

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
PROPOSED PLAN FOR FLOOD CONTROL AND RECREATION

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PURPOSE OF BROCHURE

This brochure presents the details of the plan recommended for flood control and recreational development in the Phoenix area. It also describes the various alternatives studied and the basis for the selection of the recommended plan.

You are encouraged to study this brochure and to express your views on the recommended plan at the public meeting scheduled for 21 October 1975 or by letter to the District Engineer, Los Angeles District, U.S. Army Corps of Engineers, P.O. Box 2711, Los Angeles, California 90053.

DESCRIPTION OF DRAINAGE AREA

The drainage area tributary to the New River and Phoenix City Streams project forms a roughly oval-shaped area of about 2,610 square miles. The basin is located in Maricopa and Yavapai Counties in the south central part of Arizona. About 70 percent of the area is mountainous. The mountain areas above 3,000 feet are rugged and steep; lower areas consist of fairly flat valley land with regular alluvial slopes. Elevations in the study area range from about 7,000 feet above mean sea level in the headwaters to about 900 feet at the Gila River.

The Agua Fria River rises in the Hieroglyphic Mountains and flows for about 130 miles to the Gila River near Avondale. The New River, the major tributary of the Agua Fria River, originates in the New River Mountains and flows generally southward for about 40 miles to its confluence with the Agua Fria River, about 15 miles west of Phoenix. It drains an area of approximately 340 square miles. Skunk Creek, the major tributary of the New River, rises in the New River Mountains and flows generally southwestward for about 30 miles to its confluence with the New River about 15 miles northwest of Phoenix. It drains approximately 110 square miles. Cave Creek, which also has its source in the New River Mountains, descends to the alluvial fan near the town of Cave Creek; the creek then flows south for about 13 miles before encountering Cave Creek Dam, which controls 175 square miles of drainage area. Cave Creek then flows through an alluvial fan that is undergoing urbanization between Cave Creek Dam and the Arizona Canal. Floodflows exceeding the capacity of the canal flow directly through metropolitan Phoenix to the Salt River. Cave Creek drains approximately 311 square miles. Dreamy Draw Wash, a tributary of Cave Creek, rises in the Phoenix Mountains and flows generally southwestward for about 5 miles to its confluence with Cave Creek in Phoenix. The wash has a 2-square-mile drainage area. Cudia City Wash, with a drainage area of 4.9 square miles above the Arizona Canal, rises in the Phoenix Mountains northeast of Phoenix and upstream from the Arizona Canal. Floodflows exceeding the capacity of the canal overtop the canal in the vicinity of 32d Street.

HISTORY AND AUTHORITY FOR STUDY

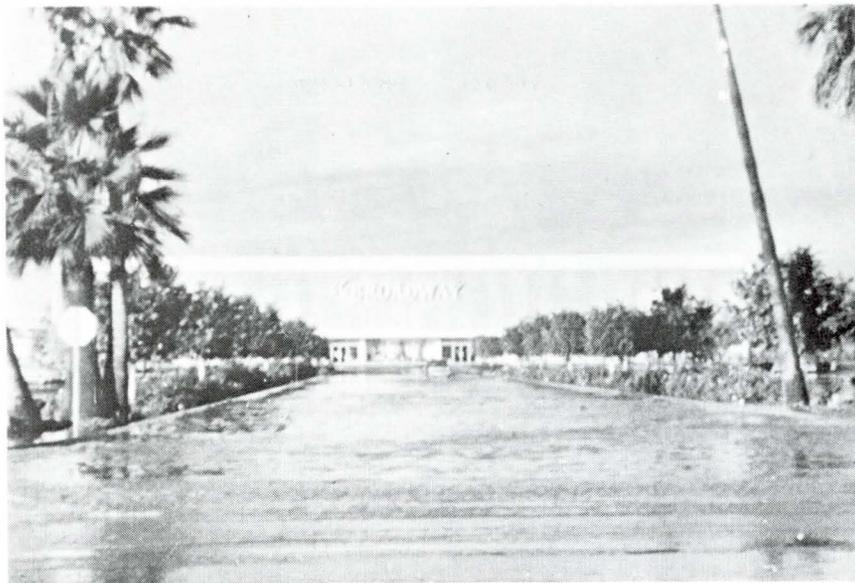
The New River and Phoenix City Streams flood control project, as described in House Document 216, 89th Congress, 1st Session, was authorized by the Flood Control Act of 1965. The plan, as authorized, provided for (a) Dreamy Draw (already constructed), Cave Buttes, Adobe, and New River Dams; (b) the Union Hills and Arizona Canal diversion channels; and (c) the Cave Creek, Dreamy Draw, Skunk Creek, and the New and Agua Fria Rivers channel improvements. The plan provided for controlling floodflows in each respective drainage area, for diverting residual flows in Cave Creek and several small washes to Skunk Creek, and for channelizing Skunk Creek, and the New and Agua Fria Rivers to carry the diverted flows to the Gila River.

Postauthorization studies were undertaken to review the authorized project and either reaffirm the plan or reformulate and develop a plan more suitable under existing conditions taking into account environmental and technical considerations, economic feasibility, social impact and public opinion and needs. During these studies, a number of formal and informal meetings were held with local government and with concerned individuals and groups to provide continual information on the progress of the study and to solicit ideas and alternative plans that should be considered in formulating solutions to the flood control and associated problems. Formal public presentations were made in April 1972, April 1974, and September 1974. Attending these meetings were representatives of Federal, State, county, and city agencies; the local news media; representatives of Congressmen Rhodes and Conlan; the Arizona State University; the Salt River Project; and private individuals. Subsequent to the April 1974 public meeting, the Maricopa County Board of Supervisors and the Phoenix City Council endorsed the plan presented as alternative 5b and requested that the Corps develop further details for this plan. The results of these additional studies are presented in this brochure.

FLOOD HISTORY AND PROBLEMS

Until relatively recent times, floods along Cave Creek, Dreamy Draw, and Cudia City Wash rarely caused large damages, mainly because of the predominance of agricultural development in the overflow area. Since 1940, however, the population in the Phoenix metropolitan area has increased almost twelve-fold, and the flood damage potential has increased tremendously. Recent development trends in the Phoenix area may be shown by considering the period of time from 1960 to 1970, when the population increased from about 524,000 to 812,000. This increase of 288,000 people required the urbanization of about 33,000 additional acres of land.

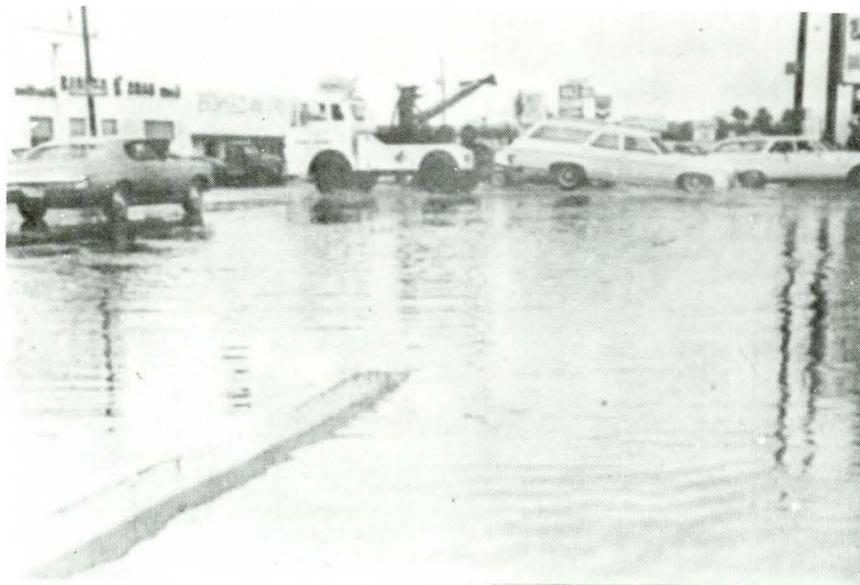
Increasing urbanization aggravates flood problems by increasing the runoff from rainfall and thus increasing the flow in streams. The natural channels of Cave Creek, Dreamy Draw, Cudia City Wash, and other washes virtually disappear at the Arizona Canal with no trace of a watercourse being evident downstream (except during floods). The area below the Arizona Canal has been subdivided and intensively developed for urban use. Many people who occupy this urban area are not aware of the potential flood danger. Because projections foresee continued population growth and urbanization in the Phoenix area, flood problems can be expected to worsen in the future.



December 20, 1967 - Rubber boot sale would be in order for the Broadway Department Store in Chris Town.



December 20, 1967 - Overflow from Arizona Canal caused this flooding northwest of 51st Avenue and Grand Avenue.



September 4-6, 1970 - Disabled auto being towed away at intersection of 16th Street and Camelback Road.



September 4-6, 1970 - Girls being splashed by passing motorist at 3rd Street and Roosevelt Street.



June 22, 1972 - Motorist endure stalled automobiles and traffic delays on Central Avenue near Indian School Road in Phoenix.



June 22, 1972 - Floodwaters and debris gush over the top of the southern bank of the Arizona Canal east of 16th Street in Phoenix.



June 22, 1972 - Young girl experiences difficulty crossing the intersection of 32d Street and Campbell Avenue.



June 22, 1972 - Residents wade in and out of home at intersection of 32d Street and Orangewood Avenue.



June 22, 1972 - Postman makes appointed rounds with his shoes tucked in mailbag on 3d Avenue south of Roosevelt Street.

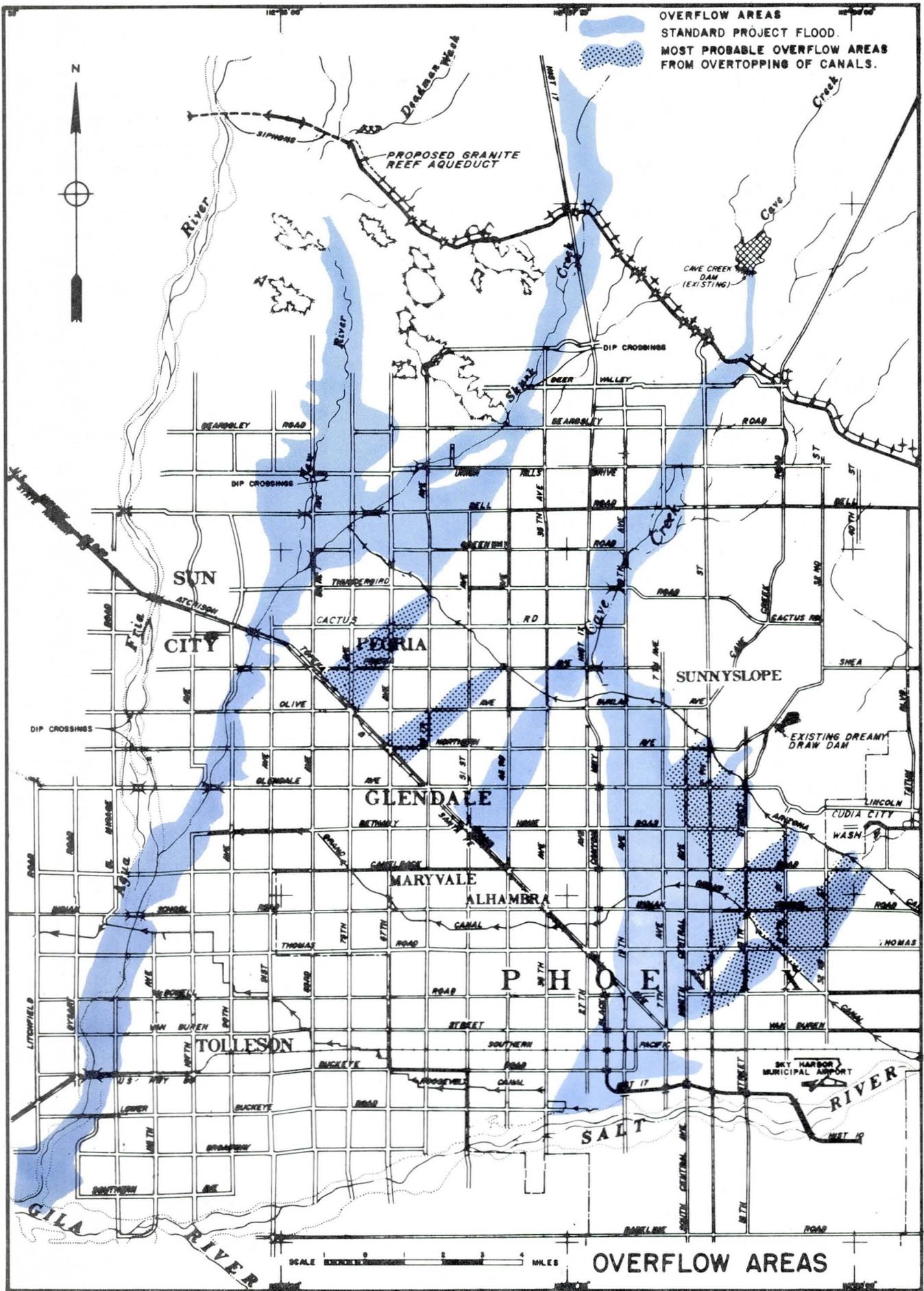


June 22, 1972 - Young girls braving knee-deep water at intersection of 3d Avenue and Roosevelt Street.

STANDARD PROJECT FLOOD

Standard Project Flood (SPF) is the name given to the flood that would be caused by the occurrence of the most severe storm of record in an area; it would be exceeded only on rare occasions. Such a flood could occur in the Phoenix area if a storm equivalent in magnitude to the largest storm on record in the general region were to center over the drainage area when ground conditions were conducive to a high rate of runoff. The estimated flood from such a storm represents a reasonable upper limit of the flood-producing potential of that part of the basin.

Two types of standard project floods, local and general, are considered in large comprehensive flood-control projects such as this. Meteorological studies show that the thunderstorm of August 1954 that occurred over Queen Creek, about 50 miles southeast of Phoenix, could occur in the Phoenix area; that storm was, therefore used as the basis for determining the local type of SPF for both peak discharge and flood volume. The general summer storm of 3-7 September 1970, which brought very heavy precipitation to all of central and northeast Arizona and to parts of other states, was the storm used in determining the general type of SPF for peak discharge. The general summer storm of 26-29 August 1951, which brought heavy precipitation to southern Yavapai County and northeast Maricopa County in Arizona, was the storm used in determining the general type of SPF for flood volume. This storm was used in the design of the proposed Cave Buttes and New River Dams.



OVERFLOW AREAS
STANDARD PROJECT FLOOD.
MOST PROBABLE OVERFLOW AREAS
FROM OVERTOPPING OF CANALS.

OVERFLOW AREAS

EXISTING AND PROPOSED IMPROVEMENTS

The system of irrigation canals, around which the various communities have grown, have been operated as emergency flood control channels in the past. These canals, however, are obviously limited in their ability to carry large quantities of water because they are generally full of irrigation water when storms occur. Even if the canals were dry when the storm occurred, they were not designed to carry floodflows. The canals' maximum capacity is upstream rather than downstream, exactly the reverse of what is required for flood control purposes. The Arizona and Grand Canals frequently overflow their banks during floods. During the flood of June 1972, the banks of both these canals were either breeched or overtopped at several locations, resulting in costly damages downstream.

As a result of a large flood along Cave Creek in 1921, when the State Capitol was flooded, the City of Phoenix, Maricopa County, and the State of Arizona, in cooperation with various private interests, constructed Cave Creek Dam in 1923 about 12 miles north of the Arizona Canal. This dam, however, is inadequate to control even the 50-year frequency flood and would be removed if Cave Buttes Dam were constructed.

Lake Pleasant Reservoir (Waddell Dam) was constructed in 1927 on the Agua Fria River about 25 miles upstream from the confluence with the New River. The 157,000 acre-foot reservoir, constructed by the Maricopa County Municipal Water Conservation District No. 1, is used for water conservation and recreation but provides incidental flood control.

Dreamy Draw Dam, which was completed in August 1973, is a small part of the Phoenix flood control project. The dam reduces flows along Dreamy Draw.

The Central Arizona Project (CAP), an authorized project under the jurisdiction of the U.S. Bureau of Reclamation, would provide Colorado River water to the southcentral part of Arizona. The Granite Reef Aqueduct, the proposed CAP facility in the Phoenix project area, would be protected by an upstream dike several feet high with cross drainage structures (culverts and overchutes) designed to pass a 50-year flood. Because the amount of storage behind the dike would be small, its influence was not considered in the computation of standard project floods. East of Cave Creek Road in the Paradise Valley reach of the CAP, however, the Bureau is constructing a dike system capable of storing all major floodwaters emanating from upstream. Construction of this CAP facility obviated the need for the Union Hills diversion channel, a unit of the authorized flood-control project.

A report has been prepared for the City of Phoenix recommending a total of eight detention basins located in the Phoenix Mountains upstream from developing residential and commercial properties. Of the eight detention basins, seven are in the project area and four of these have been completed or are scheduled for completion in 1975.

PLAN FORMULATION

Plan formulation studies included a review of the authorized plan and development of alternative plans to finally arrive at a plan that would meet all (or most) of the prerequisites necessary to a major flood control project. The major considerations in such a study, in addition to providing flood protection, are (a) the environmental and social impacts, (b) the impacts of the new State of Arizona law, passed 3 May 1973, that requires flood plain management along watercourses and the Federal Flood Disaster Protection Act of 1973, (c) current and projected urbanization trends, (d) the potential for recreational development to be incorporated into the flood-control project, and (e) economic justification.

The formulation of alternative plans was accomplished in two stages. First, alternative damsites were analyzed to determine the best site; then, alternative plans for providing flood protection to the Phoenix area were developed. Six alternatives that were considered to be the most feasible are briefly described beginning on page 49. They are (1) No further action; (2) Combination of dams and channels; (3) Dams only; (4) Channels only; and (5a) and (5b) Combination of structural and nonstructural measures.

During plan formulation, studies were made of flowage easements, channelization of the various streams in the project area, and construction of the Arizona Canal diversion channel. The primary types of channels studied were concrete-rectangular, concrete-trapezoidal, and earth-bottom-trapezoidal with revetted side slopes. The type of channel selected for each reach was based on cost, environmental and social impacts, and recreation potential.

RECREATIONAL DEVELOPMENT

In October 1973, a multiagency group was formed to consider recreational development in conjunction with the development of the project alternatives. Initially, the recreational features recommended by the task force included water-oriented recreational development at Cave Buttes, Adobe, and New River Dams; later action by the local recreation sponsors, however, caused water-oriented recreational development to be eliminated from further consideration because adequate funds were not available to finance this undertaking. The task force then recommended a dryland recreational concept for the Cave Buttes and Adobe Dams reservoir areas; the New River Dam reservoir area would not be developed. They also recommended hiking, jogging, bicycle, and equestrian trails along the channel reaches; these trails would augment and enhance the existing Sun Circle Trail system. Rest areas with comfort facilities, picnic tables, watering troughs, and shade trees would be developed at appropriate intervals. A linear park along Cave Creek which would contain community park areas connected by a trail system, was also considered for some of the alternatives and in the proposed recommended plan.

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Studies have included an analysis of the environmental and social consideration and have identified possible measures to minimize or mitigate adverse effects. The Corps has actively participated in a dialogue with responsible Federal, State and local authorities, as well as concerned individuals and conservation groups to identify areas of concern and measures to minimize or mitigate any adverse effects.

Some of the potential environmental and social impacts that would result from the construction of any of the alternative plans are summarized below.

a. Varying degrees of flood protection to the urban areas of Phoenix, Glendale, Peoria, and Avondale would be provided by the various alternatives.

b. Community morale would be improved with flood control by protecting existing and future urbanized areas from the health hazards and economic losses that would result from floods.

c. The esthetic quality of some natural landscapes would be impaired by certain project features. Replanting and sculpturing of the features would aid in making them less conspicuous.

d. A substantial increase in recreational facilities and preserved open space would be provided by some of the project alternatives

e. Varying amounts of riparian vegetation, an important source of wildlife habitat, would be disturbed or destroyed depending on the alternative being considered for construction. Lands to mitigate these losses would be acquired.

f. Some archeological sites at the dams would be altered or destroyed by the construction activities or by periodic inundation. All of the sites lie within the boundaries of three archeological districts that have been nominated for inclusion in the National Register of Historic Places. The Advisory Council on Historic Preservation is currently determining what mitigation measures would be taken.

g. The relocation of homes and businesses, primarily along the proposed Arizona Canal diversion channel would result from the construction of alternatives 2 through 5b. Owners would be justly compensated in compliance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970.

h. Relocation of streets, bridges, and utilities, which would temporarily disrupt the social and economic patterns of this area, would be required with construction of the alternatives. Associated bridge construction would ultimately improve the local transportation system.

PROPOSED
RECOMMENDED
PLAN

PROPOSED RECOMMENDED PLAN

The proposed recommended plan combines structural and nonstructural flood control measures that consist of four dams: Dreamy Draw (completed in 1973), Cave Buttes, Adobe, and New River Dams; 20 miles of channelization - Arizona Canal diversion channel and portions of Cave and Skunk Creeks; and 19 miles of flowage easements with some floodproofing, levees, and channelization - Skunk Creek and the New and Agua Fria Rivers. The proposed plan differs significantly from the authorized plan in that 41 miles of channelization are no longer recommended; a 4.6-mile extension of the Arizona Canal diversion channel is now proposed; and 19 miles of flowage easements are proposed in lieu of channelization along Skunk Creek and the New and Agua Fria Rivers.

The recommended plan would:

a. Provide urban areas of the cities of Phoenix, Glendale, and Peoria with SPF protection from floodwaters emanating from above Dreamy Draw, Cave Buttes, Adobe, and New River Dams and 100-year flood protection from floodwaters emanating from above the Arizona Canal diversion channel.

b. Reduce the width of existing floodways and consequently allow for development of additional property in the floodway fringes.

c. Reduce the number of properties that would be subject to Federal insurance requirements relative to new loans.

d. Provide recreational opportunities such as local and community park development and a trail system with rest areas.

e. Displace approximately 275 residences and businesses.

f. Minimize adverse environmental effects and mitigate, where possible, those adverse environmental effects that could not be avoided, i.e., in areas of limited present development. Flood plain management and flowage easements are recommended in lieu of channelization.

g. Through the acquisition of flowage easements, provide and assure open space, retain riparian habitat, and at the same time keep future development out of the designated floodways.

h. Disturb some archeological sites; however, a mitigation plan is being developed.

i. Create employment opportunities during and after the construction process.

The proposed recommended plan is sized at near optimum economic capacity, is functionally adequate and economically justified and it represents the most feasible plan for flood damage reduction for the area.

The estimated first costs for the proposed project include estimates for design, construction, lands and relocations, esthetic treatment, recreation, archeological mitigation measures, and mitigation of the loss of wildlife habitat. Estimated average annual charges reflect the interest and amortization of the total investment (100-year life of project at a 3-1/4 percent discount rate), interest during construction, and the average annual costs of operation and maintenance. The primary benefit that would accrue from the proposed plan would be the reduction of flood damages in metropolitan Phoenix. Additionally, benefits would accrue from the savings in the cost of floodproofing (which is required without the project in conformance with the 1973 Flood Disaster Policy Act) and from the increased utilization of land. The following tabulation summarizes the costs and benefits:

	Flood Control	Recreation	Total
First Costs			
Construction*	\$117,000,000	\$14,400,000	\$131,400,000
Archeological mitigation	900,000	--	900,000
Lands and relocations	**88,300,000	<u>5,000,000</u>	<u>93,300,000</u>
Total first costs	\$206,200,000	\$19,400,000	\$225,600,000
Average annual charges	***7,420,000	1,272,000	8,692,000
Equivalent annual benefits	†12,627,000	1,668,000	14,295,000
Equivalent annual nonprevented damages	††2,763,000	--	2,763,000
Benefit-to-cost ratio	1.7	1.3	1.6

* Includes design and esthetic treatment costs.

** Includes wildlife mitigation costs.

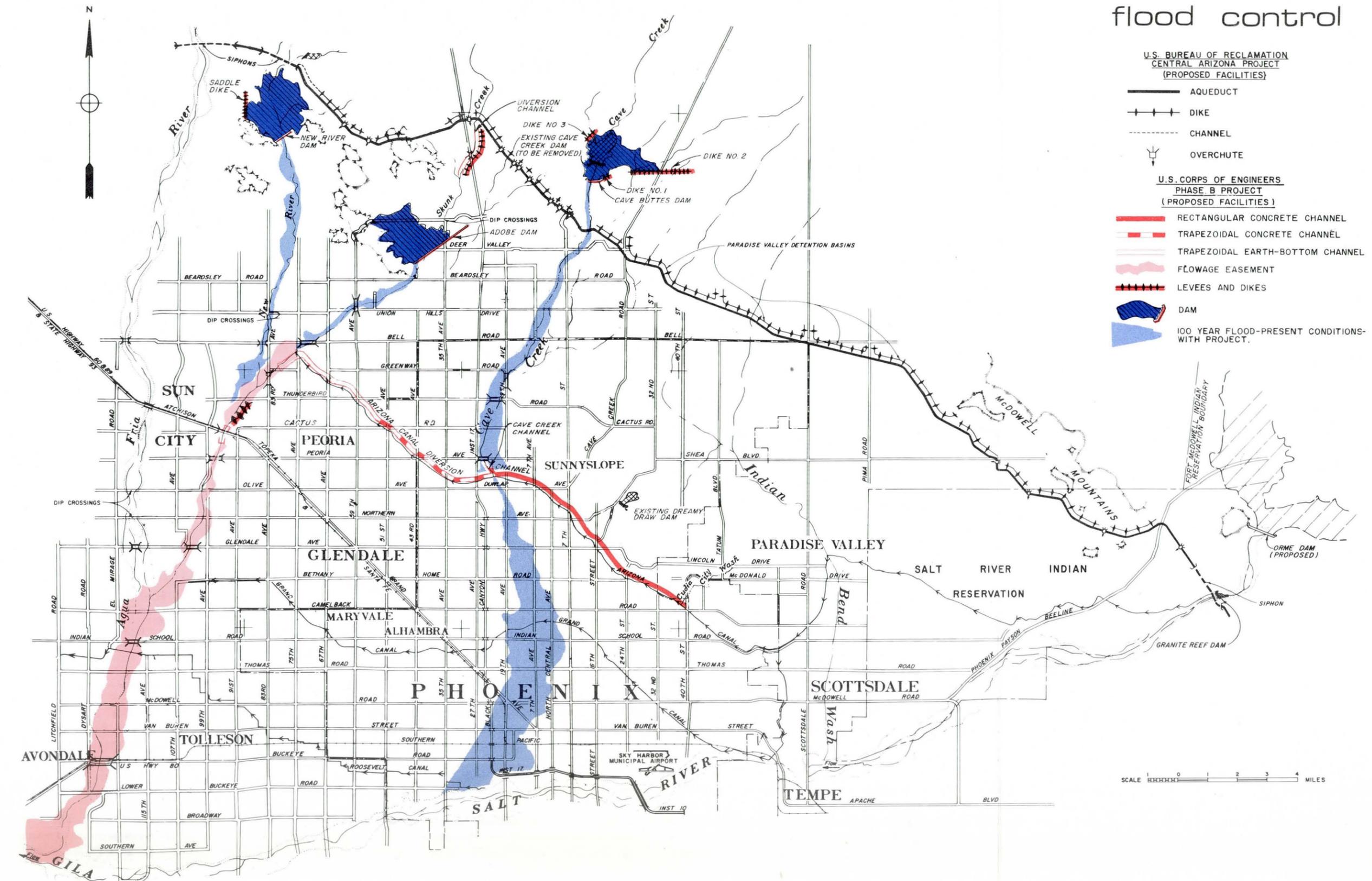
*** Excludes annual charges on archeological mitigation.

† Includes flood damages prevented (\$12,190,000), savings in floodproofing costs (\$350,000), and increased utilization of land (\$87,000).

†† Without the proposed flood control project, equivalent annual damages amounting to \$14,953,000 would occur in the project area over the period 1977 to 2076. The proposed project would reduce these flood losses to \$2,763,000.

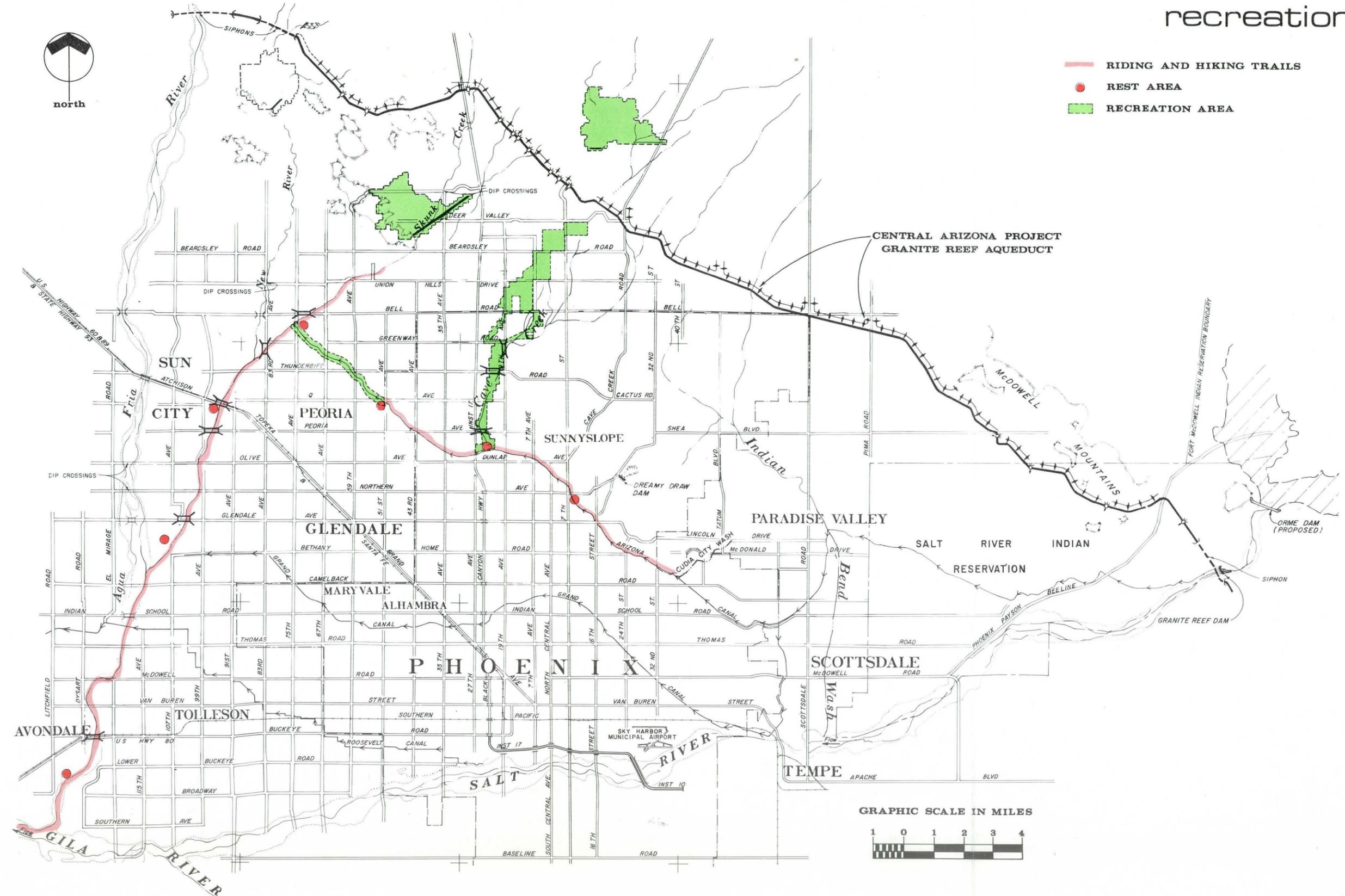
PROPOSED RECOMMENDED PLAN

flood control

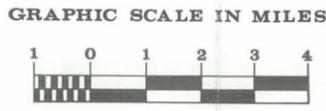


PROPOSED RECOMMENDED PLAN

recreation



- RIDING AND HIKING TRAILS
- REST AREA
- RECREATION AREA



CAVE
BUTTES
DAM

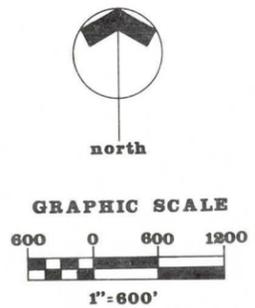
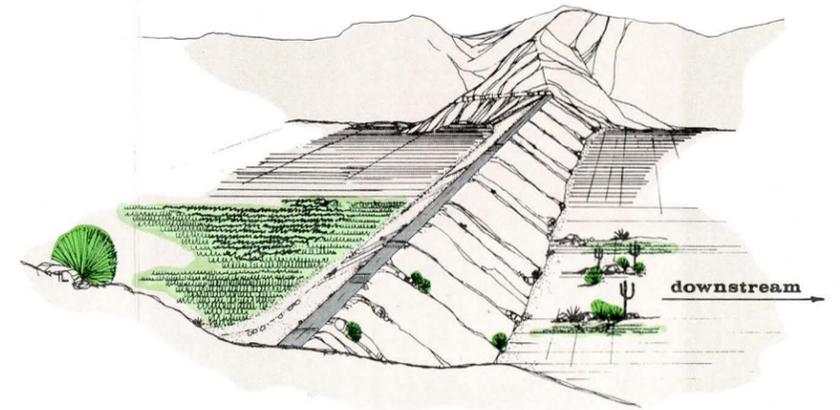
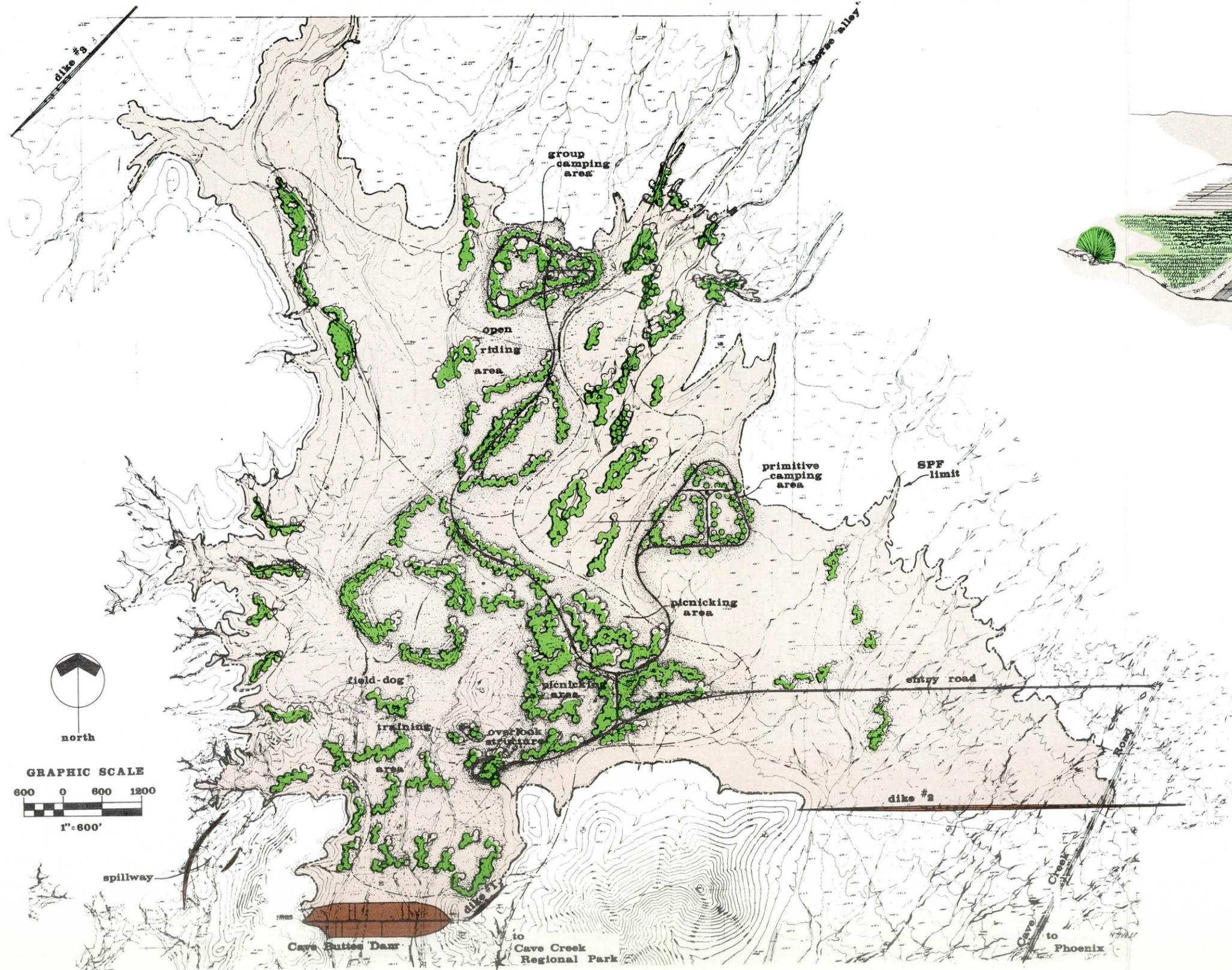
CAVE BUTTES DAM

Cave Buttes Dam, a compacted earthfill structure with a maximum height of 109 feet and length of 2,260 feet, would be constructed about 0.7 mile downstream from the existing Cave Creek Dam; additionally, three dikes would be required. The maximum outflow with floodwaters at spillway crest would be 500 cubic feet per second (cfs) through the ungated outlet.

The detention basin is a well-suited location for recreational activities that require large areas of relatively flat land. The plan includes the development of group camping areas and individual and group picnic ramadas. Hiking and riding trails would link the Cave Buttes Dam area with other nearby recreational areas. Over 300 acres in the basin would be designated as an equestrian riding and training area. Another large area would be utilized for field-dog training activities.

Cave Buttes Dam, the keystone for flood control in the Phoenix metropolitan area, would provide flood protection to downstream development; permit the removal of flood plain management restrictions on land now in open space or agricultural use; make lands available for recreational development; and preserve open space behind the dam. Potential social and environmental impacts associated with construction of Cave Buttes Dam include the alteration or destruction of wildlife habitat; the alteration or destruction of several archeological sites within the Cave Creek Archeological District, recently nominated to the National Register of Historic Places; and the relocation of three residences. Offsite lands would be acquired to mitigate the loss of wildlife habitat for this feature as well as the other project features. A program for mitigation of the archeological resources for Cave Buttes Dam and also for Adobe and New River Dams, is being coordinated with the State Historic Preservation Officer.

CAVE BUTTES DAM



LEGEND

- access roads
- - - hiking and riding trails
- restrooms
- existing and proposed vegetation

ADOBE DAM

ADOBE DAM

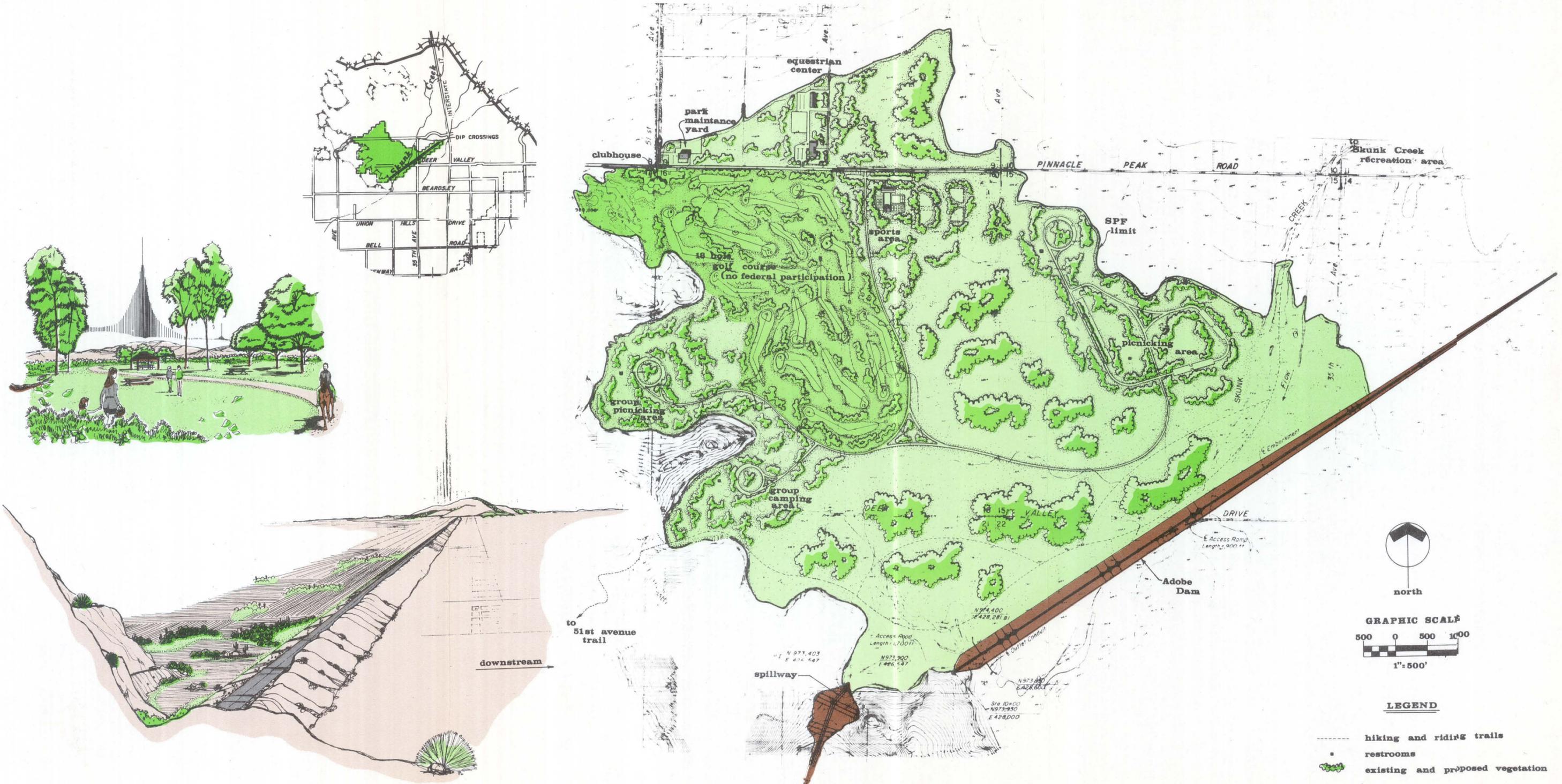
Adobe Dam, which would be constructed on Skunk Creek across Deer Valley Drive about 1 mile west of Black Canyon Highway, would be a compacted earthfill structure with a maximum height of 63 feet and length of about 2.1 miles. Floodwaters would be detained behind the dam and released at a much reduced rate (1,890 cfs maximum) through the ungated outlet. Upstream from the dam where Skunk Creek crosses under Black Canyon Highway some channelization would be required and the length of the highway and frontage road bridges would be increased by 50 percent.

The recreation concept at Adobe Dam is to develop in phases a wide variety of facilities to meet the recreational needs of increasing population in the immediate area. Thunderbird Park is adjacent to the Adobe site. To assure continuity in planning and design, plans for development of the Adobe site have been coordinated with Maricopa County's plans for development of Thunderbird Park. Facilities at Adobe Dam would include group camping and picnicking sites, an active sports area with playfields, multiple-purpose courts, and playground equipment. An equestrian center with corrals, spectator facilities and training areas is also planned. Paved bikeways would link park recreational areas, and hiking and riding trails would connect to those planned for Thunderbird Park. A visitor center would provide explanations of the purposes and functions of the flood control project and would display exhibits describing the geology, archeology, and natural and human history of the project area. The local recreation sponsor would develop an 18-hole public golf course.

Adobe Dam would protect the downstream area from floodwaters originating upstream from the dam and partly compensate for the floodwaters diverted to Skunk Creek by the Arizona Canal diversion channel. The plan allows for the development of recreational facilities and for the preservation of open space behind the dam. Potential social and environmental impacts include the alteration or destruction of wildlife habitat and several archeological sites within the recently nominated Skunk Creek Archeological District; relocation of nine homes; and the impairment of the visual quality of the surrounding area.

During phase II studies, costs and benefits will be developed in more detail for two of the alternatives. These studies will either confirm the selection of the presently proposed site for Adobe Dam or favor another alternative.

ADOBE DAM



NEW RIVER DAM

NEW RIVER DAM

The New River Dam, a compacted earthfill structure, would be constructed on the New River about 8 miles upstream from the Skunk Creek confluence. In addition to the 92-foot-high, 2,800-foot-long main embankment, a dike would be required along the west edge of the detention basin area to confine the design flood. Floodwaters would be released through an ungated outlet with a maximum outflow of about 2,560 cfs. No formal recreational facilities are proposed at New River Dam. The basin area would remain in its natural state.

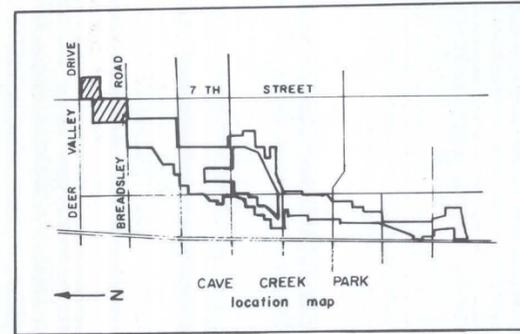
New River Dam would protect the downstream area from floodwaters originating upstream from the dam and, in conjunction with Adobe Dam, would improve the present flooding condition and more than offset the diversion effect of the Arizona Canal diversion channel under average conditions downstream from the Skunk Creek confluence. Potential social and environmental impacts include the alteration or destruction of wildlife habitat and several archeological sites within the recently nominated New River Archeological District and the impairment of the visual quality of the surrounding area. No homes are within the required land area.

CAVE
CREEK

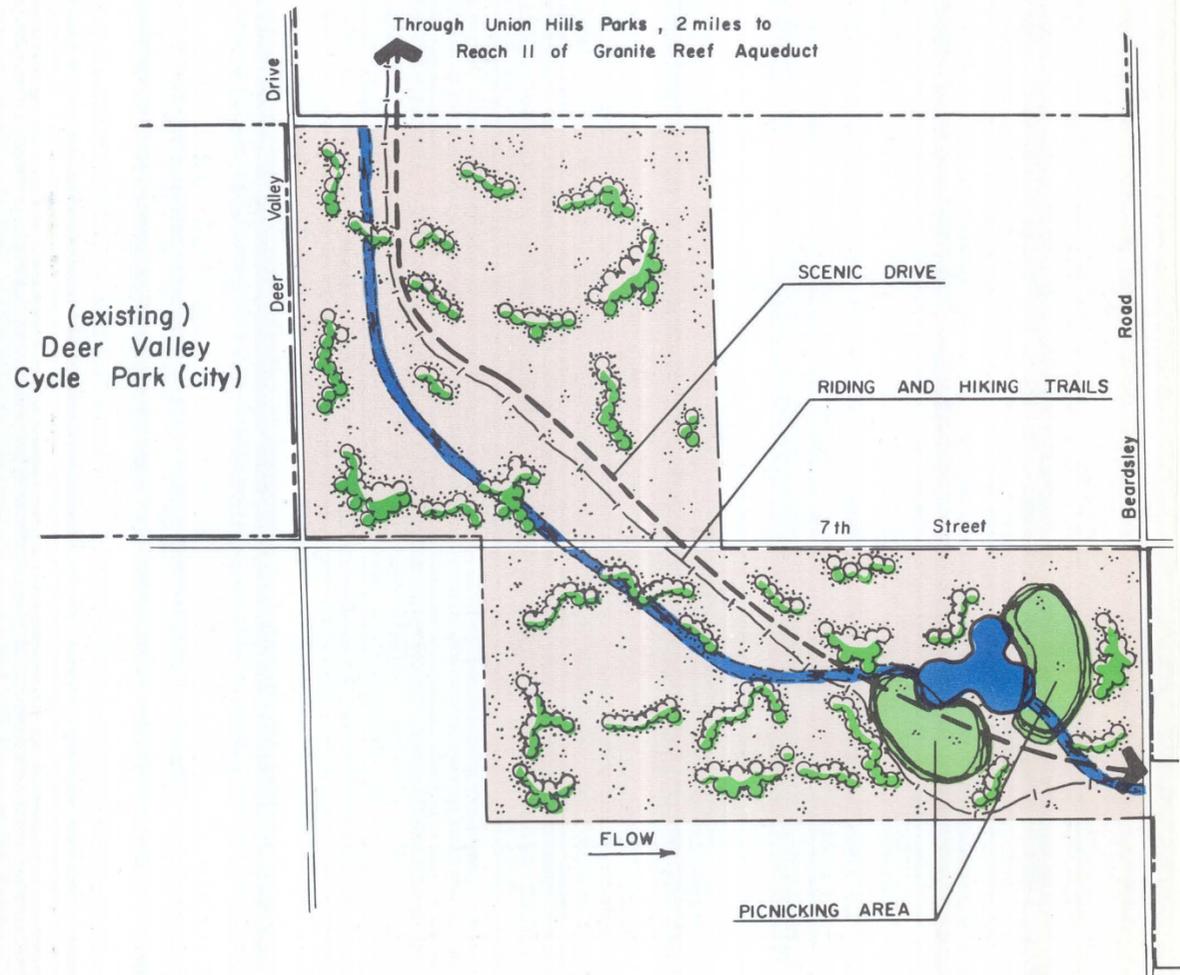
CAVE CREEK

Cave Creek must convey the maximum discharge of 500 cfs from Cave Buttes Dam to the Arizona Canal diversion channel. The existing wash has a capacity greater than the 500 cfs throughout this reach. To assure long-term capacity to operate Cave Buttes Dam as designed, Cave Creek, from the dam to Peoria Avenue, must be managed in accordance with flood plain management criteria and be provided with bridges at major street crossings to pass the maximum outflow from the dam. Cave Creek would be channelized from Peoria Avenue to the diversion channel, a distance of 0.7 mile. Required flood plain management along Cave Creek would enable local interests to realize plans for an 1,800-acre linear park along the wash. The Federal Government would participate in the development of most of the park areas. Plans for Cave Creek Regional Park include the development of several picnic and lagoon areas, intensive-use recreational areas with multiple-use courts, athletic fields, and playground apparatus. Other facilities in Cave Creek Regional Park would include amphitheaters, band shells, archery ranges, and equestrian centers. A passive-use area near Thunderbird Road and adjacent to a nature study area would be designed to meet the recreational needs of senior citizens. Local interests plan to develop orchard areas, golf courses, and a pool stadium. Trails for hikers, joggers, bicyclists, and equestrians would thread the entire length of the park. A scenic parkway, which would connect with other scenic drives, would guide motorists through the regional park.

CAVE CREEK



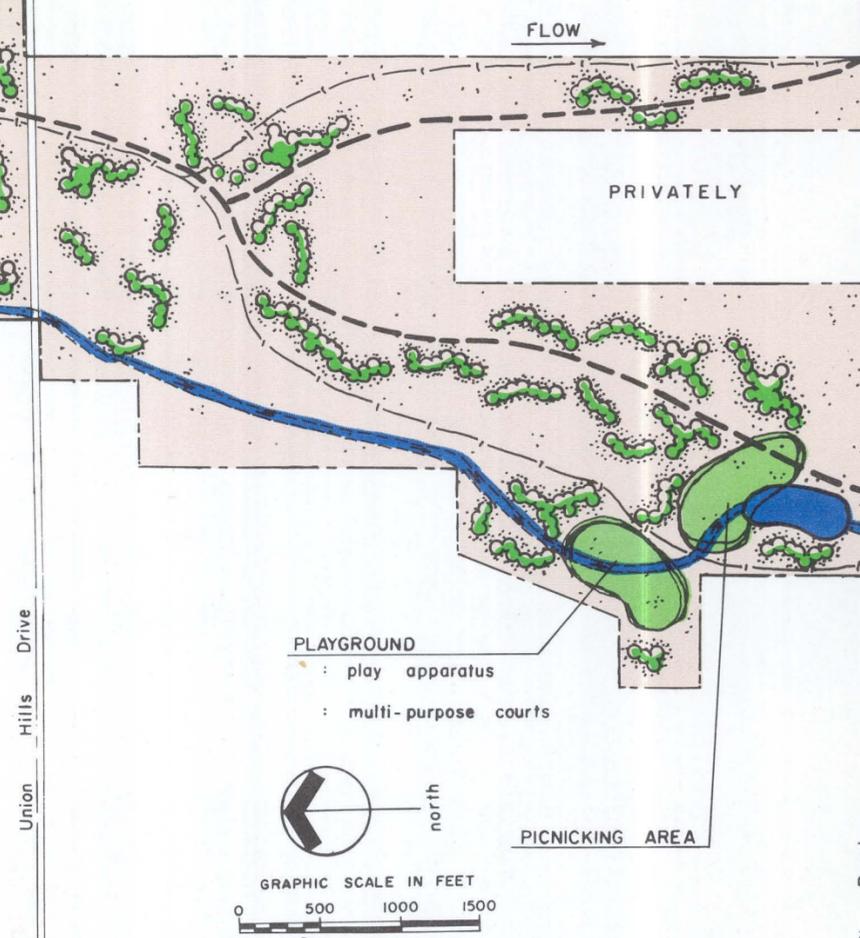
(proposed)
Union Hills
Park site



(existing)
Deer Valley
Cycle Park (city)

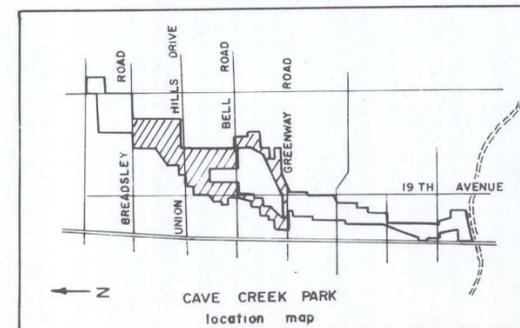
RECREATION AREA (20 acres)

- : amphitheater
- : group picnic area
- : playground
- : paved court facilities
- : athletic fields



PLAYGROUND

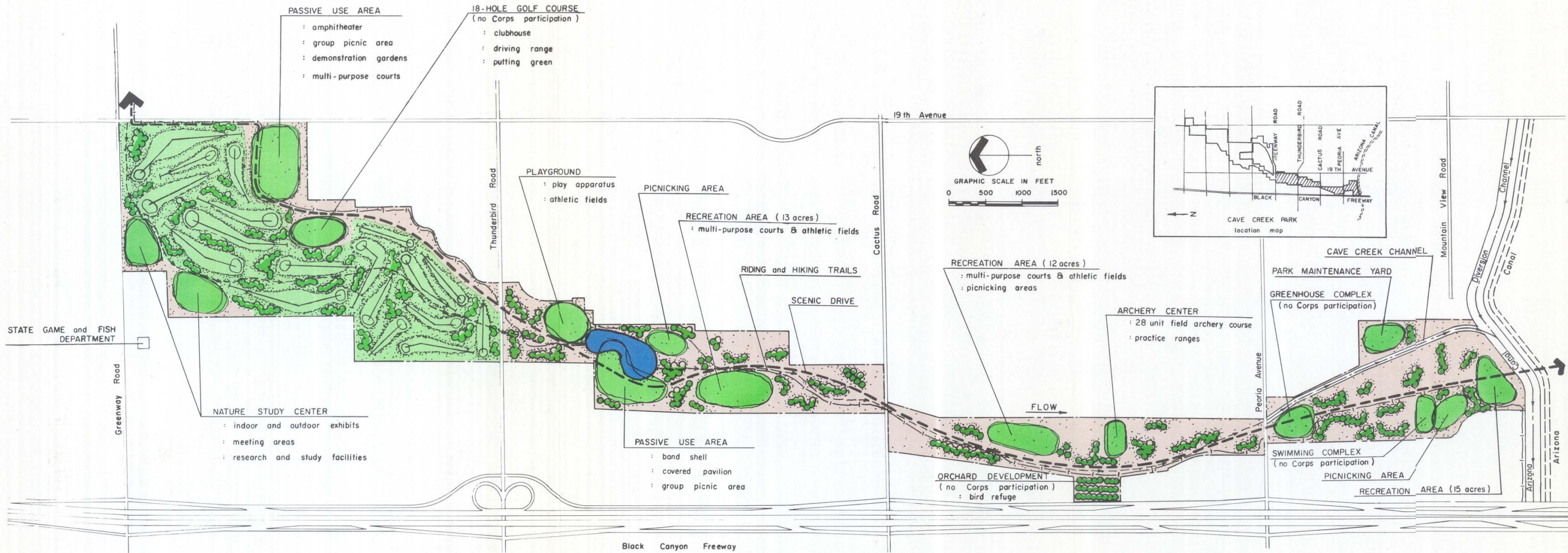
- : play apparatus
- : multi-purpose courts
- : athletic fields



ORCHARD DEVELOPMENT
(no Corps participation)

19th Avenue

SCENIC DRIVE



ARIZONA
CANAL
DIVERSION
CHANNEL

ARIZONA CANAL DIVERSION CHANNEL

The proposed diversion channel would be just north (upstream) of the Arizona Canal and nearly parallel to it. Channelization would extend from near 40th Street at the upstream end to Skunk Creek, a distance of about 17.3 miles. The channel would be entrenched for its entire length to allow side inflow to enter over the walls. A rectangular-shaped concrete channel is proposed from the upstream end to the Cave Creek confluence, a concrete-lined trapezoidal channel to near Cactus Road, and an unlined trapezoidal channel to Skunk Creek. (In 1974, a rectangular section was recommended between Cave Creek and Cactus Road; however, more detailed studies completed in February 1975 revealed that a trapezoidal section would be 27 percent less costly than a rectangular channel in this reach.)

Right-of-way requirements would range from 70 to 95 feet from 40th Street to the Cave Creek confluence, 225 to 230 feet from the Cave Creek confluence to Cactus Road, and 530 feet from Cactus Road to Skunk Creek. Where streets and highways presently cross the canal, 26 new bridges would be required across the channel. Additionally, where the canal would be relocated to the south to avoid major developments or realigned to eliminate hydraulically undesirable curves, four new bridges would be required.

The earth-bottom-trapezoidal part of the Arizona Canal diversion channel from Cactus Road west to Skunk Creek would be developed as a recreational parkway. Facilities would include lagoons, picnic areas, playgrounds, multiple-purpose courts, and athletic fields. A retirement recreational area, theater-in-the-round, field archery course and natural resource appreciation area are also planned. An equestrian area would contain facilities for riding, training, and informal competitive events. Trails for equestrians, bicyclists, and joggers would thread the recreational parkway.

Service roads adjacent to the diversion channel would serve a multiple-purpose function by being used as part of a recreational trail system. The paved road on the north side of the channel would serve as a safe, convenient bicycle route leading to shopping areas and to public park and recreational facilities. The unpaved service road south of the channel would serve as an equestrian trail. Both the bicycle and equestrian trails would pass beneath cross streets, enabling recreationists to travel several continuous miles without interruption. Rest areas with picnic facilities would be conveniently located along the trail system.

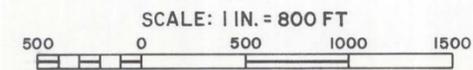
The proposed Arizona Canal diversion channel would intercept Cudia City Wash and Dreamy Draw floodwaters as well as runoff from the Phoenix Mountains and Cave Creek and would provide the urban areas of Phoenix, Glendale, and Peoria with 100-year flood protection from floodwaters emanating upstream from the channel. Construction of the channel would, however, require the acquisition of 491 acres and the displacement of 225 homes and 25 businesses. Some wildlife habitat would also be altered or destroyed.

ARIZONA CANAL DIVERSION CHANNEL

proposed right-of-way

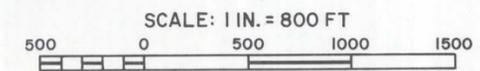


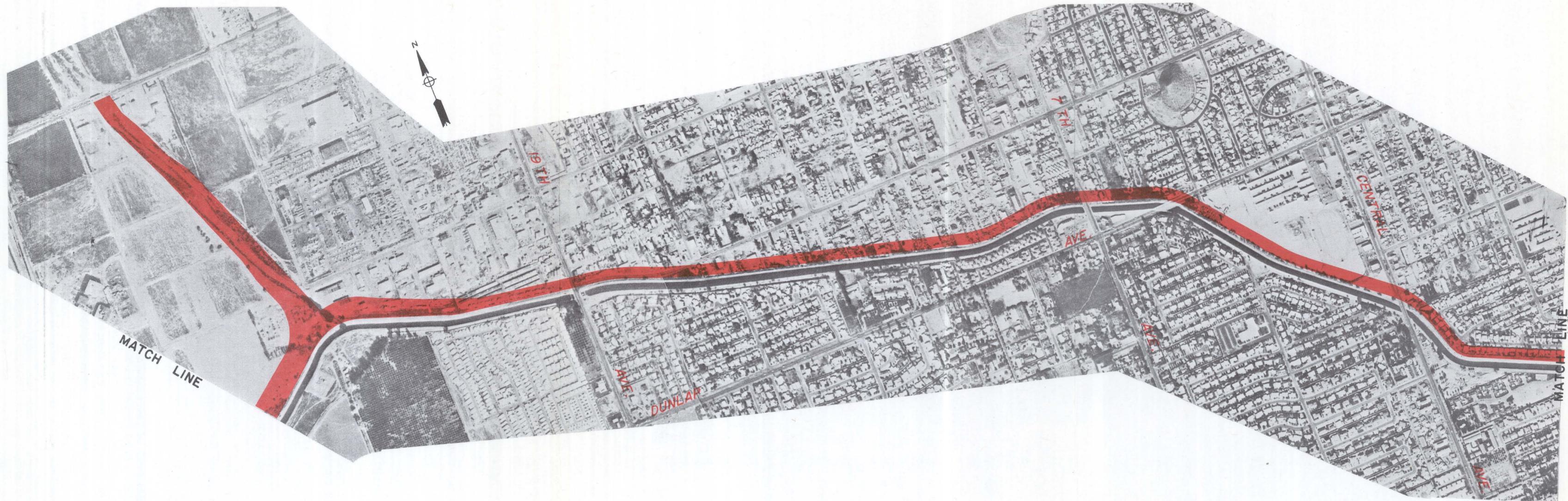
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BY LANDIS AERIAL SURVEYS,
PHOENIX, ARIZONA.



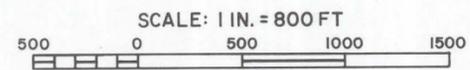


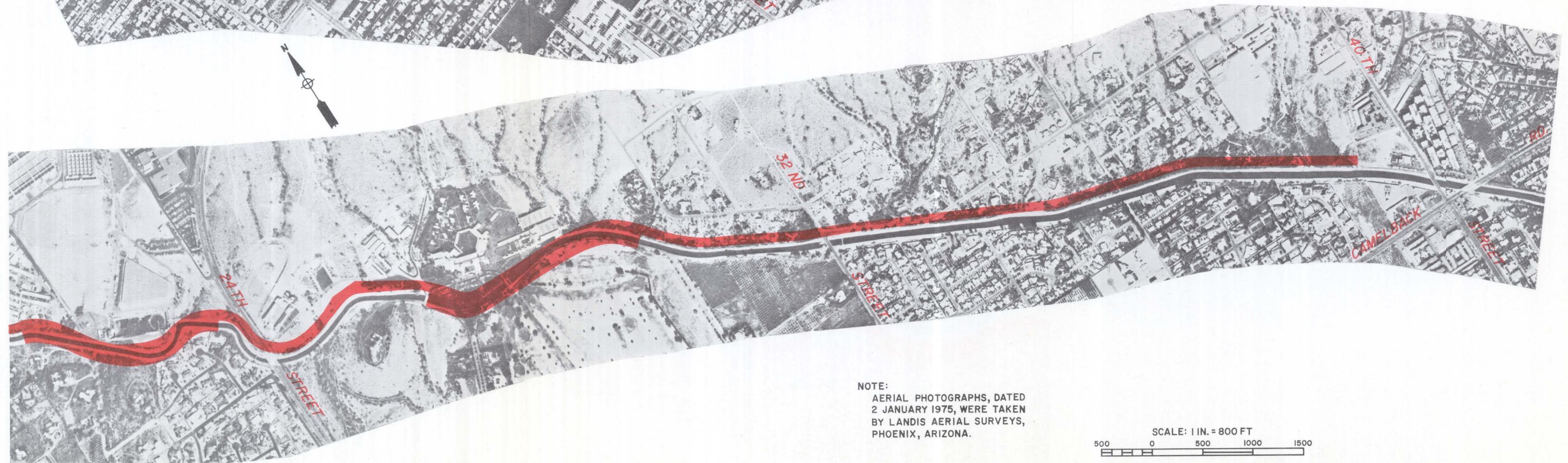
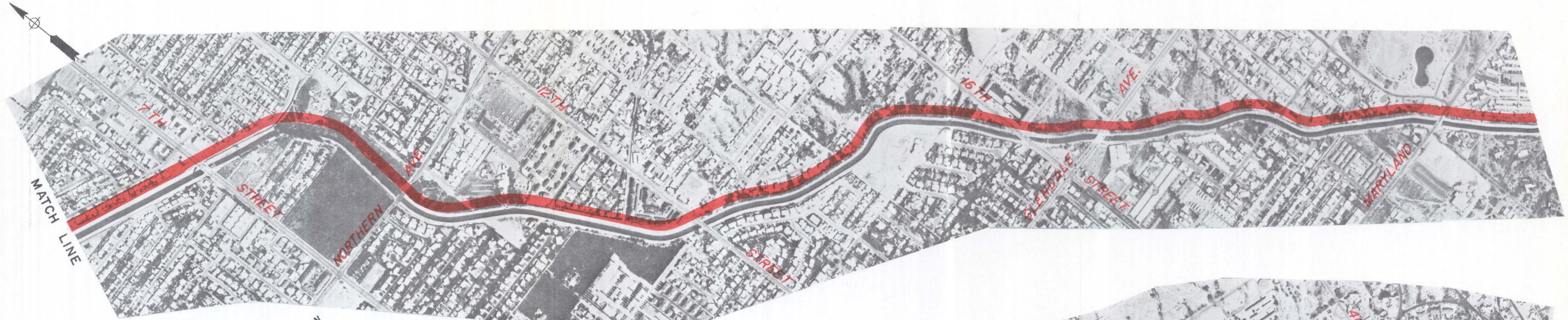
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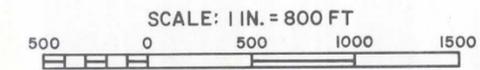


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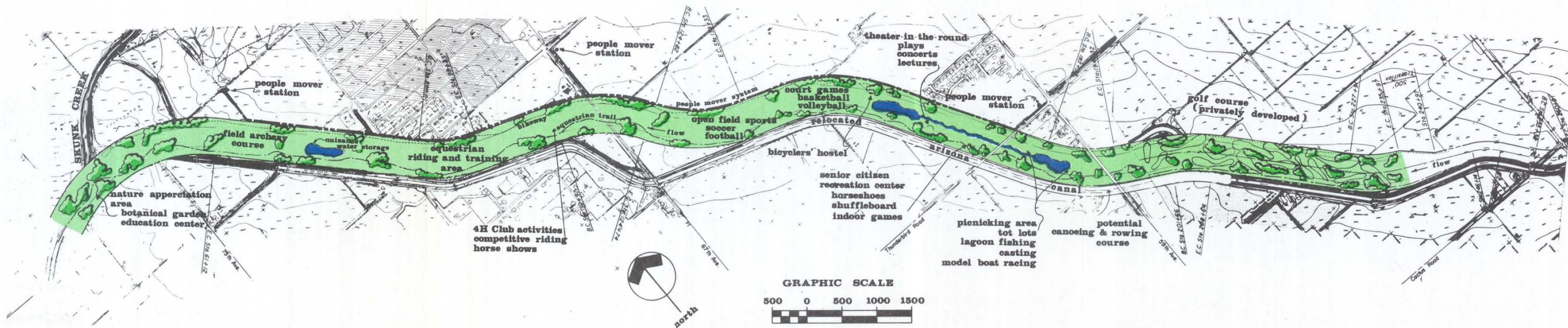




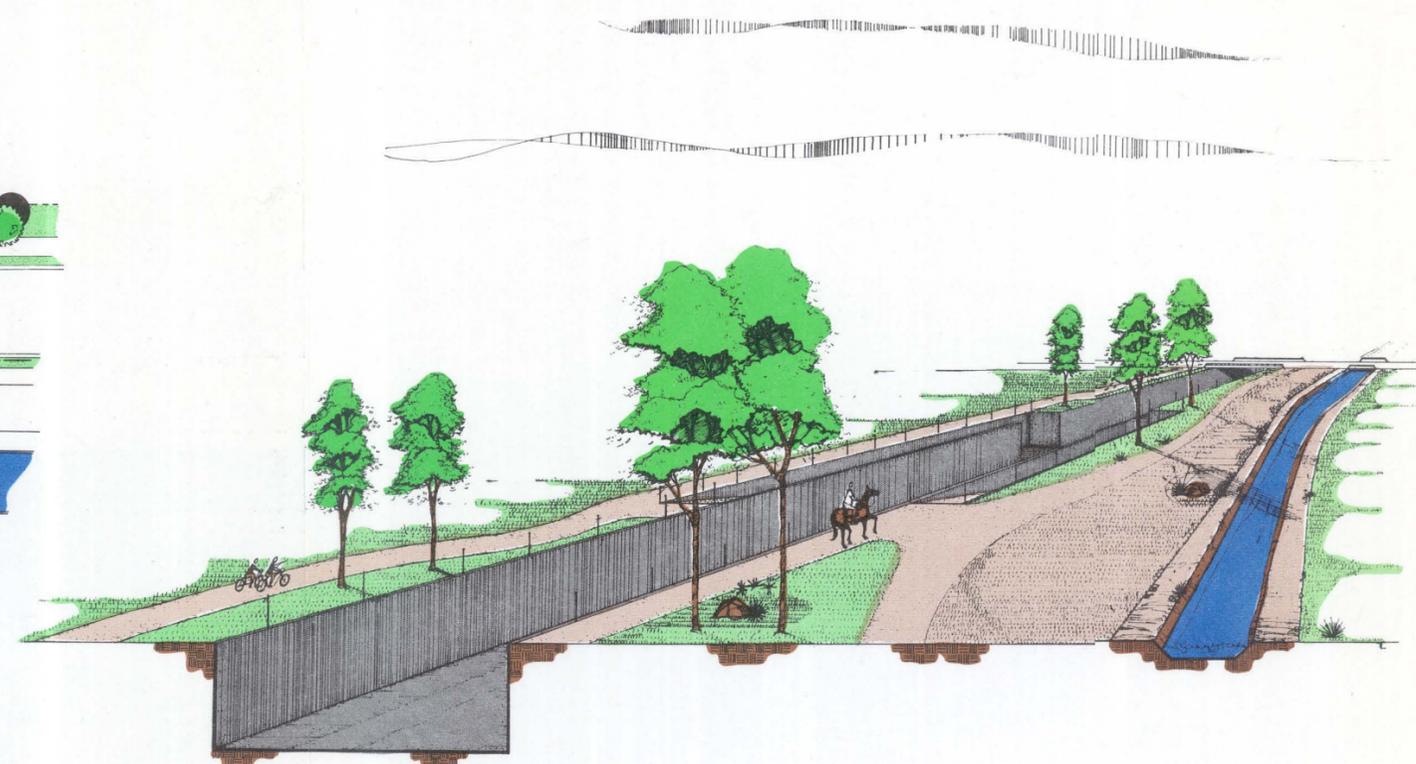
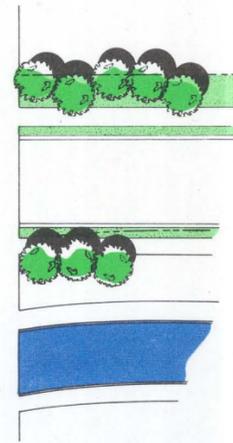
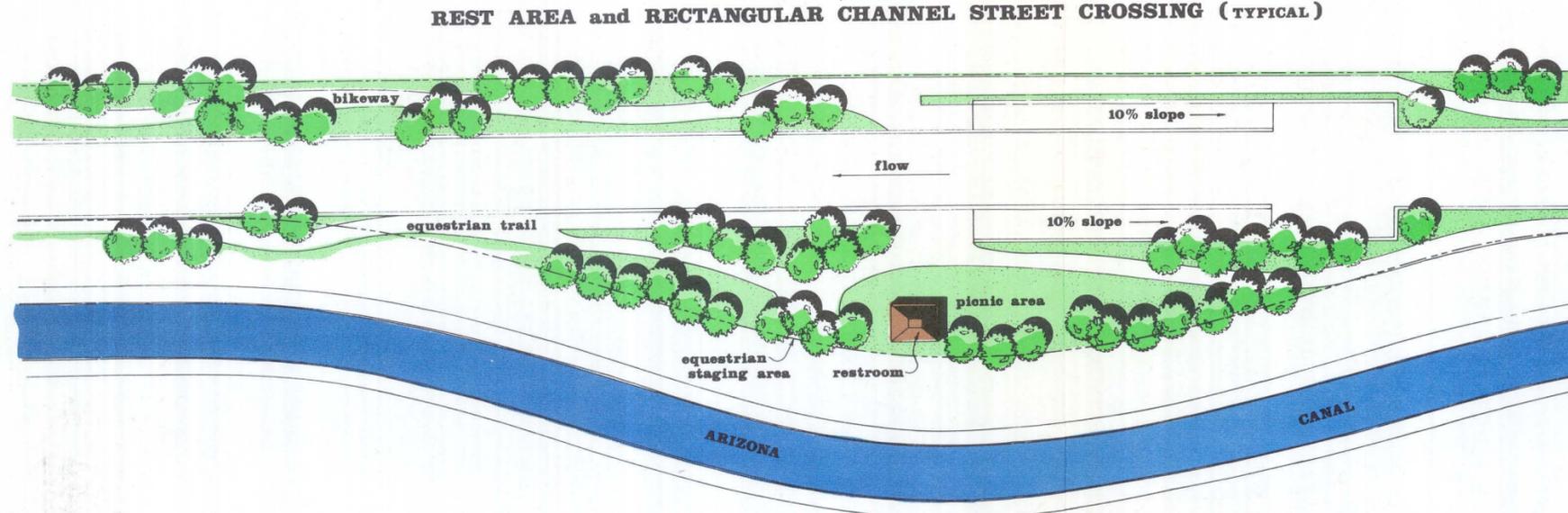
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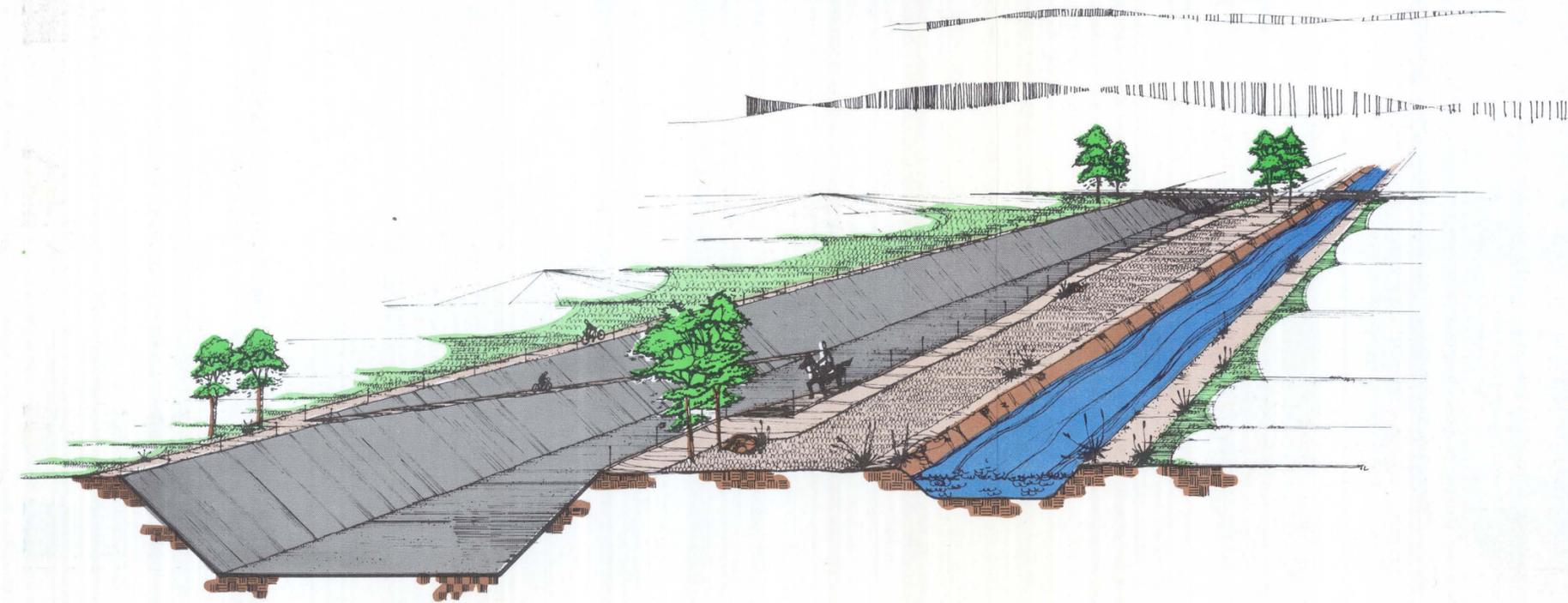
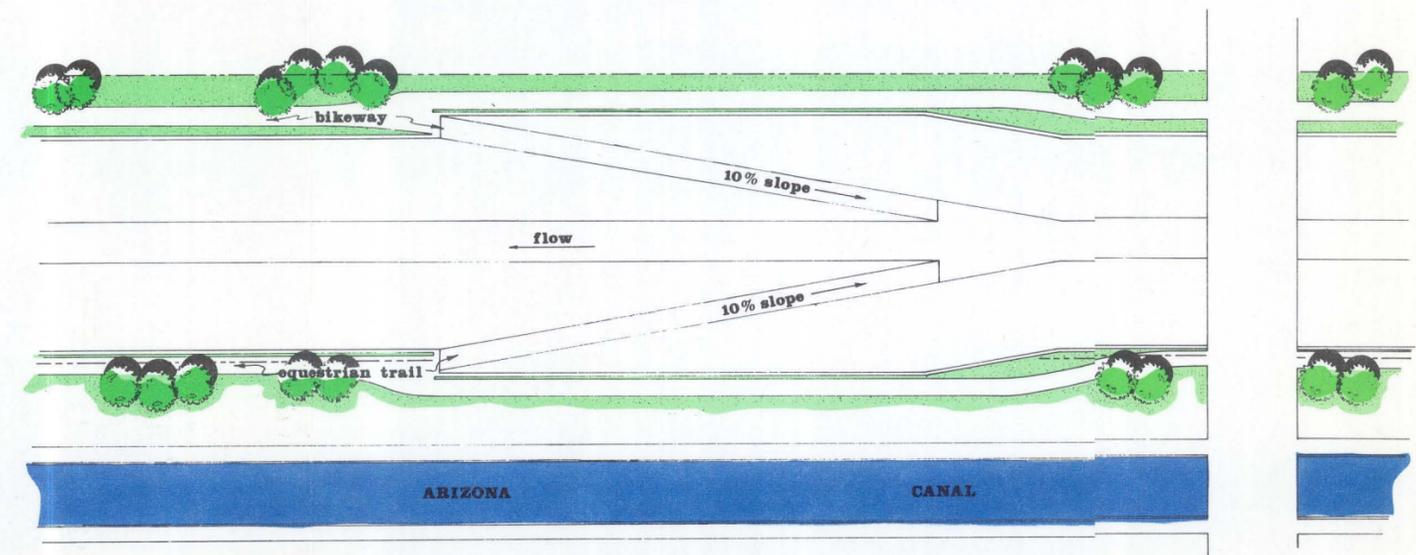
ARIZONA CANAL DIVERSION CHANNEL



REST AREA and RECTANGULAR CHANNEL STREET CROSSING (TYPICAL)



TRAPEZOIDAL CHANNEL STREET CROSSING (TYPICAL)



SKUNK
CREEK,
NEW &
AGUA FRIA
RIVERS

SKUNK CREEK, NEW RIVER, AND AGUA FRIA RIVER

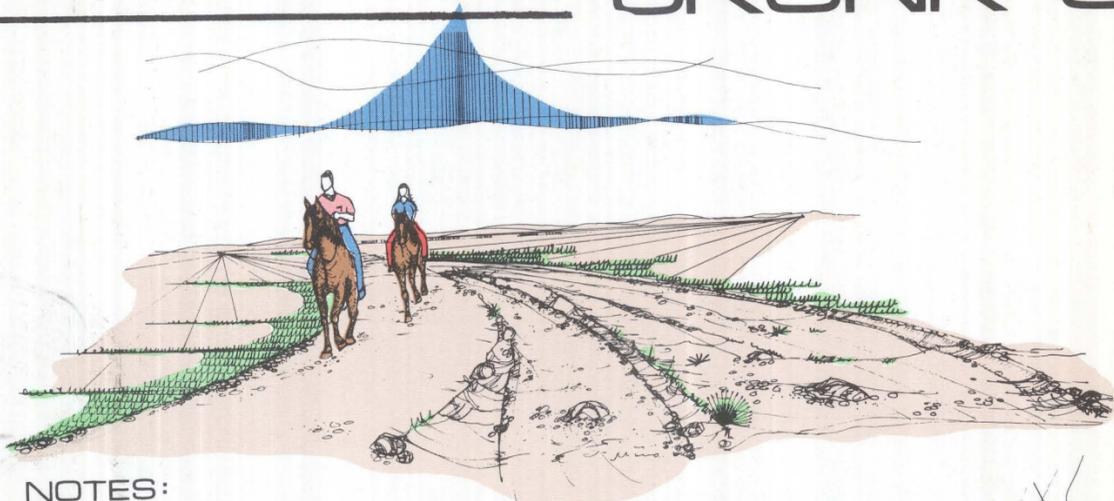
Skunk Creek between Adobe Dam and the proposed Arizona Canal diversion channel confluence (5.6 miles) and the New River between New River Dam and the Skunk Creek confluence (8.5 miles) must convey the maximum discharges from the respective dams. To assure the long-term capacity to operate the dams as designed, these river reaches must be managed in accordance with flood plain management criteria and be provided with bridges at major street crossings to pass the maximum outflow from the dams.

Downstream from the diversion channel confluence, flowage easements would be acquired; more specifically, they would be acquired along Skunk Creek from the diversion channel to the New River (1.8 miles), along the New River from the Skunk Creek confluence to the Agua Fria River (7.6 miles), and along the Agua Fria River from the New River confluence to the Gila River (10.1 miles). Within these reaches, floodproofing, permanent evacuation of dwellings in the flood plain, bank stabilization, levee construction, and some channelization and channel clearing are proposed. The major construction effort would be in the vicinity of the Grand Avenue crossing over the New River in Peoria where the Santa Fe railway bridge would be extended, a levee would be constructed, and the channel would be enlarged to pass a 100-year flood. In the vicinity of Avondale, several levees would be constructed to protect existing development along the flood plain fringe. In addition, bridges would be required at major street crossings to pass the maximum outflow from the dams.

Recreational development would consist of a trail and rest areas. A hiking and riding trail would be developed adjacent to Skunk Creek and the New and Agua Fria Rivers. At 51st Avenue the trail along Skunk Creek would connect with a proposed county trail that would lead to Thunderbird Park. The trail along the New and Agua Fria Rivers would be part of the county's Sun Circle Trail system. Rest areas with picnic sites would be located along the trail at about 5-mile intervals.

Downstream from the confluence of the diversion channel with Skunk Creek, flowage easements are proposed as a project requirement. Although construction of Adobe and New River Dams would improve flooding conditions along the New and Agua Fria Rivers and more than offset the diversion effect of the diversion channel under average conditions, flowage easements would be required to assure positive control of the flood plain under the condition of diverted flows. This requirement would restrict the use of land within the designated floodway and easement areas, would preserve open space, and would allow wildlife habitat to remain along the streambed. Thirteen homes, which are within the required flowage easement area as well as the present flood plain, would be relocated.

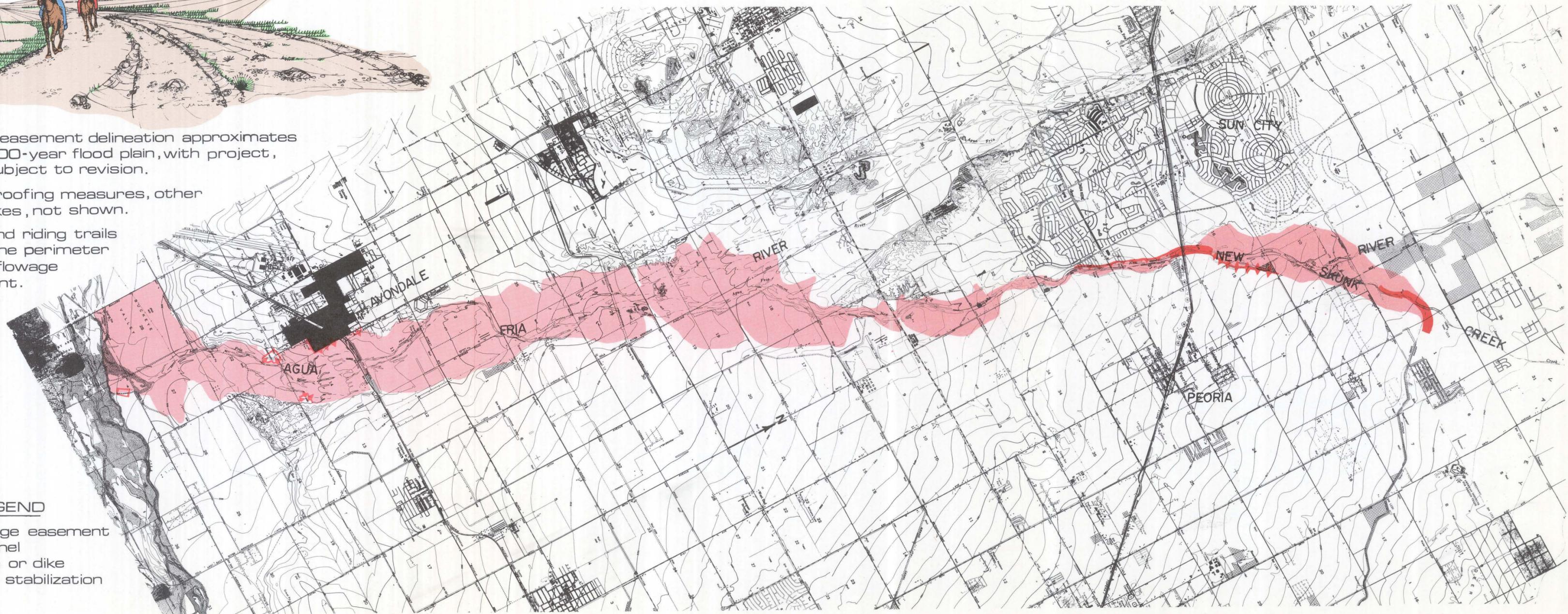
SKUNK CREEK, NEW RIVER AND AGUA FRIA RIVER



NOTES:

1. flowage easement delineation approximates future 100-year flood plain, with project, and is subject to revision.
2. flood proofing measures, other than dikes, not shown.
3. hiking and riding trails follow the perimeter of the flowage easement.

- ### LEGEND
- flowage easement
 - channel
 - levee or dike
 - bank stabilization



LOCAL
COOPERATION
REQUIREMENTS

FEDERAL &
NON-FEDERAL
RESPONSIBILITIES

LOCAL COOPERATION REQUIREMENTS

The requirements of local cooperation for the proposed flood control plan are that local interests (a) provide all lands, easements, and rights-of-way necessary for the construction of the project; (b) perform without cost to the United States all relocations of highways, bridges, and utilities, (c) hold and save the United States free from damages due to construction works, (d) maintain and operate the project after completion, (e) prevent any encroachment upon existing or improved channels or within the detention basin areas that would reduce their flood-conveying or storage capacities, (f) hold and save the United States free from damages arising from water-rights claims resulting from the project, (g) contribute in cash 2.3 percent of the total cost of project because of land appreciation benefits, (h) manage and maintain a "designated floodway" and "floodway fringes" along specified reaches of Dreamy Draw, Cave Creek, Skunk Creek and the New River, (i) obtain the permanent right to maintain the designated floodways and flowage easement areas and to remove excessive growth and sediments, (j) at least annually notify interests affected that the project will not provide complete flood protection, (k) comply with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, and (l) enter into an agreement with the Government as required by Section 221 of Public Law 91-611.

An additional requirement relative to the recreation plan is that one-half of the separable costs allocated to the recreation function of the project must be borne by local interests.

FEDERAL AND NON-FEDERAL RESPONSIBILITIES

The total first cost of the proposed project (July 1974 price levels) is estimated at \$225,600,000; of this amount, \$124,910,000 is a Federal cost and \$100,690,000 is a non-Federal cost. The apportionment of costs are summarized in the following tabulation.

	Flood Control	Recreation	Total
Federal			
Construction	\$117,000,000	\$14,400,000	\$131,400,000
Archeological mitigation	900,000	—	900,000
Cash contribution	<u>- 2,690,000</u>	<u>- 4,700,000</u>	<u>- 7,390,000</u>
Total Federal first cost	\$115,210,000	\$9,700,000	\$124,910,000
Non-Federal			
Lands and relocations	\$88,100,000	\$5,000,000	\$93,100,000
Wildlife mitigation	200,000	—	200,000
Cash contribution	<u>2,690,000</u>	<u>4,700,000</u>	<u>7,390,000</u>
Total non-Federal first cost	\$90,990,000	\$9,700,000	\$100,690,000
Total first cost	<u><u>\$206,200,000</u></u>	<u><u>\$19,400,000</u></u>	<u><u>\$225,600,000</u></u>

In addition to the first costs, non-Federal interests are responsible for the operation and maintenance of the flood control works estimated at \$312,000 annually and for the operation and maintenance of the recreation features estimated at \$615,000 annually.

ALTERNATIVE PLANS

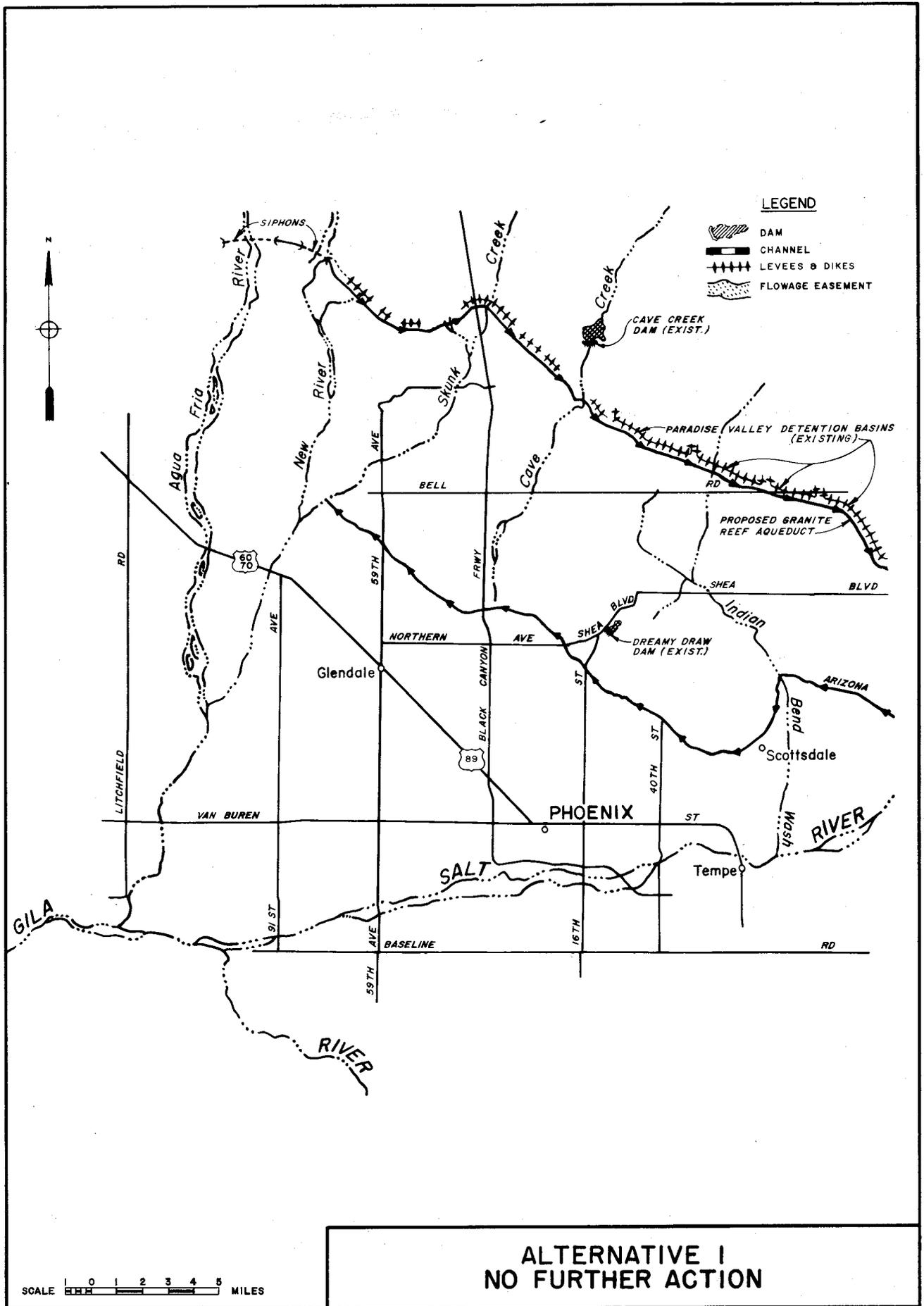
ALTERNATIVE 1 NO FURTHER ACTION

Dreamy Draw Dam, a feature of this project, was completed in August 1973. No additional features would be constructed with Federal funds under the authority of the Flood Control Act of 1965. It should be noted, however, that Dreamy Draw Dam was constructed as an interim measure for flood control in that an adequate point of disposal of dam discharges was not included as a part of the interim project. Under this alternative, no adequate point of disposal for the dam discharges would be constructed and if the Arizona Canal does not have adequate capacity to accept these discharges, flood damages could be caused by Dreamy Draw Dam discharges downstream from the canal.

Management of the flood plains would be accomplished by local governments through implementation of flood plain management laws and other pertinent laws and regulations. Existing development within the 100-year flood plains would still be subject to flooding. Floods larger than the 100-year flood would continue to cause damage. Some of the catastrophic personal loss from flood damages would be lessened through a flood insurance program, but aid would be given only after damages occur. The other problems associated with floods - disruption of communications, transportation and utilities, loss of income, and threat to life and health - would continue. Equivalent annual damages of \$14.8 million would continue to occur.

This alternative could promote the maintenance of the existing environment. It cannot guarantee that the status quo would remain, however, because the plan does not preclude local interests from constructing flood control improvements or performing work that would satisfy local requirements for protection of development within the flood plains.

Potential environmental and social impacts include: (a) continued flood threat; (b) no project associated recreational development; (c) no esthetic impact on the landscape; (d) no removal of vegetation and wildlife habitat; (e) no alteration of ground water recharge; (f) no family relocations; (g) no destruction of archeological sites; (h) no disruption of mineral extraction operations; (i) continued disruption of life styles because of flooding; (j) flood associated disruption of sanitary facilities causing unsanitary conditions to exist; (k) social impact of flood damages to homes, businesses, and industry.



ALTERNATIVE 2 DAMS AND CHANNELS

This alternative is a modification of the authorized plan and differs from it as follows: (a) Union Hills diversion channel east of Cave Creek and Dreamy Draw channel would not be constructed; (b) Cave Creek channel and the Union Hills diversion channel west of Cave Creek would be combined in a realigned channel to become the Cave Creek diversion channel; (c) the Arizona Canal diversion channel would be extended to 40th Street; (d) the recommended site of Adobe Dam would be approximately 4 miles downstream (south) from the authorized site; (e) the recommended site of Cave Buttes Dam would be approximately 1-1/2 miles upstream (north) from the authorized site; (f) the downstream end of the Agua Fria River would be realigned and extended into the Gila River flood plain; and (g) recreational development would be included as a project purpose.

The major features of alternative 2 are (a) four earth-filled dams, one each on Dreamy Draw (already constructed), Cave Creek, Skunk Creek and the New River; (b) Cave Creek diversion channel, a concrete-lined channel extending from Cave Buttes Dam to Skunk Creek; (c) Skunk Creek channel, a concrete-lined channel extending from Adobe Dam to the New River; (d) New River channel, an earth-bottom channel extending from the Skunk Creek confluence to the Agua Fria River; (e) Agua Fria River channel, an earth-bottom channel extending from the New River confluence to the Gila River; and (f) Arizona Canal diversion channel, a rectangular-concrete channel extending from 40th Street to Cave Creek, a concrete-lined trapezoidal channel extending from Cave Creek to Cactus Road, and a wide excavated earthen channel extending from Cactus Road to Skunk Creek.

Alternative 2 was developed to provide flood control along Cave Creek as well as along Skunk Creek and the New and Agua Fria Rivers and to provide flood protection for streams tributary to the Arizona Canal diversion channel. The basic unit is Cave Buttes Dam. The Cave Creek diversion channel would convey the outflow from Cave Buttes Dam to Skunk Creek.

Alternative 2, which provides flood protection using structural measures, would insure that present and future development of the flood plains would be provided with a high degree of flood protection. It would have major impacts on some important aspects of the existing environment especially on the wildlife habitat along the New and Agua Fria Rivers, on families and businesses along the Arizona Canal, and on water percolation along some of the natural watercourses.

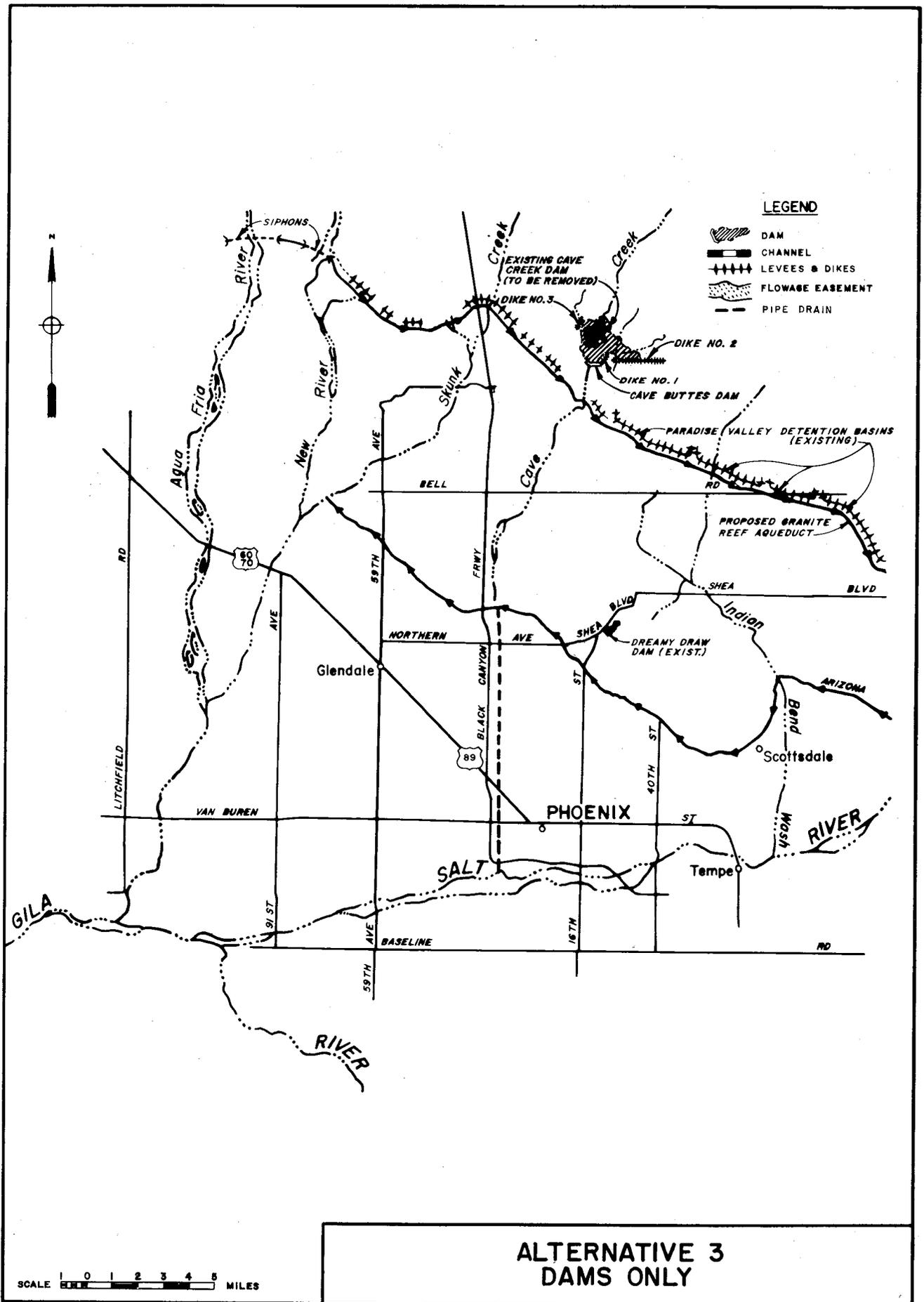
Potential environmental and social impacts include: (a) modification of the landscape; (b) removal of vegetation and loss of wildlife habitat; (c) increased duration of flooding at dip crossings because of dams; (d) recreational development; (e) increased traffic density near regional recreational facilities; (f) relocation of about 300 homes and businesses, primarily along the Arizona Canal diversion channel; (g) destruction of some archeological sites after recovery studies are completed, while preserving other sites as archeological education sites; (h) elimination of some mineral extraction operations; (i) barrier to movement of wildlife; (j) preservation of open space in dam areas; (k) increased ground water recharge along unlined channels resulting from increased duration of flows because of the dams; (l) reduced ground water recharge along the lined portion of Skunk Creek; (m) reduction of flood related damages; (n) reduced inconvenience to local residents (less flood-related disruption of normal activities); and (o) reduced fear of flooding and improved community morale.

ALTERNATIVE 3 DAMS ONLY

In addition to Dreamy Draw Dam, which has already been built, only Cave Buttes Dam would be constructed under this alternative. The dam, located about 0.7 mile downstream from the existing Cave Creek Dam, would have an ungated outlet, and the nondamaging 500 cfs outflow would flow in the natural Cave Creek channel to the Arizona Canal. The Arizona Canal has the capacity to intercept the 500 cfs discharge when empty and fully operational. During a major flood, however, the canal could be inoperable for one to several days, and during this time flooding from the dam discharge would continue downstream from the canal. To assure adequate disposal of releases from the dam, a reinforced-concrete pipe drain with a 500-cfs capacity would be constructed from the Arizona Canal to the Salt River along 19th Avenue. Under this alternative, Adobe and New River Dams would not be constructed. Economically, New River Dam is not justified and Adobe Dam is marginally justified because very little development presently exists along Skunk Creek and the New and Agua Fria Rivers. There would be no need for construction of these dams to offset diversion of flows as contemplated with the Arizona Canal diversion channel. Because there would be no structural channelization of any watercourse, the flood plains would be managed by local governments through implementation of flood plain laws and regulations.

Although this alternative would reduce floodflows below Cave Buttes Dam (and Dreamy Draw Dam), the equivalent annual flood damages estimated for no project conditions would be reduced by only 26 percent because of large residual floodflows. Residual damages would amount to \$11.1 million annually.

Potential environmental and social impacts include: (a) modification of the landscape at Cave Buttes Dam; (b) removal of vegetation and loss of wildlife habitat at the damsite; (c) recreational development; (d) increased traffic density near regional recreational facilities; (e) destruction of some archeological sites after recovery studies are completed, while preserving other sites as archeological education sites; (f) elimination of some mineral extraction operations; (g) reduction of flood related damages from storms occurring above Cave Buttes Dam; (h) preservation of open space at dam areas; (i) no relocation of families and businesses; (j) increased ground water recharge resulting from increased duration of flow because of the dam; (k) reduced inconvenience to local residents (less flood-related disruption of normal activities); and (l) reduced fear of flooding and improved community morale.



**ALTERNATIVE 3
DAMS ONLY**



ALTERNATIVE 4 CHANNELS ONLY

Under this alternative no dams would be constructed. The major features are (a) Cave Creek diversion channel, a concrete-lined channel extending from an inlet about 2 miles downstream from the existing Cave Creek Dam to Skunk Creek; (b) Skunk Creek channel, a concrete-lined channel extending from an inlet north of Beardsley Road to the New River; (c) New River channel, an earth-bottom channel extending from the Skunk Creek confluence to the Agua Fria River; (d) Agua Fria River channel extending from the New River confluence to the Gila River; and (e) Arizona Canal diversion channel, a rectangular concrete channel extending from 40th Street to Cave Creek, a concrete-lined trapezoidal channel extending from Cave Creek to Cactus Road, and a wide excavated earthen channel extending from Cactus Road to Skunk Creek.

Although this alternative would consist of the same channels as alternative 2, the channels would be much larger to convey the greater peak discharges because of no dams. Nearly the same degree of flood protection that would be provided by alternative 2 and the authorized plan would be provided by this alternative; all of the adverse environmental impacts that would result from the construction of dams would be eliminated. However, the Cave Creek diversion channel and the Skunk Creek, New River, and Agua Fria River channels would be considerably larger, and the plan would be much more costly than the combination dams and channels plan. In addition, the relocation of many more homes and businesses would be required.

Potential environmental and social impacts for this alternative include: (a) modification of the landscape; (b) removal of vegetation and wildlife habitat; (c) alteration of ground water recharge; (d) relocation of about 350 homes and businesses, primarily along the Arizona Canal diversion channel; (e) no preservation of open space typical at dam areas; (f) barrier to movement of wildlife across the channels; (g) reduction of flood related damages; (h) recreation would be limited to trail systems; (i) no archeological sites destroyed; (j) increased flow in the Agua Fria River at the Gila River confluence from about 53,000 cfs under existing conditions to 91,000 cfs (100-year flood); (k) reduced inconvenience to local residents (less flood-related disruption of normal activities); and (l) reduced fear of flooding and improved community morale.

ALTERNATIVE 5A STRUCTURAL AND NONSTRUCTURAL MEASURES

This alternative combines structural and nonstructural measures to provide flood protection to the urbanized areas of Phoenix along Cave Creek and south of the Arizona Canal while maintaining the natural floodway along Skunk Creek and the New and Agua Fria Rivers. Under this plan, local interests would acquire flowage easements and provide assurances that the floodways would be maintained through flood plain management. Construction would consist of Dreamy Draw (already built), Cave Buttes, Adobe, and New River Dams; the Arizona Canal diversion channel from 40th Street to Skunk Creek; and the Cave Creek diversion channel from Cave Buttes Dam to Skunk Creek just downstream from Adobe Dam; the other streams - Skunk Creek, the New River and the Agua Fria River - would remain natural except for some floodproofing measures and for short reaches of levee, channel, and bank stabilization in the vicinity of Grand Avenue. Flowage easements would be required for Skunk Creek and the New and Agua Fria Rivers downstream from the diversion channels to the Gila River.

The major structural measures (dams and diversion channels) would provide flood protection to downstream development. Because present development along Skunk Creek and the New and Agua Fria Rivers is rather limited and future development will be controlled through implementation of flood plain management laws, major channelization cannot be incrementally justified. It can only be justified as providing a means of conveying diverted floodflows to an adequate point of discharge - the Gila River. An alternative to channelization would be the acquisition of flowage easements along the river reaches below the diversion channels. Acquiring flowage easements would insure control of the flood plain and would also preserve open space.

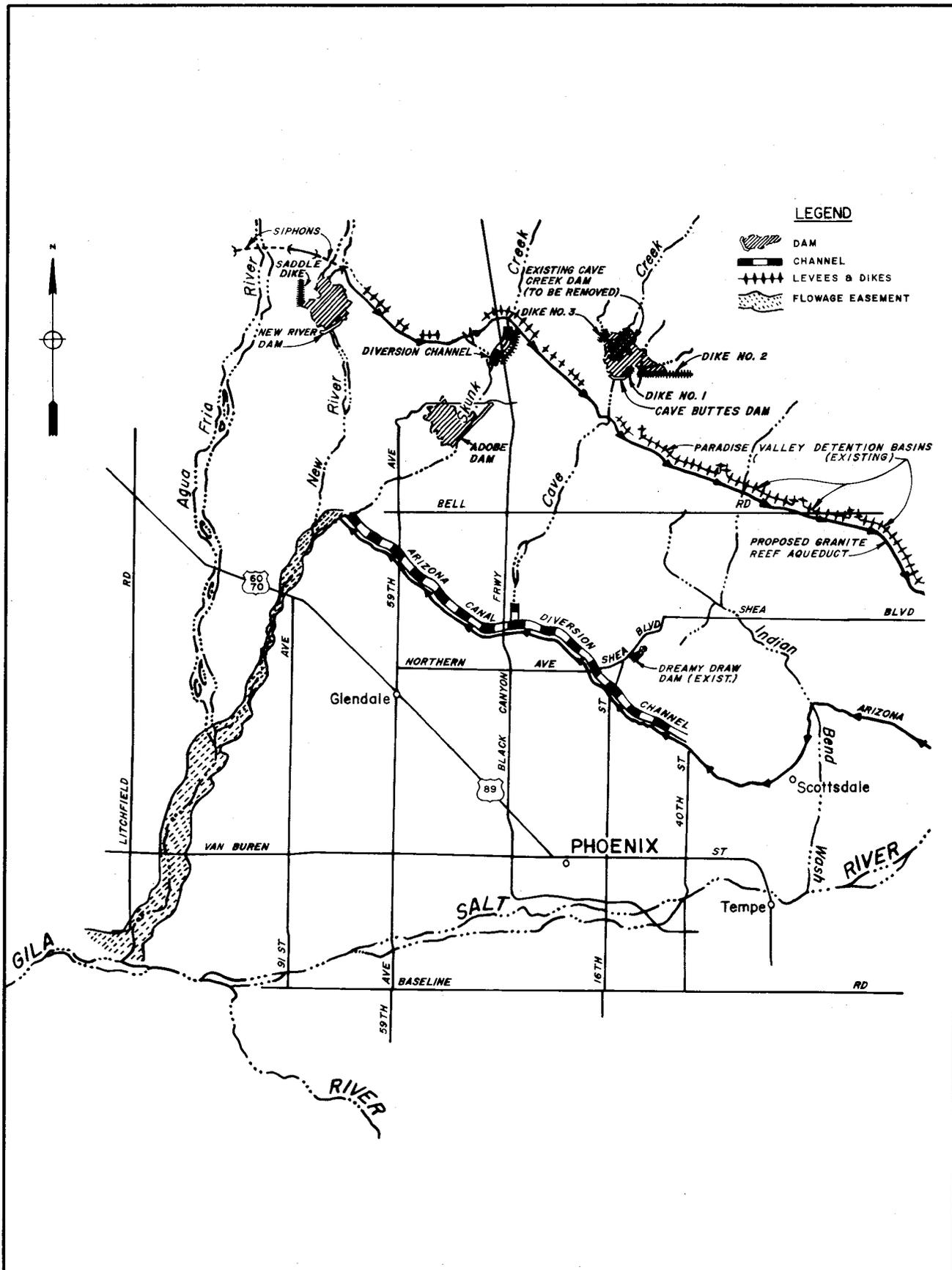
Potential environmental impacts include: (a) modification of the landscape; (b) removal of vegetation and loss of wildlife habitat; (c) increased duration of flooding at dip crossings because of dams; (d) recreational development; (e) increased traffic density near regional recreational facilities; (f) relocation of about 275 homes and businesses, primarily along the Arizona Canal diversion channel; (g) destruction of some archeological sites after recovery studies are completed, while preserving other sites as archeological education sites; (h) elimination of some mineral extraction operations at Cave Buttes damsite; (i) barrier to movement of wildlife; (j) reduction of flood related damages; (k) preservation of open space in dam areas; (l) preservation of open space and riparian vegetation along Skunk Creek and the New and Agua Fria Rivers; (m) increased ground water recharge in natural streams resulting from increased duration of flows because of the dams; (n) reduced inconvenience to local residents (less flood related disruption of normal activities); and (o) reduced fear of flooding and improved community morale.

**ALTERNATIVE 5B
(PROPOSED RECOMMENDED PLAN)
STRUCTURAL AND NONSTRUCTURAL MEASURES**

Alternative 5b, the proposed recommended plan, is basically the same as 5a except that the Cave Creek diversion channel would not be constructed and flowage easements along Skunk Creek upstream of the Arizona Canal diversion channel would not be required. Also, cost sharing in the development of Cave Creek Regional Park along Cave Creek from the proposed Granite Reef Aqueduct to the Arizona Canal is permissible. Under alternative 5b, Dreamy Draw (already built), Cave Buttes, Adobe, and New River Dams would be constructed as well as the Arizona Canal diversion channel from 40th Street to Skunk Creek. Skunk Creek and the New and Agua Fria Rivers would remain natural except for some floodproofing measures and for short reaches of levee, channel, and bank stabilization in the vicinity of Grand Avenue. Flowage easements would be required downstream from the diversion channel to the Gila River. Detailed descriptions and drawings of the features of the proposed recommended plan are included elsewhere in this brochure.

The major structural measures (dams and diversion channel) would provide flood protection to urban areas of Phoenix, Glendale and Peoria. Development in those reaches upstream of the diverted floodwater would be controlled through flood plain management. Again, major channelization along Skunk Creek and the New and Agua Fria Rivers cannot be economically justified and the flowage easement alternative was selected in lieu of major channelization to insure control of the flood plain and to preserve open space.

Potential environmental impacts are the same as those listed in alternative 5a except that the adverse effect of a diversion channel between Cave Buttes Dam and Skunk Creek would be eliminated. However, the flood protection afforded by the diversion channel would be lost.



**ALTERNATIVE 5b
STRUCTURAL & NONSTRUCTURAL MEASURES
(WITHOUT CAVE CREEK DIVERSION CHANNEL)**

SCALE 0 1 2 3 4 5 MILES

SELECTING A PLAN

Selecting the best plan of improvement for the study area involved determining which plan best satisfied the engineering, economic, social, and environmental criteria and the intangible considerations applicable to plan formulation. Because of the demand and need for recreation, plan formulation also considered recreational development.

All plans were determined to be economically justified as summarized in the table on page 63.

Factors that were considered in the selection of the recommended plan included (a) the implementation of projects by others, such as the Paradise Valley detention dike currently under construction by the Bureau of Reclamation and the detention basins and storm drains proposed and being constructed by the City of Phoenix, (b) the expression of comments and desires from other agencies and organizations, the general public and the governing board of the local entity – the Board of Directors of the Flood Control District of Maricopa County, and (c) the economic justification of the selected plan.

The relatively low initial cost of alternatives 1 and 3 are attractive, but these plans do not provide an adequate degree of flood protection. The residual flood damages under these alternatives are very high in both instances. Potential damages of \$14.8 million per year for alternative 1 are excessive and unacceptable. Alternative 3, which includes Cave Buttes Dam and Dreamy Draw Dam, would prevent only about 26 percent of the total potential damages, leaving residual damages of \$11.1 million. This plan is therefore undesirable.

Alternatives 2 and 4 provide a high degree of flood protection (about 82 percent) but both plans, when compared with alternatives 5a and 5b, cost much more, especially alternative 4. Alternative 4, which is a channels only plan, was found to be considerably more expensive than alternative 2, a combination of dams and channels.

Alternatives 5a and 5b provide the same degree of protection (82 percent) as alternatives 2 and 4 but at a substantially lower cost. Construction of Cave Creek diversion channel, at a first cost of \$8.7 million, would not provide any significant benefits. The releases from Cave Buttes Dam were reduced to 500 cfs so that they could be accommodated within Cave Creek and within the Arizona Canal for an interim period. This obviated the need for Cave Creek diversion channel as in alternatives 2, 4, and 5a. The 100-year flows along Skunk Creek and the New and Agua Fria Rivers could be accommodated through nonstructural measures with a savings in cost for work along these streams and with a relatively small loss in benefits. This obviates the need for channelization, as recommended in alternatives 2 and 4, and eliminates the adverse environmental and esthetic effects of channelization.

Summary of Economic Data for Alternative Plans
(3-1/4 percent, 100 years)

Item	Alternatives					
	1	2	3	4	5a	5b*
First cost**						
Flood control	\$671	\$250,000	\$45,300	\$278,000	\$214,000	\$205,300
Recreation	<u>0</u>	<u>7,700</u>	<u>13,600</u>	<u>4,200</u>	<u>7,800</u>	<u>19,400</u>
Total	\$671	\$257,700	\$58,900	\$282,200	\$221,800	\$224,700
Average annual charges**						
Flood control	26	9,120	1,620	10,000	7,760	7,420
Recreation	<u>0</u>	<u>550</u>	<u>880</u>	<u>335</u>	<u>554</u>	<u>1,272</u>
Total	\$26	\$9,670	\$2,500	\$10,335	\$8,314	\$8,692
Equivalent annual benefits**						
Flood control***	120	12,692	3,905	12,692	12,627	12,627
Recreation	<u>0</u>	<u>1,280</u>	<u>1,040</u>	<u>868</u>	<u>1,171</u>	<u>1,668</u>
Total	\$120	\$13,972	\$4,945	\$13,560	\$13,798	\$14,295
Equivalent annual net benefits**						
Flood control	94	3,572	2,285	2,692	4,876	5,207
Recreation	<u>0</u>	<u>730</u>	<u>160</u>	<u>533</u>	<u>617</u>	<u>396</u>
Total	\$94	\$4,302	\$2,445	\$3,225	\$5,484	\$5,603
Equivalent annual nonprevented damages (flood control)**						
	\$14,833	\$2,763	\$11,121	\$2,863	\$2,763	\$2,763
Benefit-to-cost ratio						
Flood control	4.6	1.4	2.4	1.3	1.6	1.7
Recreation	--	2.3	1.2	2.6	2.1	1.3
Flood control and recreation	4.6	1.4	2.0	1.3	1.7	1.6

* Proposed recommended plan.

** In thousands of dollars. Excludes archeological mitigation.

*** Includes flood damages prevented, savings in cost of fill, and increased utilization of land.

Based on engineering, economic, social, and environmental considerations, as well as the desires of local interests, alternative 5b was selected as the best plan. More specifically, it is proposed as the recommended plan because:

(a) The plan provides flood protection to the highly urbanized areas along Cave Creek and south of the Arizona Canal.

(b) The plan provides the maximum net benefits.

(c) The plan provides a favorable benefit-to-cost ratio.

(d) This plan has the least impact on the environment, as compared to the other plans that provide comparable benefits, in that no channelization is recommended along Skunk Creek and the New and Agua Fria Rivers and no diversion channel is recommended from Cave Buttes Dam to Skunk Creek.

(e) The plan is compatible with the desires of the general public.

(f) Dry land recreational uses could be developed in the basins above the dams and trails and associated recreational development could be incorporated along the channels. Flowage easements would limit development along the New and Agua Fria Rivers, but such limitations would be consistent with Federal and State laws governing flood plain management.