capital, Phoenix, as well as the growing communities of Mesa, Tempe, Scottsdale, Glendale, and Chandler. All of these communities have increasing urban development along with some agricultural development.

Sixty-seven percent of this watershed is administered by either the Bureau of Land Management or the State Land Department. This public land is desert. It is used by domestic animals, wildlife, and recreationists. That portion privately owned amounts to 33 percent. Of this total, 23 percent is desert rangeland. Seven percent of the remaining 10 percent is used to grow crops. Homes and roads occupy the remainder. Ownership, administration, and use of land is shown on Figure 2.

There are 40 farms in the watershed and the average farm is 450 acres. Of the total 18,500 acres of irrigated land, 6,800 acres are in cotton, 5,600 acres are in alfalfa, and 4,600 acres are in barley, grain sorghum and wheat, and 1,500 acres are in irrigated pasture. Crop yields for this subarea are high in comparison to the rest of the nation. Yields per acre in the watershed are comparable to the Gila-Salt subarea. On the average, cotton yields 2 bales per acre, alfalfa, 6 tons per acre, and small grain, 3,600 pounds per acre.

A good network of roads in the cropland area allows goods and services to flow between the town of Buckeye, about 15 miles to the east, and the southern portion of the watershed. Over these roads cattle are transported to and from one of the two feedlots located to the south of I-10. The majority of farm laborers also use these roads to get to and from work.

Maricopa County had a population growth rate of 46 percent during the period from 1960 to 1970. During this same period of time, the population of Buckeye rose by 13 percent from about 2,300 to 2,600 persons.

According to the 1970 Census, the mean income for farm families in the Buckeye area was about $5,300 and the mean wage for workers was about $7,900. The unemployment rate for this area was 8 percent. This was a substantially higher rate of unemployment than for Maricopa County which, on the average, was about 4 percent.

Fish and Wildlife Resources

There is not enough water to support a self-sustaining fishery resource within the watershed. To a lesser extent, the lack of available water limits wildlife populations in this area.

Approximately 52 species of mammals include desert mule deer, cottontail, jackrabbit, bobcat, coyote, gray fox, kit fox, badger, skunk, bats and rodents. 1/ 2/ Birds of the area include Gambel's quail, mourning dove, white-winged dove, raptors, songbirds, shore birds and waterfowl. 3/ The wide variety of wildlife species inhabiting this watershed provides a good opportunity for hunting, bird watching, and photography. 1/ State game management unit boundaries are shown on Figure 1.

Amphibians and reptiles in the watershed include several species of frogs, toads, snakes, and lizards. Included in this group are the desert tortoise and the Gila monster. 4/

Many of the species listed require a variety of habitat types to provide for their basic needs. They need woody vegetation for cover and nesting, shrubs and grasses for food, and open space. Few species can subsist entirely in either a shrub or grass area.

The Tonopah Watershed generally falls within two environmental zones; the northerly part being in Zone 40E2, which is designated as Central Arizona Basin and Range, and the southerly part being in Zone 30E2, designated as Sonoran Basin and Range. Included in these environmental zones are four basic habitat types.

Two of the basic habitat types in the watershed occur in the more moist areas. The mesquite-saltbush vegetative type occurs in the valley floors and areas where overflow occurs. Riparian vegetation occurs primarily along washes and other areas where ground water normally is more available. These two vegetative types constitute an estimated 15 to 20 percent of the native vegetation in the watershed.

The two vegetative types occurring on the drier sites are the creosote-bush type, generally occurring on the more level to gently sloping upland areas, and the paloverde-bursage-saguaro type occurring on the more moderately sloping valleys and foothills. These vegetative types occupy the remaining 80 to 85 percent of the native vegetation in the watershed.

1/ Bureau of Land Management, Wildlife Habitat Report, Vulture Unit
2/ W. H. Burt and R. P. Grossenheider, A Field Guide to the Mammals, 1956
3/ Maricopa Audubon Society, Birds of Maricopa County 1972
4/ Roger Conant, A Field Guide to Reptiles and Amphibians

Sources of some possible pollution within the watershed include agricultural spray and feedlot runoff. The effects of these pollutants on the waters in the watershed appear to be negligible, because there is flowing water only during rainfall runoff periods. The effects of agricultural sprays on wildlife species in the watershed are not well known.

Air quality problems in the watershed are associated with blowing dust during periods of high winds. No major pollution sources exist in the watershed.

Recreational Resources

There are no recreational developments in the watershed. However, the watershed is highly suited to open space recreational activities, including hiking, picnicking, horseback riding, rock hunting, and the use of all terrain vehicles. Most of the watershed is readily accessible because much of the land is publicly owned.

Archeological, Historical Values, and Unique Scenic Areas

This watershed lies within the limits of the San Dieguito-Amargosa prehistoric cultural range. The presence of this culture is better documented west of Burnt Mountain. Although artifacts of those people have been found near the Hieroglyphic Mountains, northeast of the watershed, there are more sites farther west.

Pottery evidence suggests that the later sedentary cultures made little use of the Tonopah Plains area. A few pieces of pottery from these sedentary people have been found as far west as the Belmont Mountains; however, there is not much indication of their use in this watershed.

Some archeological materials have been found along the proposed route of the Central Arizona Project Granite Reef Aqueduct. Rhyolite, quartz, and chalcedony core and flake tools, grinding implements, and an occasional Wingate or Gila Plain shard have been reported. 1/

A possible unique natural area can be found in the northeast portion of the watershed. This is an apparent pristine area atop Flatiron Mountain where there is a natural barrier against man. To the west of this mountain, in the vicinity of Burnt Mountain, exist some extremely large ironwood trees. These trees appear to be in excess of three feet in diameter and may be of natural or historical significance. Both of these areas are on public land administered by the Bureau of Land Management.

1/ Dr. R. Gwinn Vivian, "An Archeological Survey of the Granite Reef Aqueduct," for Bureau of Reclamation - CAP - July 31, 1972.

Soil, Water and Plant Management Status

There were significant changes in land use during 1973. Cropland increased by 3 percent, residential areas have increased by 1 percent, and land for a nuclear power plant has been purchased.

Active land treatment and land use planning programs are promoted by the Buckeye-Roosevelt and Wickenburg Natural Resource Conservation Districts. Overall, about 51 percent of the privately owned cropland and rangeland is adequately treated. Forty farms comprise about 50 percent of the privately owned land in this watershed. On these farms, about 65 percent of the planned land treatment practices have been applied. Table 1A shows the status of watershed works of improvement. Management plans written by the Bureau of Land Management for public land users emphasizes conservation practices to be applied.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land Treatment

Over 35 percent of the cropland needs varying amounts of land treatment. Measures are needed to control soil deterioration, to improve crop production, to maintain soil quality, and more efficiently use groundwater supplies. The efficient use of irrigation water is something for all farmers to achieve. The efficiency of water application on cropland in this watershed is estimated to be, on the average, 55 percent. Using water inefficiently necessitates pumping more water from increasingly greater depths and results in greater cost of irrigation. There is a limited amount of runoff water available for use for irrigation of cropland or for use by livestock, and wildlife. Large areas outside the cropland have no water for animals or wildlife for extended periods of time.

Forage from perennial plants has been adversely affected by year-round grazing of cattle on desert lands. This has led to the deterioration of wildlife habitat. It also has resulted in some accelerated sheet, rill and gully erosion, especially on silty soils which are not protected by surface sand and gravel.

Floodwater Damage

The principal problems in this watershed are associated with floodwater, erosion, and sediment damages. Recent floods occurred in 1970, 1972 and 1974. After the March 1974 storm, damages were estimated at $10,000. It severely damaged farm roads, washed out banks along irrigation canals, cracked irrigation pipelines, and flooded an 80-acre field of newly planted cotton. A storm of this severity is estimated to occur once in three years.

A 100-year frequency storm would flood 29,600 acres of land. About 22,000 acres of this land is rangeland and 7,600 acres is irrigated cropland. Primary damage is to cotton, alfalfa, and small grain crops. A storm of this magnitude would cause $995,000 damage to crops, irrigation facilities, roads, and other agricultural properties. About $695,000 of this is attributed to floodwater, while the remaining damage is attributed to sediment. There are approximately 2,600 acres in this watershed that are in the common flood plains of both the Centennial Wash and the Gila River. An additional 4,000 acres, not subject to flooding from this watershed, are subject to flooding by either the Centennial Wash or the Gila River. Floods are associated with summer thuderstorms and occur during the months of July through October. On the average, about 45 percent of all floods occur during these months.

This damage could increase as the demand for urban development increases. The population projections for this area indicate a growth from 1,500 to 4,900 for the period 1970 to 2000. Residential development is proposed in various areas throughout the watershed due to several factors. The metropolitan area of Phoenix will expand to this area. The Arizona Nuclear Power Plant is a joint venture with Arizona Public Service Co., El Paso Gas Co., Tucson Gas and Electric Co., Public Service Co. of New Mexico, Arizona Electric Power Cooperative, and the Salt River Project. The plant is to be constructed within the watershed by 1984. Housing, services, and commercial facilities will be needed for permanent personnel of the power plant.

Recreation

There are no recreation-related problems at present in the watershed. However, with the growth of population within the county, and with the projected developments within the watershed, some recreation-related problems may develop. There will be a need to curb plant collecting, control littering, and regulate the use of all terrain vehicles to existing roads and trails.

Fish and Wildlife

Land clearing for subdivision and agricultural land development, and the construction of roads have resulted in direct losses to wildlife habitat. These activities sometimes change drainage patterns, resulting in downstream vegetation changes. Drainage pattern changes normally result in diverting small local drainages and concentrating runoff into major drainages. The result is the conversion of minor drainages from riparian to xeric vegetation, and the concentration of floodflows in major drainages, both resulting in a reduction of the quality of habitat.

Economic and Social

Many of the farmers and their families live on the land they farm in the watershed. One farm covers 3,000 acres of irrigated land; however, the average farm size is 450 acres. There are many 5 and 10-acre tracts of land that are within the watershed, but these are not considered farms. Farm labor is provided by workers from the watershed and from the town of Buckeye.

PROJECTS OF OTHER AGENCIES

There are three projects that, when completed, will have significant impact on the development in this watershed. Figure 3 shows the location of the authorized Central Arizona Project Granite Reef Aqueduct crossing the northern portion of the watershed from west to east. Interstate 10, when finished, will allow vehicular traffic to travel across the central portion of the watershed in an east-west direction. Land has been purchased for the Arizona Nuclear Power Plant in the southeastern portion of this watershed.

PROJECT FORMULATION

Objectives

The sponsors, together with those who have an interest in the watershed, have expressed a desire to find solutions to their water related problems. Their objectives are to reduce to an acceptable level floodwater damage to crop and rangelands, and to be able to cross washes during heavy rainstorms.

Formulation

The basis for the formulation of this preliminary plan is the consideration of the sponsors' objectives. At the same time, consideration must be given to maintaining and enhancing the environment within the watershed. Guidelines used to develop this plan are found in the Principles and Standards for Planning Water and Related Land Resources, and in the USDA Interim Procedures. These Interim Procedures are to be used by the Soil Conservation Service in planning water and related land projects.

The objectives of water and land resource planning are to enhance national economic development and environmental quality. Development of water and land resources results in increased production of goods and services. Increased crop yields, expanded recreational use, and improved municipal and industrial water supplies are examples of water and land resource

developments. Development of these resources may result in increased production. Contributions to increased output due to cost savings also have a beneficial effect on the national economy.

The environmental quality objective reflects people's concern for the natural environment and its maintenance and enhancement as a source of present enjoyment and as a heritage for future generations.

To achieve the objectives in planning, at least one alternative plan must be formulated to attain the highest possible degree of national economic development, and one must be formulated to emphasize environmental quality. From these two, additional alternative plans can be formulated reflecting various combinations of parts of the national economic development and environmental quality objectives. Physical and legal, or public policy constraints, are also to be considered in the selected alternative plan. The national economic development, environmental quality, and sponsors' alternative plans are shown on the following pages.

OBJECTIVE	PROBLEMS	COMPONENT NEEDS	OPPORTUNITIES
Reduce floodwater, sediment and erosion damages	Cropland and related facilities being damaged by sediment, erosion and floodwater	Reduce damages caused by floodwater, erosion and sediment deposition on 10,200 acres of irrigated cropland	Apply land treatment practices to increase density of vegetation in watershed
	Proposed urban areas subject to flooding	Reduce floodproofing costs on 250 acres of proposed urban land	Build floodwater retarding structure
	Desert rangeland being damaged by overgrazing, erosion and floodwater	Reduce adverse effects of overgrazing, floodwater and erosion on 22,000 acres of desert rangeland	Modify channel washes
	Authorized Central Arizona Project Granite Reef Aqueduct subject to damage by sediment and floodwater	Reduce damages caused by floodwater and sediment deposition to the CAP Granite Reef Aqueduct	Floodplain management (zoning, flood plain purchase, floodproof and flood insurance)
	Feedlots being damaged by floodwater	Reduce damages caused by floodwater to 2 commercial feedlots	Construct dike around feedlots to keep floodwater out of area
	Roads being damaged by erosion and floodwater	Reduce damages caused by erosion and floodwater to 50 miles of road	Install culverts and raise roads at washes
Improve use of existing water supply	Irrigation water being used inefficiently	Improve distribution and use of irrigation water	Apply land treatment practices to cropland to increase efficiency of water use and to control erosion
	Ground water supply being depleted	Decrease amounts of ground water being pumped	Construct water spreading dams and dikes
Maintain and enhance environmental quality	Quality of surface water is being effected by runoff from feedlots	Pond floodwater and allow to percolate into ground	Construct animal waste lagoons to collect effluent
	Limited amount of water for wildlife use	Prevent animal waste effluent from getting into surface waters	Construct wildlife watering facilities
		Increase availability of water for wildlife	

PLAN ELEMENTS

TO REDUCE FLOOD DAMAGES

Develop range management plans on 100,000 acres

Practice proper range use on 150,000 acres

Build floodwater retarding structure upstream of CAP Granite Reef Aqueduct

Define flood plains in watershed and develop flood plain management program

Construct dike around feedlots to keep floodwater out

TO IMPROVE WATER USE AND SUPPLY

Develop conservation plans for cropland that include necessary land treatment practices

Construct 10 waterspreading dams and related dikes

Construct lagoons to collect animal waste effluent

Construct 40 wildlife watering facilities

MITIGATION MEASURES

Revegetate all disturbed areas in the construction zone, also revegetate dam

Install 20 pipes through dam to allow floodwater to continue down natural washes

Construct 3 wildlife watering facilities

EFFECTS

ECONOMIC

Reduce annual floodwater and sediment damages to $34,000 to 5,100 acres of irrigated cropland

Provide construction cost savings of $20,000 to proposed urban developments

Reduce erosion on 13,000 acres of rangeland

Provide average annual cost savings of $422,000 to the CAP Granite Reef Aqueduct

Reduce damages caused by erosion and flooding to 50 miles of road

Reduce pumping costs by improving irrigation efficiency by 10 percent on 10,000 acres

Optimum use of flood plain through management

QUALITY CONSIDERATION OF WATER, LAND AND AIR

Maintain and improve desert areas by the implementation of land management plans on public lands

Maintain and improve cropland by the implementation of conservation plans

Increase amounts of dust and noise during construction of dam

Increase soil loss off of disturbed areas during construction

Improve downstream water quality by storage of animal waste effluent in lagoons, prevention of flooding of feedlots, and reduction of sediment

BIOLOGICAL RESOURCES, SELECTED ECOLOGICAL SYSTEMS AND AREAS OF NATURAL BEAUTY

Temporary loss of wildlife habitat during construction of dam and other structural measures

Remove 460 acres of desert type vegetation by construction of dam

Partially destroy 380 acres of desert type vegetation in the sediment pool because of borrow removal

Reduce density and growth of riparian vegetation on 45 washes below dam and aqueduct

Limited reduction of density and growth of riparian vegetation on 20 washes where floodwaters are partially allowed to continue downstream in natural washes

Enhancement of wildlife habitat for big and small game animals will provide 130 hunter days

GEOLOGICAL, ARCHEOLOGICAL AND HISTORICAL RESOURCES

Some geological, archeological and historical resources will by lost during construction. However, every effort will be made to locate, remove and preserve these resources.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

460 acres of desert land is to be committed to the construction of a dam. Land needed for mitigation measures is also to be committed

Capital and labor needed to construct and install structural and land treatment measures is irretrievable

ENVIRONMENTAL QUALITY PLAN

OBJECTIVE	PROBLEMS	COMPONENT NEEDS	OPPORTUNITIES
Reduce floodwater, sediment and erosion damages	Cropland and related facilities being damaged by sediment, erosion and floodwater	Reduce damages caused by floodwater, erosion and sediment deposition on 10,200 acres of irrigation cropland	Flood plain management (zoning, flood plain purchase, floodproofing and flood insurance)
	Desert rangeland being damaged by overgrazing, erosion and floodwater	Reduce adverse effects of overgrazing, floodwater and erosion on 22,000 acres of desert rangeland	Zone agricultural areas to maintain a width of flood plain to convey a 10-year flood; in urban areas zone to convey a 100-year flood
	Proposed urban areas subject to flooding	Reduce floodproofing costs on 250 acres of proposed urban land	Design urban areas to keep from increasing peak discharges
	Roads being damaged by erosion and floodwater	Reduce damages caused by erosion and floodwater to 50 miles of road	Apply land treatment practices to increase density of vegetation in watershed
	Authorized Central Arizona Project Granite Reef Aqueduct subject to damage by sediment and floodwater	Reduce damages caused by floodwater and sediment deposition to the CAP Granite Reef Aqueduct	Provide means to convey floodwater over Granite Reef Aqueduct into all natural washes
	Feedlots being damaged by floodwater	Reduce damages caused by floodwater to 2 commercial feedlots	Move feedlots from flood prone areas
Improve use of existing water supply	Irrigation water being used inefficiently	Improve distribution and use of irrigation water	Apply land treatment practices to cropland to increase efficiency of water use and to control erosion
	Ground water supply being depleted	Decrease amounts of ground water being pumped	Construct waterspreading systems and allow floodwater to percolate into ground and also be used to irrigate native range
Maintain and enhance environmental quality	Deterioration and loss of wildlife food and habitat	Pond floodwater and allow to percolate into ground	Enforce existing regulations on woodcutting and plant removal on public lands
	Limited amount of water for wildlife use	Manage desert vegetation within its capabilities to support domestic animals and wildlife	Construct wildlife watering facilities
	Archeological sites being vandalized	Make floodwater more available to vegetation along natural channels and on desert valleys	Map, collect and preserve significant artifacts
	Unique natural areas are not designated or protected	Increase availability of water for wildlife	Locate and define boundaries of natural areas
	Quality of surface water being affected by runoff from feedlots	Designate, protect and preserve archeological sites	Encourage federal, state and private parties to protect natural areas
	History of area unknown	Locate and preserve unique natural areas	Construct animal waste lagoons to collect effluent
	Natural washes across croplands are being obliterated and floodwaters either being diverted into new areas or cutting across leveled fields	Prevent animal waste effluent from getting into surface runoff waters	Determine historical significance of old mines, trails and settlements of the area
	Floodwaters conveyed over the Granite Reef Aqueduct are being diverted from 45 natural washes and concentrated into 25 washes, increasing peak discharges	Identify and preserve significant historical sites	Reconstruct natural washes across cropland areas
		Reconstruct and maintain natural washes that have been obliterated through croplands	Establish program to acquire by purchase or easement the flood plain that is flooded by a 10-year storm
		Control use of natural washes	Establish program to exchange flood prone cropland for public land and let these flood prone areas be used for purposes compatible with flooding
		Reduce erosion to washes and damage to riparian vegetation along washes	Install 6 grade control structures on Winters Wash

PLAN ELEMENTS

For $1,300,000 obtain flooding easements on 2,200 acres of desert land and 1,500 acres of cropland that is privately owned and subject to flooding by the 10-year event

At a cost of $370,000 provided from federal funds (PL-566), relocate irrigation facilities within the 10-year flood plain

Land around natural drainages be zoned to insure that all new irrigation facilities be outside the 10-year flood plain. The administration cost for zoning is $5/acre

Convert 150 acres of state owned land that is being used as cropland and is subject to flooding by a 10-year event, to a greenbelt floodway, and reimburse private land user for his investment for improvements at a cost of $30,000

Where natural washes have been obliterated by agricultural or urban development reconstruct at a cost of $20,000

Zone 250 acres of proposed urban developments subject to flooding by the 100-year event to a greenbelt floodway. The estimated loss to the developer is $500,000 and the average construction cost savings is $25,000/year

At a cost of $5 million construct 45 chutes over the Granite Reef Aqueduct allowing floodwaters to outlet into the majority of washes, thus maintaining natural flow conditions

Practice proper range use on 150,000 acres

Develop range management plans on 100,000 acres

Develop conservation plans for cropland and implement needed practices to improve irrigation efficiency by 10 percent at a cost of $2,000,000

Establish a critical ground water area

Establish 2 natural areas: 100 acres of Ironwood trees near Burnt Mountain and a 480 acre site what includes Flat Iron Mountain

EFFECTS

AREAS OF NATURAL BEAUTY

Flood plain zoning on 12,850 acres will provide for development of open space and greenbelt areas

Through establishment of greenbelts, provide for a diversity of landscape in urban adjacent areas

Flood damage will be reduced by flood plain zoning on 12,850 acres of land within the 10-year flood plain

QUALITY CONSIDERATION OF WATER, LAND AND AIR RESOURCES

Flood plain zoning will cause a change in land use on 3,850 acres reducing the rate of groundwater drawdown

Increased irrigation efficiency will reduce the rate of ground water drawdown by 2 feet per year

BIOLOGICAL RESOURCES AND SELECTED ECOLOGICAL SYSTEMS

To maintain natural flow conditions, construct 45 chutes over the Granite Reef Aqueduct to outlet into the majority of washes

Construction of wildlife watering facilities together with waterspreading systems will provide improved wildlife habitat

Enhancement of wildlife habitat for big and small game animals will provide 130 hunter days

GEOLOGICAL, ARCHEOLOGICAL AND HISTORICAL RESOURCES

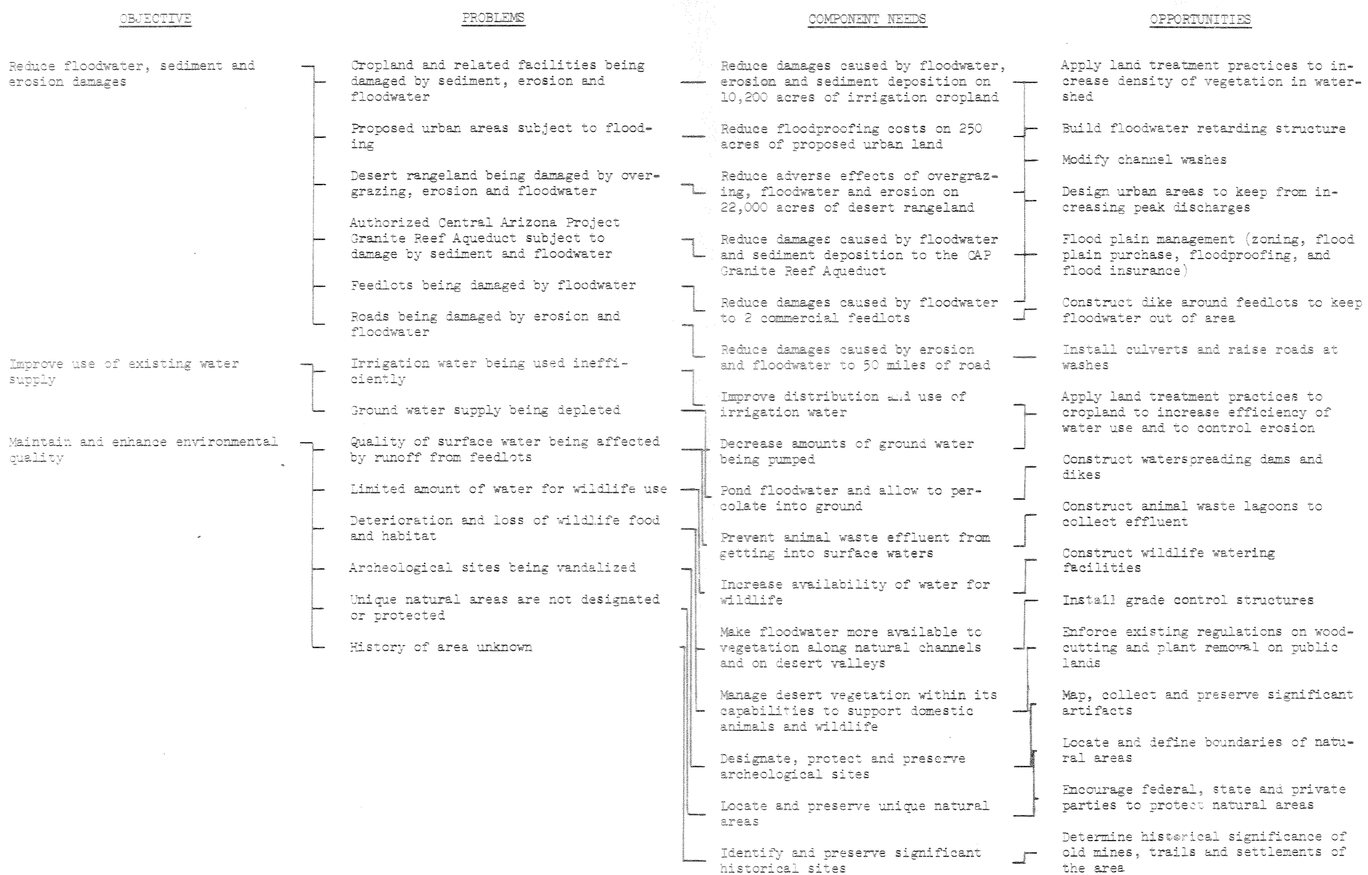
Some historical and archeological areas could be affected by this project

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS

12,850 acres of flood prone land will be zoned to have low intensity development

580 acres of land will be preserved as natural areas

SELECTED ALTERNATIVE PLAN



PLAN ELEMENTS

TO REDUCE FLOOD DAMAGES

Develop range management plans on 100,000 acres

Practice proper range use on 150,000 acres

Build floodwater retarding structure upstream of CAP Granite Reef Aqueduct

Define flood plains in watershed and develop flood plain management program

Construct dikes around feedlots to keep floodwater out

TO IMPROVE WATER USE AND SUPPLY

Develop conservation plans for cropland that include necessary land treatment practices

Construct lagoons to collect animal waste effluent

MAINTAIN AND ENHANCE ENVIRONMENTAL QUALITY

Construct 4 waterspreading dams and related dikes

Install 6 grade control structures on Winters Wash

Construct 40 wildlife watering facilities

Establish 2 natural areas: 100 acres of Ironwood trees near Burnt Mountain and a 480 acre site that includes Flat Iron Mountain

MITIGATION MEASURES

Revegetate all disturbed areas in the construction zone, also, revegetate dam

Install 20 pipes through dam to allow floodwater to continue down natural washes

Construct 3 wildlife watering facilities

EFFECTS

ECONOMIC

Reduce annual floodwater and sediment damages to $34,000 to 5,100 acres of irrigated cropland

Provide construction cost savings of $20,000 to proposed urban developments

Reduce erosion on 13,000 acres of rangeland

Provide average annual cost savings of $422,000 to the CAP Granite Reef Aqueduct

Reduce damages caused by erosion and flooding to 50 miles of road

Reduce pumping costs by improving irrigation efficiency by 10 percent on 10,200 acres

Optimum use of flood plain through management

QUALITY CONSIDERATION OF WATER, LAND AND AIR

Maintain and improve desert areas by the implementation of land management plans on public lands

Maintain and improve cropland by the implementation of conservation plans

Increase amounts of dust and noise during construction of dam

Increase soil loss off disturbed areas during construction

Improve downstream water quality by storage of animal waste effluent in lagoons, prevention of flooding of feedlots, and reduction of sediment

BIOLOGICAL RESOURCES, SELECTED ECOLOGICAL SYSTEMS AND AREAS OF NATURAL BEAUTY

Temporary loss of wildlife habitat during construction of dam and other structural measures

Remove 460 acres of desert type vegetation by construction of dam

Partially destroy 380 acres of desert type vegetation in the sediment pool because of borrow removal

Reduce density and growth of riparian vegetation on 45 washes below dam and aqueduct

Limited reduction of density and growth of riparian vegetation on 20 washes where floodwaters are partially allowed to continue downstream in natural washes

Enhancement of wildlife habitat for big and small game animals will provide 130 hunter days

GEOLOGICAL, ARCHEOLOGICAL AND HISTORICAL RESOURCES

Some geological, archeological and historical resources will be lost during construction. However, every effort will be made to locate, remove and preserve these resources.

IRREVERSIBLE OR IRRETRIEVABLE COMMITMENTS OF RESOURCES

460 acres of desert land is to be committed to the construction of a dam. Land needed for mitigation measures is also to be committed

Capital and labor needed to construct and install structural and land treatment measures is irretrievable

580 acres of land will be preserved as natural areas

Alternate Structural Measures

Alternate structural measures that were investigated, but are not a part of any plan, include making the dam upstream from the Granite Reef Aqueduct a multi-purpose structure. The structure could store water for such purposes as groundwater recharge or irrigation. The sponsors have not chosen this type of dam because of insufficient water yields, additional costs, and limited benefits.

Another potential site could be located on Winters Wash, downstream from the Buckeye Salome-Road. It could store water for municipal and industrial use. This site was not included in this plan because downstream from this location there is limited floodwater damage; also, there is little interest in storing water for multiple use.

A 4.4 mile channel modification to convey floodwaters to the Hassayampa River was not included because of excessive costs and limited benefits. This channel could be located south of the eastbound lane of Interstate-10.

WORKS OF IMPROVEMENT RECOMMENDED

Land Treatment Measures

Managing land within its capability and improving land that has been mismanaged is an excellent way to minimize runoff, thus decreasing flooding and sediment deposition on agricultural and urbanized lands. On rangeland, measures such as proper grazing use, deferred grazing, and stock water development will provide food and water for livestock, and habitat for wildlife. Disturbed areas around waterspreading dams will be revegetated.

The main elements of the land treatment program on cropland are design of irrigation systems, land leveling, lining of irrigation ditches, installation of irrigation pipelines and tailwater return systems, conservation cropping systems, proper use of crop residue and minimum tillage. Included in land treatment measures are ponds for disposal of animal waste and earthen dikes around feedlots to keep floodwaters out. In order to get land treatment practices effectively installed on agricultural lands, 10 conservation plans need to be developed and 20 plans need to be revised. During the project installation period, about 75 percent of the remaining land treatment practices needed on private lands will be completed and will provide adequate treatment of the land.

On public land, the Bureau of Land Management will administer management plans as they are completed.

Structural Measures

A 16-mile long compacted earthfill dam is proposed that will control 35 percent of the watershed runoff and will be located on land that is administered by the Bureau of Land Management. The location of this dam may be seen in Figure 3. It will be designed to retard floodwaters and trap sediment, and will have a life of 100 years. The storage in the sediment pool will be available to retain floodwaters until it is depleted by sediment. This site is underlain mostly by older fill deposits which have considerable calcium carbonate cementation. The depth to bedrock is believed to be shallow at the east end of the site area. A principal spillway will be located at this end of the structure. The emergency spillway will also be located at the east end. These spillways will outlet into Jackrabbit Wash. The emergency spillway will be designed to carry floodwaters at a non-erosive velocity. Another principal spillway, outletting into Old Camp Wash, is necessary because of the extreme length of this structure. Structural data information is shown in Table 3.

Downstream from the Big Horn Mountains, the surface soils are suspected to be collapsible. It will probably be necessary to strip these soils from the foundation. This will necessitate drainage measures, earth blankets, or a deep cutoff trench.

Ample fill material will be obtained from the sediment-floodwater pools. At present, this area has desert type vegetation.

Mitigation measures related to the dam consist of 20 pipes conveying runoff water through the dam and into diversion systems that allow floodwaters to outlet into washes downstream. Establishing native vegetation in all disturbed areas, and the construction of three wildlife watering facilities is also proposed. Structural measures that will be used to enhance wildlife habitat include 4 waterspreading systems, 6 grade control structures, and 40 wildlife watering facilities.

EXPLANATION OF INSTALLATION COSTS

The estimated total cost for installation of the proposed floodwater retention dam and the mitigation measures is $6,179,000. This estimate was based in part on the unit cost for compacted earth dam fill, and was determined from current contracts. Associated costs for the establishment of cacti, native grasses, shrubs, and riparian vegetation on the dam and in disturbed areas are included in this unit price. The cost of contingencies, engineering services, and project administration will each amount to approximately 20 percent of the total construction cost. Five percent of the total cost will be for conduits to carry stream flow through the structure and back into its natural channel. Also included in the total cost are waterspreading systems that will be installed on 100 acres of land and three wildlife watering facilities. Investigations have shown that the project will not result in the displacement of any person, business, or farm operation. Also, there are no utility lines to be relocated in the site area.

Fencing 2 natural areas and enhancing wildlife habitat by constructing 4 waterspreading systems, 6 grade control structures and 40 wildlife watering facilities are expected to cost $162,000. The estimated project installation cost and structural cost distribution are shown in Tables 1 and 2. It is planned that the cost of these enhancement features will be either shared by private land users or borne by the Bureau of Land Management.

ECONOMIC EVALUATION, BENEFITS AND EFFECTS

Benefit-Cost Ratio

The average annual cost of installing the selected alternative plan is estimated to be $407,525 as shown in Table 4. The average annual benefits, including secondary benefits, are estimated to be $510,690. The ratio of average annual benefits to average annual costs is 1.3 to 1.0, as shown in Table 6.

Project Benefits

Installation of the proposed structural measures will have beneficial effects in the watershed. Agricultural damage will be reduced by providing protection to irrigation facilities, roads, and cropland. Quantity and quality of crop production will be increased and other agricultural damages will be reduced, such as weed infestation, releveling of land, and removal of sediment and debris from cropland. Total average annual benefits to crop and pastureland is estimated to be $13,700, while benefits to other agricultural facilities are estimated to be $19,610.

Urban development which is projected for the area will require reduced floodproofing measures. On an average annual basis, the cost saving benefits resulting from reduction of potential floodwater damage is estimated to be $19,030. Other nonagriculturally related cost saving benefits are estimated to be $670.

The Central Arizona Project Granite Reef Aqueduct will be constructed below the proposed structural measures. The protection afforded this aqueduct will provide a cost savings benefit of $422,000 by eliminating the need for protective overchutes and necessary operation and maintenance expenses.

The residents will benefit overall when expenses for repair and replacement of flood damaged property is eliminated. These funds can then be used for other community developments and projects. Employment of local labor will be increased with the construction of the proposed structural measures.

Wildlife facilities, including waterspreading systems, wildlife watering devices, grade control structures, and other natural area developments will be developed as part of the proposed structural measures. The estimated average annual benefits for wildlife facilities total $10,250, based upon an estimated hunting value attributed to these improvements.

Indirect benefits are estimated to be $3,380, based upon agricultural and related agricultural facilities. Secondary benefits were evaluated only upon agricultural benefits resulting from installation of the proposed structural measures.

FINANCING PROJECT INSTALLATION

Land Treatment

The cost of land treatment on private and state lands will be borne by the private landowner or the lessees of state trust lands. Financial assistance may be available from the Agricultural Stabilization and Conservation Service through the Rural Environmental Conservation Program.

Structural Measures

Structural installation costs not borne by P.L. 566 funds will be the responsibility of the Flood Control District of Maricopa County. The installation cost, referred to as land rights, is the responsibility of the sponsors. Land rights may be negotiated for or acquired by eminent domain. No relocation payments are anticipated for this project.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Landowners and operators cooperating with the Buckeye-Roosevelt Natural Resource Conservation District and the Wickenburg Natural Resource Conservation District will be responsible for the maintenance of land treatment measures installed on their property and on state lands they lease.

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

Structural Measures

The Flood Control District of Maricopa County will be responsible for the operation and maintenance of all structural and mitigation measures after installation. The District will obtain all necessary funds for operation, maintenance, and replacement from tax or assessment levies.

It is estimated that the total annual operation, maintenance, and replacement cost of structural measures will be $3,000.

TABLE 1 - ESTIMATED INSTALLATION COST

Tonopah Watershed, Arizona

Installation Cost Item	Unit	Number			Estimated Cost (Dollars) 1/							
					P.L. Funds			Other Funds				
		Fed. Land	Non-Fed Land	Total	Fed. Land SCS 2/	Non-Fed Land SCS 2/	Total	Fed Land BLM 2/	Fed Land SCS 2/	Non-Fed Land SCS 2/	Total	TOTAL
LAND TREATMENT												
Rangeland	Ac.		15,000	15,000						1,500	1,500	1,500
Cropland	Ac.		5,500	5,500						800,000	800,000	800,000
Flood Control Dikes	No.		1	1						27,000	27,000	27,000
Feedlot Lagoons	No.		3	3						30,000	30,000	30,000
Grade Control Structures	No.		6	6						10,800	10,800	10,800
Technical Assistance										131,000	131,000	131,000
TOTAL LAND TREATMENT	xxxx	xxxx	xxxx	xxxx						1,000,300	1,000,300	1,000,300
STRUCTURAL MEASURES												
Construction-SCS												
Floodwater Retarding Structure	No.	1		1	5,310,000		5,310,000					5,310,000
SCS Subtotal					5,310,000		5,310,000					5,310,000
Construction-BLM												
Waterspreading Systems								15,000			15,000	15,000
Wildlife Watering Facilities								115,000			115,000	115,000
Natural Areas	No.	2		2				6,000			6,000	6,000
Subtotal-Construction					5,310,000		5,310,000	136,000			136,000	5,446,000
Engineering Services					427,600		427,600	10,000			10,000	437,600
Project Administration												
Construction Inspection					259,900		259,900					259,900
Other					173,300		173,300		4,400		4,400	177,700
Subtotal-Administration					433,200		433,200		4,400		4,400	437,600
Other Costs												
Land Rights 3/									9,000		9,000	9,000
Subtotal-Other												
TOTAL STRUCTURAL MEASURES					6,170,800		6,170,800	146,000	13,400		159,400	6,330,200
TOTAL PROJECT					6,170,800		6,170,800	146.000	13,400	1,000,300	1,159,700	7,330,500

1/ Price base 1974

2/ Federal agency responsible for assisting in installation of works of improvement.

3/ Special use permit, legal fees and survey costs. Actual value of land is $830,000.

July 1974

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At Time of Work Plan Preparation) 1/

Tonopah Watershed, Arizona

Measures	Unit	Applied to Date	Total Cost (Dollars) 2/
LAND TREATMENT			
Non-Federal Land			
Irrigation Land Leveling	Ac.	11,445	1,144,500
Irrigation Ditch and Canal Lining	Ft.	355,835	533,800
Irrigation Pipeline	Ft.	20,000	60,000
Irrigation Water Management	Ac.	6,000	18,000
Cropland Adequately Treated	Ac.	9,900	-
TOTAL			1,756,300

1/ Preliminary data in Table 1A does not include rangeland or pastureland. There are only limited conservation accomplishments reported and available for use in this preliminary study. Irrigated pastureland is increasing and needs improved management.

2/ Price Base 1974

July 1974

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Tonopah Watershed, Arizona

(Dollars) 1/

Item	Installation Cost P. L. 566 Funds					Installation Cost - Other Funds						Total Installation cost
	Construction	Engineering	Land Rights	Relocation Payments	Total P.L. 566	Construction	Engineering	Land 2/ Rights	Relocation Payments	Water Rights	Total Other	
Floodwater Retarding Structure	5,310,000	427,600	0	0	5,737,600	0	0	9,000	0	0	9,000	5,746,600
Wildlife Facilities	0	0	0	0	0	130,000	10,000	0	0	0	140,000	140,000
Natural Area	0	0	0	0	0	6,000	0	0	0	0	6,000	6,000
Subtotal	5,310,000	427,600	0	0	5,737,600	136,000	10,000	9,000	0	0	155,000	5,892,600
Project Administration	xxx	xxx	xxx	xxx	433,200	xxx	xxx	xxx	xxx	xxx	4,400 3/	437,600
GRAND TOTAL	5,310,000	427,600	0	0	6,170,800	136,000	10,000	9,000	0	0	159,400	6,330,200

1/ Price Base 1974

2/ Special Use Permit, Legal Fees and Survey Costs. Actual Value of Land is $830,000

3/ Includes Arizona Dam Filing Fees

July 1974

TABLE 3 - STRUCTURAL DATA

STRUCTURES WITH PLANNED STORAGE CAPACITY
Tonopah Watershed, Arizona

ITEM	UNIT	STRUCTURE NUMBER 1
Class of Structure		C
Drainage Area	Sq. Mi.	137
Maximum Height of Dam	Ft.	41
Volume of Fill	Cu. Yds.	5,400,000
Total Capacity 1/	Ac. Ft.	15,070
Sediment Total	Ac. Ft.	2,570
Retarding	Ac. Ft.	12,490
Surface Area		
Sediment Pool	Ac.	380
Retarding Pool 1/	Ac.	1,580
Capacity Equivalents (Total)	In.	2.0
Sediment Volume	In.	0.3
Retarding Volume	In.	1.7

1/ Crest of Emergency Spillway

TABLE 4 - ANNUAL COSTS

Tonopah Watershed, Arizona

(Dollars) 1/

Evaluation Unit	Amortization of 2/ Installation Cost	Operation and Maintenance Cost	Total
Floodwater Retarding Structure	324,620	1,000	325,620
Wildlife Facilities	7,910	2,000 3/	9,910
Natural Areas	340	-	340
Project Administration	24,720	xxxx	24,720
GRAND TOTAL	357,590	3,000	360,590

1/ Price Base - 1974

2/ 100 years at 5-5/8 percent interest

3/ Includes replacement costs

July 1974

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Tonopah Watershed, Arizona

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Agricultural			
Crop and Pasture	25,760	16,170	9,590
Other Agricultural	32,480	20,160	12,320
Farm Roads	3,650	2,240	1,410
CAP Savings	295,480	0	295,480
Nonagricultural			
Urban	13,320	0	13,320
Roads	1,220	750	470
Subtotal	371,910	39,320	332,590
Sediment			
Agricultural			
Crop and Pasture	11,040	6,930	4,110
Other Agricultural	13,920	8,640	5,280
Farm Roads	1,570	970	600
CAP Savings	126,630	0	126,630
Nonagricultural			
Urban	5,710	0	5,710
Roads	520	320	200
Subtotal	159,390	16,860	142,530
Indirect	9,010	5,630	3,380
Total	540,310	61,810	478,500

1/ Current Normalized Prices for Agricultural Products and Current Prices for Agricultural and Nonagricultural Properties

July 1974

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURE

Tonopah Watershed, Arizona

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/				Average Annual Cost 2/	Benefit Cost Ratio
	Damage Reduction	Recreation	Secondary	Total		
Floodwater Retarding Structure	478,500	-	3,330	481,830	325,620	1.5:1.0
Wildlife Facilities	-	10,250 3/	1,020	11,270	10,250	1.1:1.0
Project Administration	xxxx	xxxx	xxxx	xxxx	24,720	xxxx
GRAND TOTAL	478,500	10,250	4,350	493,100	360,590	1.4:1.0

1/ Current Normalized Prices for Agricultural Products and Current Prices for Agricultural and Nonagricultural Properties

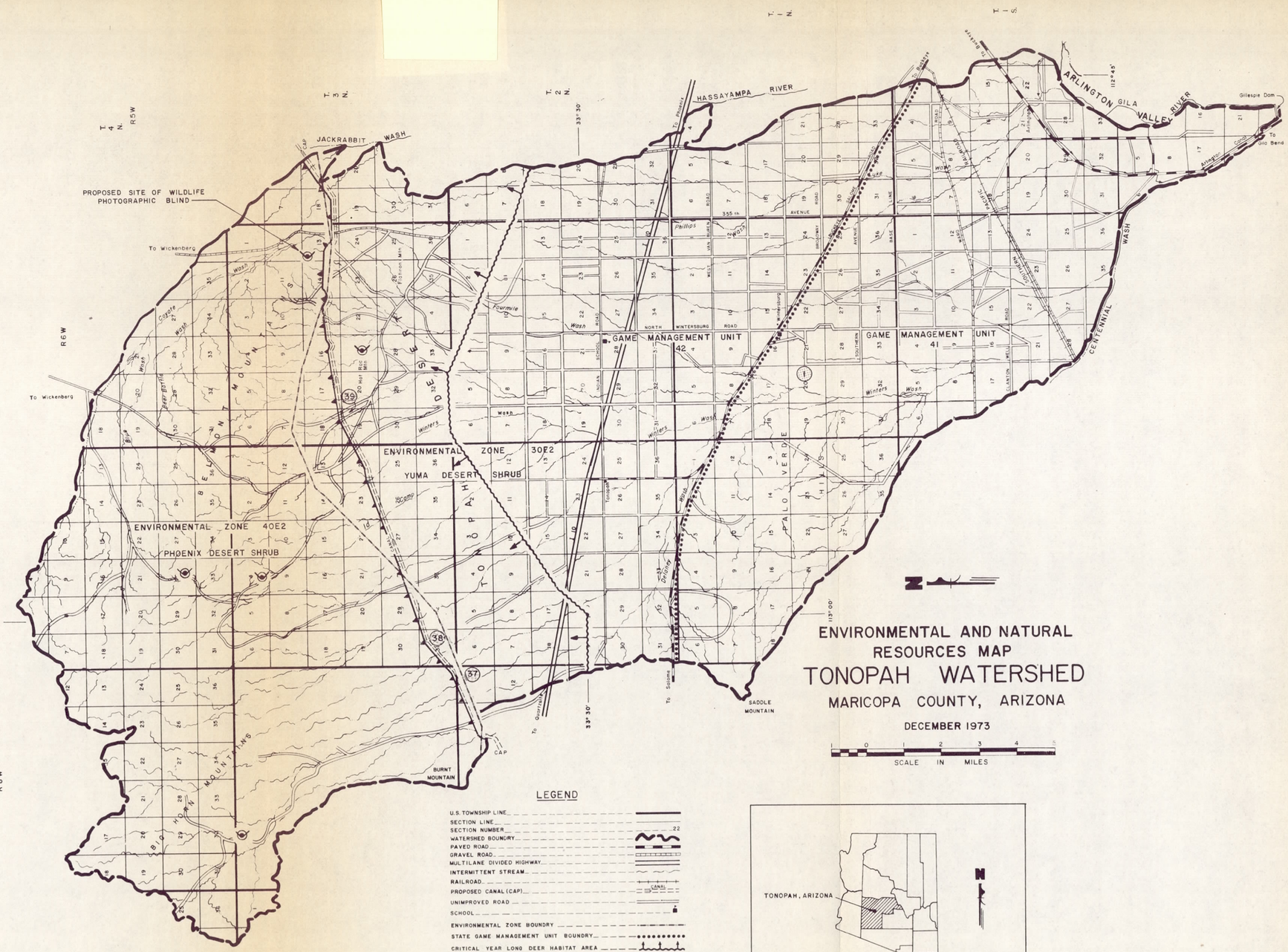
2/ From Table 4

3/ Benefits to recreation are from hunting and observing wildlife

July 1974

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



ENVIRONMENTAL AND NATURAL RESOURCES MAP

TONOPAH WATERSHED

MARICOPA COUNTY, ARIZONA

DECEMBER 1973

SCALE IN MILES 0 1 2 3 4 5

LEGEND

- U.S. TOWNSHIP LINE
- SECTION LINE
- SECTION NUMBER 22
- WATERSHED BOUNDRY
- PAVED ROAD
- GRAVEL ROAD
- MULTILANE DIVIDED HIGHWAY
- INTERMITTENT STREAM
- RAILROAD
- PROPOSED CANAL (CAP) CANAL
- UNIMPROVED ROAD
- SCHOOL
- ENVIRONMENTAL ZONE BOUNDRY
- STATE GAME MANAGEMENT UNIT BOUNDRY
- CRITICAL YEAR LONG DEER HABITAT AREA
- WILDLIFE WATERING CATCHMENT
- BR CAP ARCHAEOLOGICAL SITE AND SITE NUMBER (3)
- SCS LITHIC AND OR SHERD SITES (1)
- PROPOSED STRUCTURE

FIGURE 1

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PRELIMINARY

OWNERSHIP, ADMINISTRATION AND USE OF LAND

TONOPAH WATERSHED

MARICOPA COUNTY, ARIZONA

DECEMBER 1973

SCALE IN MILES

0 1 2 3 4 5

LEGEND

- U.S. TOWNSHIP LINE
- SECTION LINE
- SECTION NUMBER .22
- WATERSHED BOUNDRY
- PAVED ROAD
- GRAVEL ROAD
- MULTILANE DIVIDED HIGHWAY
- INTERMITTENT STREAM
- RAILROAD
- PROPOSED CANAL (CAP) CANAL
- UNIMPROVED ROAD
- SCHOOL
- STATE TRUST LANDS
- PUBLIC DOMAIN-ADMINISTERED:
- BY BUREAU OF LAND MANAGEMENT
- WITHDRAWN BY BUREAU OF RECLAMATION
- PRIVATE LANDS:
- RANGELAND (DESERT) USE
- IRRIGATED CROPLAND USE
- RESIDENTIAL USE

LOCATION MAP

FIGURE 2

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE