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ENVIRONMENTAL IMPACT STATEMENT

CENTRAL ARIZONA PROJECT
REGULATORY STORAGE DIVISION

CENTRAL ARIZONA WATER CONTROL STUDY

SEPTEMBER 1982

FIELD DRAFT

ENVIRONMENTAL IMPACT STATEMENT

CENTRAL ARIZONA PROJECT

REGULATORY STORAGE DIVISION

Maricopa, Pinal, and Gila Counties, Arizona

U.S. DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

As Lead Agency in cooperation with

U.S. DEPARTMENT OF ARGRICULTURE, FOREST SERVICE, TONTO NATIONAL FOREST

This Environmental Impact Statement describes five alternatives for the proposed construction and operation of the Regulatory Storage Division of the Central Arizona Project. The alternatives described provide for CAP Regulatory Storage, flood control of the Salt River through the Phoenix metropolitan area, and concurrent and coincident aspects of the Safety of Dams program. A No Action alternative is also described. This EIS fulfills the requirements of Clean Water Act of 1977, Section 404, requiring U.S. Army Corp of Engineers approval for the discharge of dredged or fill materials into navigable waterways.

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SUMMARY

A. Purpose and Need for the Action

This environmental impact statement (EIS) describes the proposed construction and operation of the Regulatory Storage Division of the Central Arizona Project (CAP). Construction of the CAP Regulatory Storage Division was authorized by Section 301(a)(3) of the Colorado River Basin Project Act (P.L. 90-537). This feature of the CAP is being investigated under the title Central Arizona Water Control Study (CAWCS).

The EIS also describes concurrent and coincident aspects of the Safety of Dams (SOD) program. The 1978 Reclamation Safety of Dams Act (P.L. 95-578) directs the Secretary of the Interior to preserve the structural safety of Bureau of Reclamation (Bureau) dams and related facilities by performing modifications that may be reasonably required. Since the construction and operation of CAP Regulatory Storage Division and SOD features will involve common timing and locations, the purposes of both authorizing legislations have been combined in the CAWCS.

The CAWCS study area encompasses approximately 13,400 square miles (8,576,000 acres) in central Arizona, including portions of Maricopa, Gila, and Pinal Counties. The entire Phoenix metropolitan area is located within the CAWCS boundaries. Figure 1 shows the CAWCS study area. The population of the area is about 1.5 million people, almost 90 percent of whom live in Maricopa County. There are five Indian communities in the study area.

The alternative actions described in this EIS have three principal purposes. These are:

1. to increase the operating efficiency of the CAP by: providing regulatory storage capacity; conserving Salt, Verde, and Agua Fria River flows; and regulating Colorado River water deliveries from the granite Reef Aqueduct.

2. to provide storage capacity to meet the flood control needs on the Salt River through the Phoenix metropolitan area.

3. to provide for the structural safety of existing Bureau of Reclamation dams on the Salt and Verde Rivers.

Construction of a regulatory storage unit for CAP water will improve the operating flexibility and efficiency of the CAP and will allow the importation of grater quantities of Colorado River water in years when it is available. Without regulatory storage capacity the CAP system can be operated only in direct response to demand.

A series of floods between February 1978 and February 1980 caused substantial damage in the form of property damage, income losses, and emergency costs, and had severe impacts on transportation and on people living in the flood zone.

Hydrologic analyses for the maximum probable floods (MPF) indicate that six Salt River Project (SRP) storage dams on the Salt and Verde Rivers have inadequate storage and/or spillway and outlet capacity to contain and/or pass the MPF without overtopping. Such an occurrence could jeopardize the safety of the dams. The potential overtopping or failure of any of these dams is considered serious because of the extreme consequences which would result for Phoenix and downstream communities.

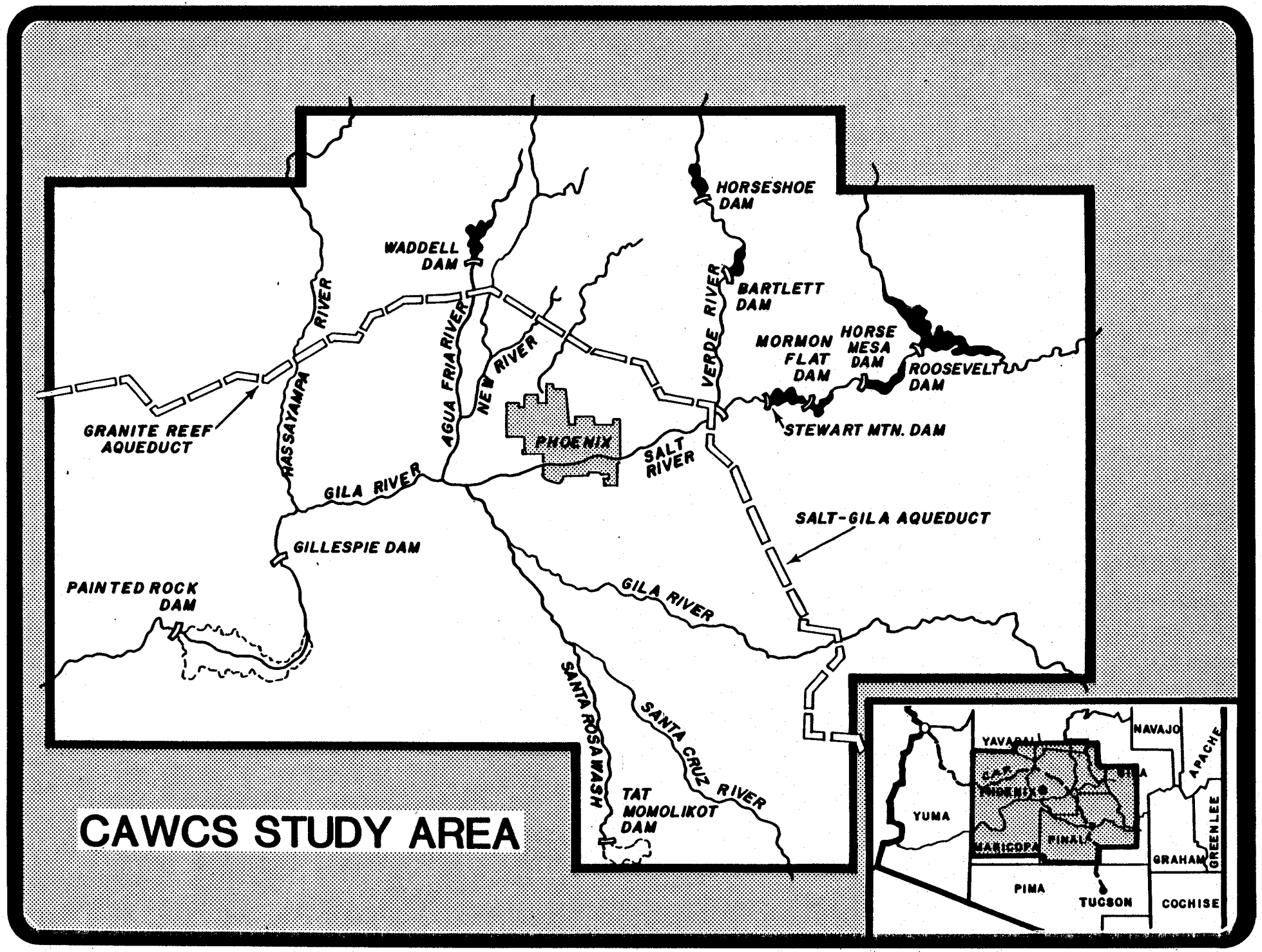
CAWCS STUDY AREA
HORSESHOE DAM
WADDELL DAM
BARTLETT DAM
MORMON FLAT DAM
HORSE MESA DAM
ROOSEVELT DAM
STEWART MTN. DAM
GRANITE REEF AQUEDUCT
HASSAYAMPA RIVER
AGUA FRIA RIVER
NEW RIVER
VERDE RIVER
PHOENIX
SALT RIVER
GILA RIVER
SALT-GILA AQUEDUCT
GILLESPIE DAM
PAINTED ROCK DAM
GILA RIVER
SANTA ROSA WASH
SANTA CRUZ RIVER
TAT MOMOLIKOT DAM
YUMA
YAVAPAI
NAVAJO
APACHE
GILA
MARICOPA
PINAL
GRAHAM
GREENLEE
PIMA
TUCSON
COCHISE

Figure 1

B. Alternatives Including the Proposed Action

1. Alternatives Eliminated from Further Study

The CAWCS was initiated in July 1978. The study was conducted in three stages, following a process of transition from a wide array of possible solutions in Stage I to a single proposed action at the end of Stage III.

During Stage I and Stage II, individual "elements" were analyzed which could provide CAP regulatory storage and/or flood control. Elements which were evaluated and eliminated from consideration during the CAWCS are shown in Table 1.

At the beginning of Stage III the Bureau widened the focus of the CAWCS to include SOD as a major objective. All "plans" (combinations of elements) developed for Stage III analysis considered both SOD and CAWCS purposes. These plans were evaluated on the basis of performance, cost, and envrionmental and social impacts. Eight "candidate" plans resulted from this analysis; two of these were subsequently eliminated from consideration: Plans 4 and 5.

2. Alternatives Analyzed in Detail

Plans 1, 2, 3, 6, 7, and 8 were analyzed in detail. In November 1981, the Secretary of the Interior selected Plan 6 as the agency proposed action. His selection was based on the strong local support for Plan 6, the functional ability to meet statutory obligations required by authorizing legislation, and the fact that the severe impacts to the Fort McDowell Indian Community associated with some plans were avoided.

Table 1

ELEMENTS ELIMINATED FROM CONSIDERATION

VERDE RIVER:

Tangle Creek Dam, Modified Horseshoe Dam, New Bartlett Dam

SALT RIVER:

Carrizo Creek Dam, Klondike Buttes Dam, Coon Bluff Dam, Granite Reef Dam, Rio Salado Low Dams

AGUA FRIA RIVER:

Lake Pleasant Storage, Agua Fria Siphon, Calderwood Butte Dam, North Phoenix CAP Dams

GILA RIVER, SANTA ROSA WASH:

Coolidge Dam, Florence Dam, Buttes Dam, Tat Momolikat Reservoir, Painted Rock Reservoir

CHANNELS:

Granite Reef Dam to Country Club Drive, Country Club Drive to 35th Avenue, 35th Avenue to Gillespie Dam

LEVEES:

Granite Reef Dam to Country Club Drive, Country Club Drive to 35th Avenue, 35th Avenue to Salt/Gila Confluence, Salt/Gila Confluence to Gillespie Dam

GILA RIVER CHANNEL CLEARING FOR CAWCS FLOOD CONTROL

WATER EXCHANGE WITH SALT RIVER PROJECT (SRP)

SRP REREGULATION

GROUNDWATER RECHARGE

A description of the six candidate plans follows:

a. Plan 1: Cliff + New/Modified Roosevelt + New/Modified Stewart Mountain Dams

Under this plan, Cliff Dam would be constructed on the Verde River between Horseshoe Dam and Bartlett Dam (see Figure 1) and a new or modified Roosevelt Dam would be constructed. Both dams would provide flood control and CAP regulatory storage in addition to SOD. New or Modified Stewart Mountain Dam would be for SOD purposes only in all plans. This plan would not connect directly with the CAP aqueduct. Conservation space at Cliff and Roosevelt Reservoirs would increase CAP yield through exchange by 107,600 acre-feet (af) per yer. Dedicated flood control space at Cliff and Roosevelt Dams would reduce the 200-year flood (275,000 cfs) to 92,000 cfs at Sky Harbor Airport and 100-year event to 55,000 cfs at the airport. Conceptual recreation plans for Cliff and Roosevelt feature an increase (14 sites) in camping, picnicking, and boating facilities.

b. Plan 2: Cliff + New/Modified Roosevelt + New/Modified Stewart Mountain Dams + Nonstructural Measures

This plan limits construction at Cliff and Roosevelt Dams to that necessary for SOD purposes. Flood control, provided by the use of the surcharge space at Cliff and Roosevelt in combination with nonstructural flood damage reduction measures downstream, would reduce the 200-year flood to 157,000 cfs and the 100-year flood to 150,000 cfs at the airport. Increased water supply for CAP (16,000 af per year) could be developed at Roosevelt Reservoir. Because this is a limited structural plan, additional recreational facilities would not be provided.

c. Plan 3: Confluence + Cliff + New/Modified Roosevelt + New/Modified Stewart Mountain Dams

Under this plan, a dam at confluence of the Salt and Verde Rivers (see Figure 1) would be constructed as well as Cliff, Roosevelt, and Stewart Mountain Dams. Cliff and Roosevelt Dams would provide flood control, new conservation space, and SOD. Confluence Dam would be constructed for regulatory storage purposes. Routing floodwaters through this reservoir may provide some incidental flood damage reduction. Confluence Dam would connect directly with the Salt-Gila Aqueduct via a pumping plant and canal. Under this plan, the 200-year flood would be reduced to 92,000 to 70,000 cfs and the 100-year flood to 55,000 to 50,000 at the airport. The CAP yield would be increased by 162,600 af per year. Conceptual recreation plans for Confluence, Cliff, and Roosevelt Dams include new recreation sites.

d. Plan 6: (Agency Proposed Action) New Waddell + Cliff + New/Modified Roosevelt + New/Modified Stewart Mountain Dams

New Waddell Dam would replace the existing Waddell Dam at Lake Pleasant on the Agua Fria River (see Figure 1). It would be constructed for regulatory storage and would provide incidental flood control. New Waddell would be connected to the Granite Reef Aqueduct by a canal with a pumping plant. The CAP water supply would be increased by 142,500 af per year. Flood control, additional water conservation, and SOD would be provided at Cliff and Roosevelt. This plan would reduce the 200-year flood at the airport to 92,000 cfs and the 100-year flood to 55,000 cfs. Conceptual recreation plans include additional sites at New Waddell, Cliff, and Roosevelt.

e. Plan 7: New Waddell + Cliff + New/Modified Roosevelt + New/Modified Stewart Mountain Dams (environmental enhancement)

This plan is the same as Plan 6, but would be operated to emphasize opportunities for environmental enhancement. A portion of the water supply generated by the new conservation space at Cliff and Roosevelt Dams and the regulatory storage at New Waddell Dam would be used for recreation and fish and wildlife conservation. Due to system losses for these purposes, the increase in CAP water supply is 116,000 af per year, which is less than in Plan 6. Recreation plans are the same as for Plan 6.

f. Plan 8: No CAWCS Action

The No Action alternative provides the baseline against which all other plans are compared (future-without-the-project). With this option, CAP would be constructed, but no CAWCS regulatory storage or flood control would be provided. SOD studies would, however, continue toward selection of a preferred SOD solution. This solution may differ from the Cliff/Roosevelt combination in CAWCS/SOD plans. Plan 8 also includes the following assumptions: Thirteen bridges in metropolitan Phoenix would be constructed or modified by state and local governments to withstand flows of 200,000 cfs. Floodplain management would occur, including enforcement of existing laws and regulations. Channelization around existing facilities at the airport would be conducted. Limited Channel clearing in the Gila River would be undertaken. Flood warning systems would be improved. Several flood control facilities on area rivers would be constructed. A tempe Salado Project would be implemented; the overall Rio Salado concept was assumed not be be developed.

3. Comparative Evaluation of Alternatives

Economic costs and benefits of plans are shown on Table 2.

Table 3 displays the environmental effects of alternative action plans (Plan 1, 2, 3, 6, and 7). Effects are an interpretation of the significance of impacts to environmental and social resources. The impacts of plans were quantified by measuring the difference between the future-without-the project and future-with-the-project condition for specific factors within each resource category. Effects were determined using criteria developed by CAWCS investigators. Mitigation measures, where possible, were applied to each resource category to determine how the effects of impacts would change. Table 3 displays unmitigated and mitigated effects separated by a slash (unmitigated/mitigated). Effects are shown as:

- Insignificant (I): a small change, or one involving a low-quality resource
- Significant Beneficial (SB): major improvement in a condition, usually long-term and affecting high-quality resources
- Significant Adverse (SA): major degradation of a condition, usually long-term and affecting high-quality resources
- Beneficial Flag (BF): extraordinary beneficial change in a unique, protected, or very high-quality resource
- Adverse Flag (AF): extraordinary adverse change in a unique, protected, or very high-quality resource

Table 2

ECONOMIC COSTS AND BENEFITS OF PLANS

Plan Options	Total Construction Cost[a,b] ($)	Total Annual Cost[a,c] ($)	Total Annual Benefits[a] ($)	Net Economic Benefits[a] ($)
Plan 1				
Cliff + Modified Roosevelt + Modified Stewart Mountain	694,940,000	58,060,000	89,040,000	30,980,000
Cliff + New Roosevelt + New Stewart Mountain	874,230,000	71,300,000	89,040,000	17,740,000
Cliff + New Roosevelt + Modified Stewart Mountain	788,340,000	69,960,000	89,040,000	24,080,000
Cliff + Modified Roosevelt + New Stewart Mountain	780,830,000	64,400,000	89,040,000	24,640,000
Plan 2				
Cliff + Modified Roosevelt + Modified Stewart Mountain	541,570,000	41,870,000	53,310,000	11,440,000
Cliff + New Roosevelt + New Stewart Mountain	713,840,000	54,590,000	53,310,000	- 1,280,000
Cliff + New Roosevelt + Modified Stewart Mountain	627,950,000	48,250,000	53,310,000	5,060,000
Cliff + Modified Roosevelt + New Stewart Mountain	627,460,000	48,210,000	53,310,000	5,100,000
Plan 3				
Confluence + Cliff + Modified Roosevelt + Modified Stewart Mountain	1,116,250,000	93,970,000	125,970,000	32,000,000
Confluence + Cliff + New Roosevelt + New Stewart Mountain	1,295,540,000	107,200,000	125,970,000	18,770,000
Confluence + Cliff + New Roosevelt + Modified Stewart Mountain	1,209,650,000	100,860,000	125,970,000	25,110,000
Confluence + Cliff + Modified Roosevelt + New Stewart Mountain	1,202,140,000	100,310,000	125,970,000	25,660,000
Plan 6				
New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain	978,430,000	82,710,000	174,290,000	91,580,000
New Waddell + Cliff + New Roosevelt + New Stewart Mountain	1,157,720,000	85,450,000	174,290,000	78,350,000
New Waddell + Cliff + New Roosevelt + Modified Stewart Mountain	1,071,830,000	89,600,000	174,290,000	84,690,000
New Waddell + Cliff + Modified Roosevelt + New Stewart Mountain	1,064,320,000	89,050,000	174,290,000	85,240,000
Plan 7				
New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain	978,430,000	82,710,000	168,160,000	85,450,000
New Waddell + Cliff + New Roosevelt + New Stewart Mountain	1,157,720,000	95,940,000	168,160,000	72,220,000
New Waddell + Cliff + New Roosevelt + Modified Stewart Mountain	1,071,830,000	89,600,000	168,160,000	78,560,000
New Waddell + Cliff + Modified Roosevelt + New Stewart Mountain	1,064,320,000	89,050,000	168,160,000	79,110,000

[a]Costs and benefits are shown in January 1982 dollars. Annual equivalents are calculated at 7 3/8%.
[b]Includes interest ~~during~~ construction (IDC).
[c]Includes operation, maintenance, and replacements costs (OM&R).

Table 3

ENVIRONMENTAL EFFECTS OF ACTION PLANS

Resource/Factors	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
BIOLOGICAL RESOURCES					
Threatened and Endangered Plants and Wildlife	SA/I	SA/I	AF/AF	SA/I	SA/I
Riparian and Wetland Biotic Communities	SA/SB	SA/I	AF/SA	SA/SB	SA/SB
Perennial Stream and Riverine Biotic Communities	I/I	I/I	AF/AF	I/I	SB/SB
Reservoir Aquatic Communities	I/I	I/I	SA/SA	SA/SA	SA/SA
WATER QUALITY					
Water Quality Constituents (i.e., salts, total dissolved solids, hardness)	I/I	No effect	SA/SA	I/I	I/I
Entrophication Potential	I/I	No effect	SA/I	I/I	I/I
CULTURAL RESOURCES					
Prehistoric Resources	AF/AF	AF/AF	AF/AF	AF/AF	AF/AF
Historic Resources	AF/AF	AF/AF	AF/AF	AF/AF	AF/AF
RECREATION					
Stream-Oriented Recreation	I/I	I/I	AF[a]	I/I	I/I
Reservoir-Oriented Recreation (no mitigation required)	SB	I	SB	SB	BF
SOCIAL RESOURCES					
Relocation of Indian People	No effect	No effect	AF/AF	No effect	No effect

Table 3 (continued)

Resource/Factors	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
SOCIAL RESOURCES Cont'd					
Relocation of Non-Indian People	SA/I	No SA/effect	SA/I	SA/I	SA/I
Flood Reduction (no mitigation required	BF	SB	BF	BF	BF
ECONOMICS	---------- effects not determined ----------				
AIR QUALITY					
Contruction Increases in Total Suspended Particulates (TSP)	SA/I	SA/I	SA/I	SA/I	SA/I
AESTHETICS					
Change in Visual Quality Zones	SB	I	SA[a]	SB	SB
NOISE					
Environmental Protection Agency Goals (no mitigation required)	I	I	I	I	I
GEOLOGY/SOILS					
Prime Farmland	SA[a]	SA[a]	SA/SA	SA[a]	SA[a]
Mineral Resources (no mitigation required)	SB	SB	SB	SB	SB
LAND RESOURCES					
Land Use Compatability (no mitigation required)	I	I	I	I	I
Land Use Conversion (no mitigation required)	SB	I	I	SB	BF

[a]Mitigation not possible.
Note: Effect are determined based on comparison to Plan 8 (future-without-the-project)

Eleven resource categories are shown in the table, as are the important factors within each category which would be affected by project actions. Resources determined to be significant during the EIS scoping process are:

- Biological Resources
- Water Quality
- Recreation
- Cultural Resources
- Social Resources
- Economics

Resources which would be affected by project actions but were determined not to be significant to the choice among the alternatives are air quality, aesthetics, noise, geology/ soils, and land resources.

C. Affected Environment

1. General Description of CAWCS Area Signficant Resources

a. Biological Resources

Six resource factors within the CAWCS area have been identified as having importance with respect to action-related impacts:

1. Riparian/Wetland Biotic Communities
2. Other Terrestrial Biotic Communities
3. Perennial Stream/Riverine Aquatic Communities
4. Other Aquatic Communities (Lakes and Lacustrine Communities)

5. Threatened and Endangered Plants and Wildlife

6. Management and Special Use Areas

Acreage and percent ranges of the major biotic communities occuring in the CAWCS study area are shown in Table 4.

Table 4

ACREAGE AND PERCENT RANGE OF
BIOTIC COMMUNITIES IN CAWCS AREA

Biotic Community	Acres	Percent of Study Area
Temperate Uplands		
including Montane conifer forest, Pinyon-juniper series, Oak-pine series, Interior chapparal, Sonoran savanna grassland	1,167,000	13.6
Riparian and Wetland Communities		
including warm-temperate, tropical-subtropical, and riparian forests	59,000	.7
Desert Uplands		
including Creosotebush-bursage series, Paloverde-mixed cacti series, Saltbush series	5,957,000	69.4
Aquatic Communities		
including lakes, rivers, and reservoirs	75,000	.9
Human Dominated Communities		
including argicultural and developed urban lands.	1,318,000	15.4

b. Water Quality

The water quality of local surface water sources in the CAWCS area is measured by levels of concentrations for 45 constituents including a number of elements and compounds, alkalinity, fecal coliforms, hardness, specific conductance, sodium absorption ratio, dissolved solids, and phenolics. Safe levels of some of these constituents are proscribed by law for various water uses; the levels of water quality constituents in surface water sources in the CAWCS area vary considerably from one source to another. These local sources could be either improved or degraded by regulatory storage mixing.

c. Recreation

Significant water-related recreation resources and facilities are described as either stream-oriented or reservoir-oriented. The five-county region of Maricopa, Pima, Pinal, Gila, and Yavapai Counties was defined as the affected area to assess recreation impacts of CAWCS plans. Existing recreation resources and facilities in the five-county region include over 9,000 campsites, 11,600 picnic sites, 51 improved swimming sites, 985 miles of fishable stream, 34 miles of stream suitable for tubing (river floating), and 35,000 water surface acres suitable for boating.

d. Cultural Resources

Prehistoric resources in the CAWCS area date from the area's occupation from about 1100 B.C. to the advent of recorded history in the mid-1600's A.D. Some of the more significant sites in the study area reflect the highly-develped Hohokam tradition and culture, and present an opportunity

to examine different models for the development of complex social, political, and argicultural systems. Larger archaeological sites are popular tourists attractions such as Tonto National Monument, Casa Grande National Monument, and Pueblo Grande Museum.

Historic resources in the study area date from Arizona's pre-territorial (to 1863) through territorial and statehood periods. Several of these sites, such as Theodore Roosevelt Dam, have been recognized as nationally significant resources.

e. Social Resources

CAWCS plans would affect the communities, individuals, families, and businesses who are currently subject to flooding along the Salt and Gila Rivers through metropolitan Phoenix, and the people who would be relocated because of construction and reservoir inundation associated with alternative action plans.

Communities particularly affected by flooding are the cities of Mesa, Tempe, and Phoenix, the communities of Buckeye and Holly Acres, and the Salt River Pima-Maricopa and Gila River Indian Communities.

Relocation of residents living in Roosevelt Lake Estates, Rockhouse Farm, North Bay Estates, Roosevelt Gardens East, and the KA (Johnson) Ranch would be required under all action plans. Residents of the Fort McDowell Indian Community would be relocated by one plan.

2. Description of Affected Site Areas

a. New/Modified Stewart Mountain Site Area

This site area is entirely included within the Confluence site area, and is described in Section d.

b. Cliff Site Area

The Cliff Dam and Reservoir site area is located on the Verde River between Horseshoe and Bartlett Dams. All of the land within the Cliff site area, with the exception of the KA Ranch, is owned and managed by the U.S. Forest Service, Tonto National Forest.

Significant biological resources include mature cottonwood-willow forests and mesquite woodlands, 20 miles of flowing stream with associated native and introduced fish species, and a bald eagle (federal-listed endangered species) breeding area. Horseshoe Reservoir and the flowing stream are used for recreational activities.

Cultural resources within the Cliff site area include 1,454 prehistoric sites composed of artifact scatters, pueblo sites, and several special features such as trash mounds. Nine signficiant historic sites include the Verde River Sheep Bridge, which was placed on the National Register of Historic Places in 1978.

There are no communities in the Cliff site area, but the family who lives at the KA Ranch would be relocated under CAWCS action plans. Approximately 130 acres of prime farmland are located at the KA Ranch.

c. Roosevelt Site Area

The site area surrounds the existing Roosevelt Dam and Roosevelt Lake, the largest lake in the study area. Most of the land in the Roosevelt site area is publicly-owned, and is managed by the Tonto National Forest for recreation, grazing, and wildlife habitat.

Important biological resources include 15 miles of flowing stream, self-sustaining fisheries, a bald eagle breeding areak and a water-fowl refuge and a managed wildlife area. Stream and lake recreational resources and facilities are heavily used.

Cultural resources include 1,495 prehistoric sites similar to sites found in the CAWCS area in general. Of 57 significant historic sites, the most important is Theodore Roosevelt Dam, a National Historic Landmark.

Four communities at Roosevelt Lake would be affected by CAWCS alternatives. Some residents of Roosevelt Lake Estates, Rockhouse Farm, Roosevelt Gardens East, and North Bay Estates would be relocated under alternative plans. Many of the residents of these communities are retired and prefer to live in a rural setting.

d. Confluence Site Area

The Confluence site area is located around the confluence of the Salt and Verde Rivers approximately 25 miles northeast of Phoenix. Lands within the area are mainly controlled by public agencies and Indian

Communities. Private holdings include several residential communities such as Fountain Hills.

Biological resources include important acres of riparian and wetland community types such as cottonwood-willow and mature mesquite forests, 35 miles of flowing stream with native and introduced fish species, 3 bald eagle breeding areas and associated preferred habitat, Yuma clapper rail (federal-listed endangered species) and several species of Arizona special status wildlife, and a cottonwood habitat rehabilitation site. The 35 miles of stream are used intensively for tubing, fishing, and other recreational activities.

Prehistoric sites are generally much larger than sites at the other affected site areas and include 13 ball courts. The most significant historic site in the Confluence area is Fort McDowell.

The Fort McDowell Indian Community would be affected by one CAWCS alternative. Residents of this Yavapai Indian reservation would be relocated by dam construction. There are approximately 400 residents in the community, which is highly cohesive and maintains the traditional Yavapai culture, religion, and customs. The reservation also contains commercially-mined sand an gravel resources and approximately 680 acres of prime farmland.

e. New Waddell Site Area

The New Waddell site area is located around Waddell Dam and Lake Pleasant on the Agua Fria River approximately 45 miles northwest of Phoenix. The land in the area is mainly controlled by state, federal, and county agencies.

There are no perennial streams or special use and management areas in the site area. Recreation resources and facilities include Lake Pleasant and Lower Lake Pleasant, both used intensively by area residents, mainly for sailing and motorboating. The lakes are within Lake Pleasant Regional Park.

Cultural resources include 138 prehistoric sites and 11 significant historic sites representative of agricultural, water control, and transportation activities.

No people live in the New Waddell site area who would be affected by CAWCS plans. The area contains approximately 70 acres of prime farmland.

f. Downstream Area

The areas affected by flooding includes the Salt and Gila River floodplain from the Granite Reef Diversion Dam through metropolitan Phoenix to Gillespie Dam.

Biological resources include Yuma clapper rail habitat, and state and federally-managed wildlife areas. There are no streams or lakes of recreational value in the downstream area. While records of prehistoric and historic sites exist for the area, these sites are generally not identifiable or are in poor condition due to previous flooding.

Communities in the downstream area affected by CAWCS alternatives are the cites of Mesa, Tempe, and Phoenix; the Salt River Pima-Maricopa and Gila River Indian Communities; and the Buckeye and Holly Acres subdivi-

sion areas. Numerous infrastructure and transportation networks and facilities are also located in the floodplain area.

D. Environmental Consequences of Alternatives

Table 3 displays the environmental and social effects of plans on significant and other resources. Impacts to significant resources which would occur as a result of alternative plans are summarized on Tables 5, 6, 7, 8 and 9. Impacts are based on a "typical-year" reservoir surface area.

Table 5

IMPACTS OF PLAN 1

Biological Resources	Water Quality	Social Resources
Loss of 290 acres of riparian and wetland habitat. Los of 3 miles of perennial stream. No changes in flow characteristics of Salt and Verde Rivers. Loss of 390 acres of preferred habitat of bald eagle. Disruption of productivity in 1 bald eagle breeding area. Gain of 400 surface acres of aquatic habitat. No gain of maintained minimum pools in reservoirs for fisheries.	Insignficant changes in water quality constituents as a result of mixing in regulatory storage reservoirs. Increases in potential for artificial eutrophication in or downstream of storage reservoirs. **Recreation** Loss of 3 recreational stream miles. Gain of 683 useable water surface acres. Gain of 681,000 maximum annual recreation days.	Impacts to 347 Roosevelt Lake area residents: Slight increase in mortality rates and increased illness rates Substantial decrease in satisfaction with way of life Moderately reduced financial capacity Moderate decrease in informal support networks Moderate decrease in community cohesion Substantial decrease in potential for sustain community viability Important physcial and mental health, elimination of financial losses and lifestyle disruption for most people who have experienced flooding disasters. Elimination of transportation disruption and significant reduction in damages to infrastructure. Approximately 3,530 creas of floodplain lands available for higher urban uses. **Cultural Resources** 29 Historic and 130 prehistoric sites destroyed by construction and operation activities. Loss of scientific or educational value of cultural resources, Theodore Roosevelt Dam adversely affected.

Table 6

IMPACTS OF PLAN 2

Biological Resources	Water Quality	Social Resources
Loss of 270 acres of riparian and wetland habitat. Gain of 1 mile of prernnial stream. No changes in flow characteristics of Salt and Verde Rivers. Loss of 350 acres of preferred habitat of bald eagle. Disruption of productivity in 1 bald eagle breeding area. Loss of 360 surface acres of aquatic habitat. No gain of maintained minimum pools in reservoirs for fisheries.	No changes in water quality constituents as a result of mixing in regulatory storage reservoirs. No potential for artificial eutrophication in or downstream of storage reservoirs. **Recreation** Gain of 1 recreational stream mile. Loss of 853 useable water surface acres. Loss of 48,000 maximum annual recreation days.	Impacts to 247 Roosevelt Lake area residents: Slight increase in mortality rates and increased illness rates Substantial decrease in satisfaction with way of life Moderately reduced financial capacity Moderate decrease in informal support networks Slight decrease in informal interactions between familial households Moderate decrease in community cohesion and slight decrease in social organization Substantial decrease in potential for sustained community viability. Improvement in physical and mental health, significant reduction of financial losses and lifestyle disruption for many people who have experienced flooding disasters. Signficant reduction in transportation disruption and damage to infrastructure. Approximately 2,250 acres of floodplain lands available for higher urban area. **Cultural Resources** 29 Historic and 70 prehistoric sites destroyed by construction and operation activities. Loss of scientific or educational value of cultural resources, Theodore Roosevelt Dam adversely affected.

Table 7

IMPACTS OF PLAN 3

Biological Resources

Loss of 2,480 acres of riparian and wetland habitat.

Gain of 16 miles of perennial stream.

No changes in flow characteristics of Salt and Verde Rivers.

Loss of 850 acres of preferred habitat of bald eagle and Yuma clapper rail.

Disruption of productivity in 3 bald eagle breeding area.

Gain of 3,080 surface acres of aquatic habitat.

Gain of 1 maintained minimum pool in Confluence Reservoir for fisheries.

Water Quality

Significant adverse changes in water quality constituents as a result of mixing in regulatory storage reservoirs.

High potential for artificial eutrophication in or downstream of storage reservoirs.

Recreation

Loss of 16 recreational stream miles.

Gain of 5,243 useable water surface acres.

Loss of 2 million maximum annaul recreation days.

Social Resources

Impacts to Roosevelt Lake area residents:
Same as Plan 1.

Impacts to 290 Fort McDowell Indian Community residents:
- Substantial increase in illness and mortality rates
- Extreme decrease in satisfaction with way of life.
- Substantial decrease in potential for sustained financial self-sufficienty
- Substantial decrease in extended family ties
- Substantial increase in incidence of family problems
- Extreme decrease in community cohesion and viability
- Substantial decrease in potential for tribal economic self-sufficiency; substantial increase in unemployement
- Extreme decrease in potential to sustain Yavapai culture

Changes in physical and mental health, financial losses, and lifestyle disruption for people who have experienced flooding disasters.

Reduction in transportation disruption and damages to infrastructure

Changes in land use of floodplain lands

Flood reduction impacts same as Plan 1.

Cultural Resources

73 Historic and 154 prehistoric sites destroyed by construction and operation activities.

Loss of scientific or educational value of cultural resources. Theodore Roosevelt Dam adversely affected.

Table 8

IMPACTS OF PLAN 6

Biological Resources	Water Quality	Social Resources
Loss of 270 acres of riparian and wetland habitat.	Insignficiant changes in water quality constituents as a result of mixing in regulatory storage reservoirs.	Impacts to Roosevelt Lake area residents: Same as Plan 1.
Gain of 1 mile of perennial stream.	Low ot moderate potential for artificial eutrophication in or downstream of storage reservoirs.	Changes in physical and mental health, financial losses, and lifestyle disruption for people who have experienced flooding disasters.
No changes in flow characteristics of Salt and Verde Rivers.	**Recreation**	Reduction in transportation disruption and damages to infrastructure.
Loss of 290 acres of preferred habitat of bald.	Gain of 1 recreational stream mile.	Changes in land use of floodplain lands.
Disruption of productivity in 1 bald eagle breeding area.	Gain of 4,222 useable water surface acres.	Flood Reduction impacts same as Plan 1.
Gain of 1,900 surface acres of aquatic habitat.	Gain of 997,000 maximum annual recreational days.	**Cultural Resources**
Gain of 1 maintained minimum pool in New Waddell Reservoir for fisheries.		39 Historic and 156 prehistoric sites destroyed by construction and operation activities.
		Loss of scientific or educational value of cultural resources. Theodore Roosevelt Dam adversely affected.

Table 9

IMPACTS OF PLAN 7

Biological Resources	Water Quality	Social Resources
Loss of 40 acres of riparian and wetland habitat.	Insignficiant changes in water quality constituents as a reulst of mixing in regulatory storage reservoirs.	Impacts to Roosevelt Lake area residents: Same as Plan 1.
Gain of 2 miles of perennial stream.	Low to moderate potential for artificial eutrophication in or downstream of storage reservoirs.	Flood reduction impacts same as Plan 1.
Guaranteed minimum flows of 200 cfs in Salt and Verde Rivers.	**Recreation**	
Loss of 340 acres of preferred habitat of bald eagle.	Loss of 2 recreational stream miles.	**Cultural Resources**
Disruption of productivity in 1 bald eagle breeding area.	Gain of 1 million maximum annual recreational days.	39 Historic and 156 prehistoric sites destroyed by construction and operation activities.
Gain of 3,690 surface acres of aquatic habitat.		Loss of scientific or educational value of cultural resources. Theodore Roosevelt Dam adversely affected.
Gain of 2 maintained minimum pool in Cliff and New Waddell Reservoirs for fisheries.		

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I. PURPOSE AND NEED

I. PURPOSE AND NEED

A. Background

This environmental impact statement (EIS) describes the proposed construction and operation of the Regulatory Storage Division of the Central Arizona Project (CAP). Construction of the CAP Regulatory Storage Division was authorized by Section 301(a)(3) of the Colorado River Basin Project Act (P.L. 90-537). This feature of the CAP is being investigated under the title Central Arizona Water Control Study (CAWCS).

The six alternative plans described in detail in this EIS address regulatory storage of Central Arizona Project water and flood control of the Salt and Gila Rivers through the metropolitan Phoenix area. The EIS also describes concurrent and coincident aspects of the Safety of Dams (SOD) program. The 1978 Reclamation Safety of Dams Act (P.L. 95-578) directs the Secretary of the Interior to preserve the structural safety of Bureau of Reclamation (Bureau) dams and related facilities by performing modifications that may be reasonably required. Since the construction and operation of CAP Regulatory Storage Division and SOD features will involve common timing and locations, the purposes of both authorizing legislations have been combined in the CAWCS.

A number of alternatives have been evaluated in the CAWCS planning process which provide the authorized Regulatory Storage Division and include means to insure the structural safety of the Salt River Project (SRP) dams. Based on the development and ranking of preliminary plans, six "candidate" plans, including a CAWCS "no action" alternative, have been identified.

B. Geographical Setting

The CAWCS study area encompasses approximately 13,400 square miles, or 8,576,000 acres, in central Arizona, including portions of Maricopa, Gila, and Pinal Counties. Figure I-1 shows the CAWCS study area. The entire metropolitan Phoenix area is located within the CAWCS boundaries. Portions of the study area outside the metropolitan area are characterized by mountain ranges with steep slopes and rugged topography separated by broad, gently sloping valleys. The climate is marked by low annual rainfall, hot summers, and mild winters. Vegetation and wildlife are typical of the southwestern Sonoran Desert.

Water in the study area comes from four major streams and their tributaries supplemented by groundwater. These streams are the Salt, Verde, Gila, and Agua Fria Rivers. Several dams are located on these rivers including six SRP-operated dams on the Salt and Verde Rivers which impound water for distribution to municipal, residential, and agricultural users. The SRP-operated dams are federally owned. Waddell Dam on the Agua Fria River, a non-federal dam, develops water for agricultural use by Maricopa County Municipal Water Conservation District #1 (MCMWCD#1).

The population of the area is about 1.5 million people, almost 90 percent of whom reside in Maricopa County. There are five Indian communities in the study area: Fort McDowell Apache-Mohave (Yavapai), Gila River, Salt River Pima-Maricopa, Ak-Chin, and Papago. The aggregated population of these Indian communities is just over 13,000.

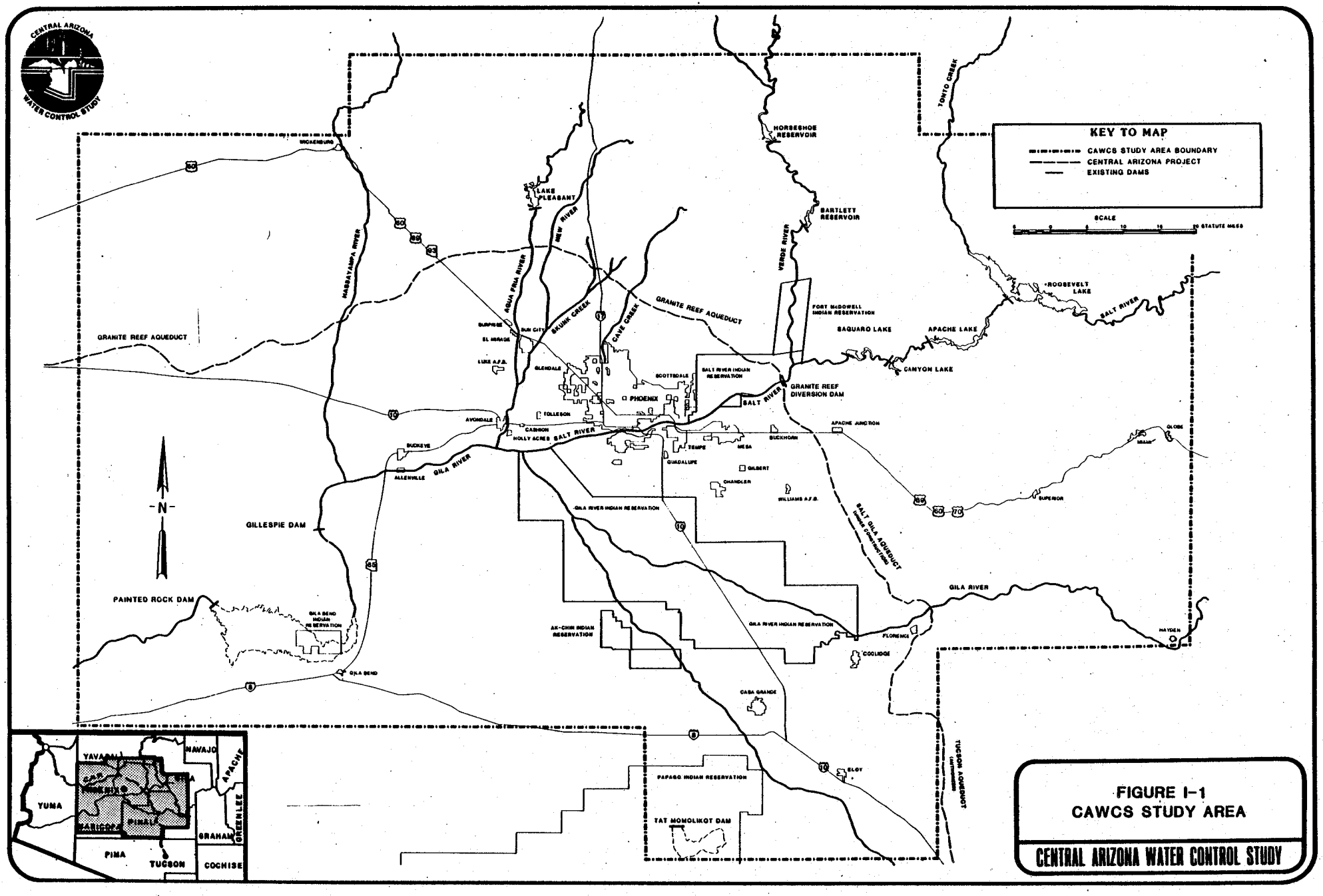

FIGURE I-1
CAWCS STUDY AREA

CENTRAL ARIZONA WATER CONTROL STUDY

Vast portions of the CAWCS area remain in their natural state, unaltered or only slightly modified by man's activities. About 75 percent of the area is rangeland. Agricultural lands, urban built-up lands, forest lands, barren lands, water bodies, and wetlands comprise the remainder. About 70 percent of the lands in the area remain in public ownership or are Indian reservations.

The CAWCS area is a major center for economic activity in the Southwest. Leading factors in the area's economy are manufacturing, tourism, retail trade and services, government, and agriculture. Over the last twenty years, the area has experienced unprecedented growth because of heavy in-migration to the Phoenix area.

C. Purpose

The alternative actions described in this EIS have three principal purposes. These are:

1. to increase the operating efficiency of the CAP through the conservation of Salt, Verde, and Agua Fria River flows; and regulation of Colorado River water deliveries from the Granite Reef Aqueduct.
2. to provide storage capacity to meet the flood control needs on the Salt River through the Phoenix metropolitan area.
3. to provide for the structural safety of existing Bureau of Reclamation dams on the Salt and Verde Rivers.

In addition to these major project purposes, several additional planning objectives were adopted to aid in developing and evaluating plans. These

included, among other things, opportunities for fish and wildlife enhancement, opportunities for hydroelectric power production associated with structural and nonstructural alternatives, opportunities to improve the management and protection of open space and the potential for multi-purpose projects such as the Rio Salado concept, and protection of unique archeaological and historical resources in the CAWCS study area. These objectives are addressed either in the design of the alternative plans or in recommendations for impact mitigation.

D. Need

1. Regulatory Storage

Construction of a regulatory storage unit for CAP water would improve the operating flexibility and efficiency of the CAP and would allow the importation of greater quantities of Colorado River water in years when it is available. Without regulatory storage capacity the CAP system could be operated only in direct response to demand. The demand for water is greatest during the summer and during the daytime hours. If regulatory storage space is available, water could be pumped and stored, irrespective of demand, during off-peak periods for delivery during peak periods.

A major advantage of flexible operation of the CAP system is more efficient power management. With regulatory storage, water could be pumped during off-peak periods at night or during the winter when energy is less valuable. The benefit resulting from this power management would be the ability to sell the peak-period power not used by the CAP System.

Regulatory storage would increase the efficiency of the CAP system during years when the Colorado River supplies are reduced, and during possible interruptions in the system such as power failures. In the event of the latter occurences, water from regulatory storage could continue to be delivered to at least part of the system. During supply surpluses, regulatory storage would allow for storage and use of water which would otherwise be spilled and wasted.

2. Flood Control

Flooding of the Salt and Gila Rivers has been a problem in Phoenix since its early settlement. Most recently, a series of floods caused substantial damages in the form of income losses, emergency costs, and property damage, and had severe impacts on transportation and on people living in the flood zone. Fiscal damages resulting from the February 1978 floods were estimated at $31 million, with damages from the December 1978 and February 1980 floods set at $46 million and $64 million, respectively (U.S. Army Corps of Engineers). These floods created strong public and private-sector demand for flood control through the metropolitan area.

The worst of these floods in February 1980 peaked at 170,000 cubic feet per second (cfs) through Phoenix. The U.S. Army Corps of Engineers (Corps) has calculated the uncontrolled flow for a 200-year event as 275,000 cfs. The 100-year event would have a flow of 215,000 cfs.

3. Dam Safety

Hydrologic analyses based on revised Bureau's calculations for the maximum probable floods (MPF) indicate that six SRP storage dams have

inadequate storage and/or spillway and outlet capacity to contain and/or pass the MPF without overtopping. Such an occurrence could jeopardize the safety of the dams. The potential overtopping or failure of any of these dams is considered serious because of the extreme consequences which would result for Phoenix and other downstream communities.

II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

II. ALTERNATIVES INCLUDING THE PROPOSED ACTION

A. Alternatives Eliminated from Further Study

The CAWCS was initiated in July 1978 to develop and evaluate alternatives for regulatory storage of Central Arizona Project (CAP) water in central Arizona and flood control of the Salt and Gila Rivers through the Phoenix metropolitan area. Safety of Bureau of Reclamation dams on the Salt and Verde Rivers was also included as a major objective of the CAWCS.

The study was conducted in three stages, following a process of transition from a wide array of possible solutions in Stage I to a single proposed action at the end of Stage III.

1. Stage I Alternatives

Initially, in Stage I, 34 separate elements were identified which singly or in combination could provide the two main CAWCS purposes of flood control and regulatory storage. The elements were examined at an initial level of study to determine their effectiveness, and 20 elements were recommended for more detailed study in Stage II, largely on the basis of site suitability, location, and cost. The results of the Stage I analysis are displayed in Table II-1.

2. Stage II Alternatives

Some of the elements carried into Stage II were "competing"; this means that two or more elements provided essentially the same function in different locations. Therefore, the first step in Stage II was to screen the

Table II-1

STAGE I RESULTS OF ELEMENT EVALUATION

Element	Purpose		Further Study	
	Flood Control	CAP Storage	Warranted	Unwarranted
VERDE RIVER				
Tangle Creek	o	o		o
Modified Horseshoe	o	o	o	
Cliff	o	o	o	
New Bartlett	o	o	o	
SALT RIVER				
Carrizo Creek	o			o
Klondike Buttes	o			o
Modified Roosevelt	o	o	o	
Coon Bluff		o		o
Confluence	o	o	o	
Granite Reef	o	o	o	
Rio Salado Low Dams		o		o
AGUA FRIA RIVER				
Lake Pleasant		o	o	
New Waddell		o	o	
Agua Fria Siphon		o		o
Calderwood Butte		o		o
North Phoenix Dams (for CAP)		o		o
GILA RIVER, SANTA ROSA WASH				
Coolidge		o		o
Florence		o	o	
Buttes		o	o	
Tat Momolikot		o	o	
Painted Rock Reservoir		o		o

Table II-1 (Continued)

Element	Purpose		Further Study	
	Flood Control	CAP Storage	Warranted	Unwarranted
CHANNELS				
Granite Reef to Country Club	o			o
Country Club to 35th Ave.	o		o	
35th Ave. to Gillespie Dam	o			o
LEVEES				
Granite Reef to Country Club	o			o
Country Club to 35th Ave.	o		o	
35th Ave. to Salt-Gila	o			o
Salt-Gila Confluence to Gillespie Dam	o		o	
CHANNEL CLEARING	o		o	
WATER EXCHANGE W/SRP		o	o	
SRP REREGULATION	o		o	
NONSTRUCTURAL	o		o	
GROUNDWATER RECHARGE	o	o	o	
NO ACTION			o	

competing elements to identify the best to be used in forming systems which could provide both regulatory storage and flood control. The results of the screening were as follows:

- Three sites were screened primarily for flood control on the Verde River: New Horseshoe Dam; Cliff Dam, 6 miles downstream from the existing Horseshoe Dam; and New Bartlett Dam. The analysis showed that the New Horseshoe site was clearly inferior to New Bartlett in terms of environmental impact. However, the cost for New Bartlett was over twice that of other elements. Cliff Dam was comparable to New Horseshoe in cost and better in terms of environmental impact. Therefore, Cliff Dam was selected for use in forming systems.

- The two sites that were investigated for flood control and/or regulatory storage at the Salt/Verde confluence were Confluence Dam and Granite Reef Dam, 4 miles downstream. Granite Reef Dam was eliminated because, while environmental and social impacts were essentially the same at both sites, geology and cost significantly favored the Confluence site.

- Three channelization elements were studied: channels on the Salt River, levees on the Salt and Gila Rivers, and greenbelt areas constructed with the Salt River levee system. The screening indicated that the elements were similar except for cost. On the basis of cost, levees were selected for forming systems.

- Several sites not located on the Salt or Verde River were considered primarily for regulatory storage: New Waddell Dam on the Agua Fria River; use of existing storage in Lake Pleasant behind the existing

Waddell Dam on the Agua Fria River; Buttes Dam on the Gila River; Florence Dam on the Gila River; and Tat Momolikot Dam on Santa Rosa Wash. The analysis showed that, on the basis of engineering, cost and environmental/social impact, sites on the Agua Fria River were preferred; therefore the elements on the Gila River and Santa Rosa Wash were eliminated. Comparison of New Waddell and Lake Pleasant storage indicated that, while Lake Pleasant storage was less costly and had less environmental impact, New Waddell was preferred on the basis of better regulatory storage performance and the potential to provide other benefits, such as recreation and incidental flood control.

Table II-2 shows the Stage II element screening results.

During Stage II, the feasibility of modifying existing Roosevelt Dam was questioned. As a result, the New Roosevelt Dam and the New Stewart Mountain Dam elements were added for flood control, SOD, and CAP storage on the Salt River.

The remaining elements were combined into 13 systems which provided 1) Salt OR Verde River control; 2) Salt AND Verde River control; 3) downstream protection; 4) a combination of upstream control and downstream protection; 5) limited structural (taking advantage of existing structures); or 6) nonstructural flood damage reduction measures. The "No Action" alternative was included as well. The Stage II systems are displayed in Table II-3. The analysis of systems on the basis of performance, dam safety, economics, social and environmental impacts, and institutional constraints resulted in the elimination of several alternatives:

Table II-2

STAGE II RESULTS OF SCREENING FOR COMPETING ELEMENTS

Element	Purpose		Further Study	
	Flood Control	CAP Storage	Warranted	Unwarranted
VERDE RIVER				
New Horseshoe Dam	o	o		o
Cliff Dam	o	o	o	
New Bartlett Dam	o	o		o
SALT RIVER				
New/Enlarged Roosevelt Dam	o	o	o	
New Stewart Mountain Dam[a]	o	o	o	
CONFLUENCE				
Confluence Dam	o	o	o	
Granite Reef Dam	o	o		o
SRP REREGULATION	o		o	
CHANNELIZATION				
Channels	o			o
Levees	o		o	
Phoenix Greenbelt	o			o
NONSTRUCTURAL MEASURES	o		o	
OFF-SALT/VERDE REGULATORY STORAGE				
New Waddell Dam		o	o	
Lake Pleasant Storage		o		o
Buttes Dam		o		o
Florence Dam		o		o
Tat Momolikot Dam		o		o
UNDERGROUND STORAGE/ GROUNDWATER RECHARGE		o	o	
WATER EXCHANGE W/SRP		o	o	
NO ACTION			o	

[a]Multipurpose

Table II-3

STAGE II SYSTEMS

CONCEPT 1	SALT OR VERDE CONTROL
1A	Cliff Dam
1B	Enlarged/New Roosevelt Dam
1C	New Stewart Mountain Dam[a]
CONCEPT 2	SALT AND VERDE CONTROL
2A	Confluence Dam
2B	Cliff Dam + Enlarged/New Roosevelt Dam
2C	Confluence Dam + Enlarged/New Roosevelt Dam
2D	Cliff Dam + New Stewart Mountain Dam + New Waddell Dam
CONCEPT 3	DOWNSTREAM
3	Phoenix Levee + Gila Levee + New Waddell Dam
CONCEPT 4	UPSTREAM/DOWNSTREAM
4A	Enlarged/New Roosevelt Dam + Phoenix Levee + Gila Levee
4B	New Stewart Mountain Dam + Phoenix Levee + Gila Levee
CONCEPT 5	LIMITED STRUCTURAL
5A	SRP Reregulation (without modifications) + Underground Storage/ Groundwater Recharge
5B	SRP Reregulation (with modifications) + Underground Storage/ Groundwater Recharge
CONCEPT 6	NONSTRUCTURAL
6	Nonstructural Flood Damage Reduction Measures + SRP Exchange

[a]Multipurpose

- Large levees were eliminated due to excessive cost and the lack of positive environmental/social benefits to offset the high cost. However, the option to use small, local levees where justified was retained.

- Underground storage was eliminated because of difficult operation associated with institutional and legal problems and because of energy dependency. However, groundwater recharge was retained as possible mitigation for Salt River Project (SRP) Reregulation water losses and also a possible method of conserving flood waters.

- Water exchange with the existing SRP dams for regulatory storage was eliminated on the basis of low performance, increased dam safety risks, and potential adverse environmental/social impact. However, the option was retained to exchange water with SRP if new water conservation space were provided in upstream reservoirs.

3. Stage III Alternatives

At the start of Stage III, 10 elements remained for combination into plans for the most detailed level of study. These elements were:

Cliff Dam

New/Modified Roosevelt Dam

Confluence Dam

New Stewart Mountain Dam (multipurpose)

New Waddell Dam

SRP Reregulation

Groundwater Recharge (as mitigation for water losses with SRP reregulation)

Water Exchange (with new upstream storage only)

Limited Local Levees

Nonstructural Measures

Concurrent with the CAWCS, the Bureau of Reclamation had been conducting a study of Safety of Dams (SOD) on the Salt and Verde Rivers. SOD considerations became increasingly important in CAWCS plan development. Therefore, at the outset of Stage III, the Bureau widened the focus of the CAWCS to include SOD as a major objective. All plans developed for Stage III analysis considered both SOD and CAWCS purposes.

With the inclusion of SOD, over 100 possible plans were developed. Since the two studies were under separate authorization, and either portion of a plan could be delayed, plans were developed in which 1) a joint SOD/CAWCS solution could be implemented; 2) a CAWCS solution could be implemented first with SOD delayed; or 3) there was no CAWCS action and SOD studies continued. A complete list of plans developed is contained in the Bureau of Reclamation's CAWCS Stage III Report. The plans were screened on the basis of performance, cost, and environmental/social impact to reduce the number of alternatives for detailed analysis. As a result of the screening and further analysis:

- Cliff and New/Modified Roosevelt Dams were included in all candidate plans for SOD purposes because 1) these large upstream structures could suppress flows to a level which limited the need for major modifications at downstream structures, and 2) CAWCS and SOD solutions could be combined in each of the structures.

- New (enlarged) Stewart Mountain Dam was eliminated from further consideration as a regulatory storage and flood control element due to high cost. Reconstructed Stewart Mountain Dam was included in all candidate plans for SOD purposes only.

- SRP Reregulation was eliminated because, with Cliff and New Roosevelt Dams as the CAWCS dam safety solution, incidental flood control at a level comparable to SRP Reregulation could be obtained without the institutional problems and water loss associated with dedicating flood control space in existing SRP dams.

Eight "candidate" plans resulted from this analysis:

Plan 1	Cliff + New/Modified Roosevelt + Reconstructed Stewart Mountain Dams
Plan 2	Cliff (SOD only) + New/Modified Roosevelt (SOD only) + Reconstructed Stewart Mountain Dams + Nonstructural Measures
Plan 3	Confluence (CAP storage only) + Cliff + New/Modified Roosevelt + Reconstructed Stewart Mountain Dams (concurrent construction)
Plan 4	Confluence (CAP storage and flood control) with a large service spillway + Cliff (SOD only) + New/Modified Roosevelt (SOD only) + Reconstructed Stewart Mountain Dams (SOD only)
Plan 5	Same as Plan 4 but Confluence has an emergency spillway and a small service spillway
Plan 6	New Waddell + Cliff + New/Modified Roosevelt + Reconstructed Stewart Mountain Dams
Plan 7	Same as Plan 6 but with emphasis on opportunities for environmental enhancement from water development
Plan 8	CAWCS No Action and continued SOD studies

In September, 1981 analysis of the plans in terms of effectiveness, efficiency, completeness, and acceptability resulted in the elimination of

Plans 4 and 5 from all further consideration. A more detailed discussion of plan development and selection is contained in the Stage III Report.

B. Alternatives Analyzed in Detail

Plans 1, 2, 3, 6, 7, and 8 were analyzed in detail. In October, 1981, the Governor's Advisory Committee, representing the interests of affected communities, environmental groups, business groups, Indian tribes, the media, and citizens, recommended Plan 6 as their preferred plan to the Governor of Arizona and the Bureau of Reclamation.

The Bureau of Reclamation concluded that Plans 1, 3, and 6 were appropriate for consideration as the proposed action because 1) they had moderate to high levels of performance for flood control, regulatory storage and energy management, and 2) they could be implemented for a reasonable cost.

In November 1981, following review of the eight candidate plans and after conferring with the Governor of Arizona and the Arizona congressional delegation, the Secretary of the Interior selected Plan 6 as the agency proposed action. His selection was based on the strong local support for Plan 6, the functional ability to meet statutory obligations required by authorizing legislation, and the fact that the severe impacts to the Fort McDowell Indian Community associated with some plans were avoided.

Subsequently, the Bureau found that the level of reconstruction being considered for Stewart Mountain Dam might not be sufficient to solve existing dam safety problems. Because the exact nature and extent of required construction has not been determined, it was decided to include descriptions

of both New and Modified Stewart Mountain Dams in the EIS. Consequently, both the Modified and New Stewart Mountain Dams appear in all candidate plans.

A determination has not yet been made whether to reconstruct the existing Roosevelt Dam or to construct a new dam. For the same reasons cited for Stewart Mountain, both New and Modified Roosevelt Dam appear in the EIS. Impacts are assessed for construction of new dams at both the Roosevelt and Stewart Mountain sites, with the difference in impact from modification also noted.

In July 1982, the Bureau completed a sizing study of New Waddell Dam to determine the size at which regulatory storage and power management benefits are maximized. The optimum size reservoir is larger than the reservoir which was under consideration at the time Plan 6 was chosen by the Interior Secretary. The larger New Waddell Dam is described in the EIS.

All plans, except the No Action alternative, share common components. These are Cliff, Roosevelt, and Stewart Mountain Dams. Cliff and Roosevelt Dams would be constructed and operated basically the same in Plans 1, 3, 6, and 7; they differ significantly in Plan 2 (SOD only). Stewart Mountain Dam would be the same in all plans. Therefore, for purposes of brevity, Cliff, Roosevelt, and Stewart Mountain Dams are described once and referenced in plans in which they are the same.

1. Plan 8: No CAWCS Action

The No Action plan includes future conditions in the study area without CAWCS projects for CAP regulatory storage, flood control, and dam

safety. Under this plan, CAP would be constructed, but no CAWCS regulatory storage or flood control would be provided. SOD studies would, however, continue toward selection of a preferred SOD solution. Such a solution may differ from the Cliff/Roosevelt combination in plans described in this EIS. With no CAWCS action and continued SOD studies, the following is assumed:

- The CAP aqueducts would operate essentially as a demand system. Bureau operation studies indicate that an average annual water supply of 1,006,000 acre-feet (af) of Colorado River water would be delivered to central and southern Arizona without regulatory storage.

- No flood control measures or structures under study by the CAWCS would be implemented by the federal government.

- Under the Reclamation Safety of Dams Act, dams operated by SRP would be modified. Modifications could include large spillways to pass flows or, as in Plan 2, construction of Cliff and New Roosevelt Dams to suppress flows on the Verde and Salt Rivers. Stewart Mountain Dam would also be replaced or modified to include a larger spillway. More detailed information on the SOD studies is contained in the Bureau's Stage III Report.

- Twelve bridges on the Salt and Gila Rivers would be constructed or modified by state and local governments to withstand flows of up to 200,000 cubic feet per second (cfs). None would be large enough to remain open should large floods such as the 200-year flood (275,000 cfs) occur. The new bridges would eliminate much of the traffic disruption which now results during floods.

- Buttes Dam and Reservoir is an authorized feature of the CAP. Studies are underway to determine if this dam or a suitable alternative should be implemented. The purposes of this feature could include development of Gila River water for CAP water supply, flood control and/or sediment control for the Gila River valley below Ashurst-Hayden Diversion Dam. Other CAP features which would be constructed are the Granite Reef Aqueduct, Salt-Gila Aqueduct, the Tucson Aqueduct, and Hooker Dam or a suitable alternative.

- Floodplain management, including enforcment of existing laws and regulations, is assumed. No existing structures in the floodplain would be abandoned, but new structures in 100-year floodplain fringes would be floodproofed to protect against a 100-year flood.

- The City of Phoenix would construct an interim 100-year flood channel in the Salt River near Sky Harbor Airport. The channel would protect the runways against damages similar to those which have occurred in the past. The channel is, however, an interim protection plan and would have a limited life because the present airport expansion plans include adding another runway south of the existing south runway.

- Limited channel clearing along the Salt and Gila Rivers from 91st Avenue to Gillespie Dam would be completed by the Flood Control District of Maricopa County. The clearing would ultimately be 1,000 feet wide and would be regularly maintained. Gillespie Dam would not be modified in conjunction with channel clearing.

- There would be an improved flood warning system, under an appropriation of $400,000.

- Several flood control facilities (New River, Cave Buttes, and Adobe Dams, several Soil Conservation Service dams, Indian Bend Wash) would be completed.

- The U.S. Forest Service Cottonwood Recovery Program on the Verde River, designed to improve wildlife habitat, would be implemented.

- The Tempe Rio Salado Project would be implemented. For the purposes of this study, the overall Rio Salado concept was assumed not to be developed in the future without the project, because upstream flood control would be required for implementation of this recreational and commercial development project along the Salt River floodplain through Phoenix. Studies for the Rio Salado Development District are progressing at a reconnaissance level.

2. Plan 1: Cliff + Roosevelt + Stewart Mountain Dams

This plan consists of construction of Cliff Dam on the Verde River and New or Modified Roosevelt Dam on the Salt River to provide flood control, additional water conservation, hydropower, recreation and dam safety, and New or Modified Stewart Mountain Dam on the Salt River for dam safety purposes. The general location of the structures is shown in Figure II-1.

This plan would provide 107,600 af of new water conservation space at Cliff Dam and would use one half of the sediment pool at Roosevelt Reservoir to increase the average annual amount of available CAP water

(CAP yield) by 107,600 af/yr. Projected CAP water yield for this plan is 1,113,600 af/yr.

Sufficient flood control space would be provided to control the 200-year event (275,000 cfs) to a flow of 92,000 cfs, measured at Sky Harbor International Airport and the 100-year event (215,000 cfs) to 55,000 cfs at the airport.

The hydrologic safety problems at the existing Salt and Verde River dams within the SRP system would be corrected. Because this plan would not connect directly with the CAP aqueduct, there is no potential for energy management.

Water supply, hydropower capacity, and recreation facilities at the existing Roosevelt and Stewart Mountain Dams would be maintained at the sites whether a new dam is built or the existing dam is modified. If a new dam is built at these sites, the existing dams would be breached. This plan requires relocation of some residents living around Roosevelt Lake. On the Verde River, Horseshoe Dam would be breached, and the storage replaced in Cliff Reservoir. A ranch below Horseshoe Dam would be inundated, requiring relocation of residents.

Design information on dams and related features included in Plan 1 is displayed in Table II-4. Economic characteristics of Plan 1 are shown on Table II-9.

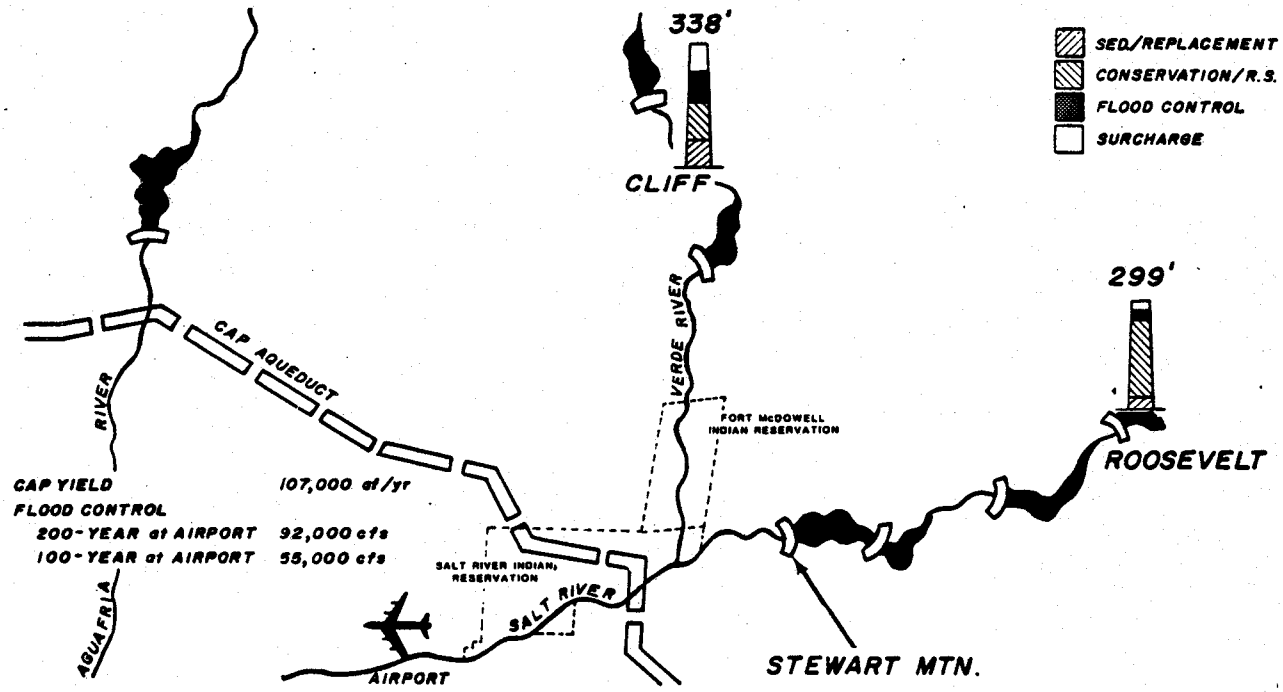

FIGURE II-1
PLAN 1
CLIFF+ROOSEVELT+
STEWART MTN. DAM

CENTRAL ARIZONA WATER CONTROL STUDY

Table II-4

DESIGN DETAILS - PLAN 1

	CLIFF
DAM STRUCTURE:	
Height	338 feet
Crest Length	2,900 feet
Embankment Volume	15,000,000 cubic yards
SPILLWAY:	(ungated)
Crest Length	125 feet
Head	47 feet
Capacity	150,000 cfs
APPURTENANT WORKS:	
Hydropower Plant	--
Pumping Plant Combined for Cliff and Roosevelt	1,600 cfs
Service Outlet	4,000 cfs
Flood Outlet:	
Capacity in Flood Pool	25,000 cfs
Capacity at MWS	36,000 cfs
Reversible Canal:	
Capacity	--
Length	--

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,810
Sediment	41,300	41,300	Varies	Varies
Inactive	--	--	--	--
Replacement	131,400	172,700	3,316	1,962
New Conservation	170,000	342,700	5,328	2,001
Flood Control	445,000	787,700	8,713	2,066
Surcharge	861,000	1,648,700	14,246	2,143
Dam Crest	--	--	--	2,148

TABLE II-4 (Continued)

	ROOSEVELT	
	New	Modified
DAM STRUCTURE:		
Height	299 feet	299 feet
Crest Length	1,250 feet	1,220 feet
Embankment Volume	340,000 cubic yards (concrete)	300,000 cubic yards
SPILLWAY:	(gated)	(gated)
Crest Length	200 feet	200 feet
Head	90 feet	90 feet
Capacity	150,000 cfs	150,000 cfs
APPURTENANT WORKS:		
Hydropower Plant	--	--
Pumping Plant	--	--
Service Outlet	11,000 cfs	11,000 cfs
Flood Outlet:		
Capacity in Flood Pool		
Capacity at MWS	Spillway to be used as flood outlet	
Reversible Canal:		
Capacity	--	--
Length	--	--

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,902
Sediment	268,000	268,000	Varies	Varies
Inactive	--	--	--	--
Replacement	1,344,000	1,612,000	20,933	2,147
New Conservation	--	--	--	--
Flood Control	565,000	2,177,000	25,256	2,172
Surcharge	774,000	2,951,000	30,004	2,201
Dam Crest	--	--	--	2,201

TABLE II-4 (Continued)

STEWART MOUNTAIN

	New		Modified (same as existing)	
DAM STRUCTURE:				
Height	118 feet		116 feet	
Crest Length	1,300 feet		1,260 feet	
Embankment Volume	130,000 cubic yards (concrete)		130,000 cubic yards	
SPILLWAY:	Existing	Auxiliary	Existing	Auxiliary
Crest Length	270 feet	150 feet	270 feet	150 feet
Head	27 feet	37 feet	27 feet	37 feet
Capacity	123,000 cfs	87,000 cfs	123,000 cfs	87,000 cfs
APPURTENANT WORKS:				
Hydropower Plant	--		--	
Pumping Plant	--		--	
Service Outlet	4,000 cfs		4,000 cfs	
Flood Outlet:				
Capacity in Flood Pool	--		--	
Capacity at MWS	--		--	
Reversible Canal:				
Capacity	--		--	
Length	--		--	

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,417
Sediment	--	--	--	--
Inactive	--	--	--	--
Replacement	69,800	69,800	1,254	1,529
New Conservation	--	--	--	--
Flood Control	--	--	--	--
Surcharge	--	--	--	1,533
Dam Crest	--	--	--	1,535

a. Cliff Dam and Reservoir

Cliff Dam and Reservoir would be located on the Verde River about 6 miles downstream from the existing Horseshoe Dam. The site area includes approximately 52,800 acres. Most of the land required for the project is currently under federal ownership.

Cliff Dam would be an earthfill structure and would include flood and water supply outlet works. All releases would be to the Verde River channel. No minimum pool for purposes of fish and wildlife and recreation would be included in Cliff Reservoir in Plan 1.

Conceptual Recreation Plans have been developed by the U.S. Army Corps of Engineers and the Bureau for all elements. Plans for Cliff Reservoir feature four recreation sites. Recreation sites at Cliff Reservoir in Plans 1, 3, 6, and 7 include a total of 162.5 acres. The plate entitled "Cliff Site - Plan 1" in the map pocket in the back of the document shows the locations of the dam, spillway, reservoir area, recreation sites, borrow and waste areas, construction staging areas, and roads. The plate also shows the various pool levels of the reservoir including the maximum storage pool (MSP), the Standard Project Flood (or 200-year flood) pool (SPF), the Inflow Design Flood (IDF) level, and the "typical-year" high and "typical-year" low pools.

(1) Description of "Typical-Year Scenario"

During the CAWCS impact analysis, it was recognized that a range of impacts was associated with each reservoir depending on which

pool level was assumed to be in place. These levels could vary from minimum conservation and regulatory storage pools to the maximum IDF pool. To anchor the impact assessment, a "representative" pool was needed. In response to this need for assessing impacts, a "typical-year" scenario was developed, based on the Bureau's CAPSIM computer model elevation-duration curves, for each reservoir included in the CAWCS plans. The typical-year pool fluctuates during a year due to reservoir operations. This pool was devised for use in impact assessment because it is representative of the way a reservoir could reasonably be expected to look and, therefore, provides a basis for analyzing probable impacts.

(2) Cliff Dam Water Supply Operation

Cliff Dam would be operated in the same manner Horseshoe Dam has been operated. Natural runoff would be collected through late summer and released downstream when storage volume becomes available in Bartlett Reservoir. The conservation pool would normally be fullest in the late winter-early spring, and lowest in the late summer. The typical-year fluctuation would be 71 feet.

The CAP Granite Reef Aqueduct would not be directly connected to Cliff Reservoir. CAP storage space in the reservoir would be created "on paper" by exchange with the SRP system. When CAP demand is less than the rated capacity of the aqueduct, excess CAP water could be delivered to SRP users with an equal amount of SRP water credited to CAP and stored in the new Cliff Reservoir. This stored water could then be delivered to the CAP aqueduct users by SRP when CAP demand exceeds supplies in the aqueduct, usually during the summer.

The water would be allowed to flow downstream to a point above Granite Reef Diversion Dam where it would be pumped up to the CAP aqueduct through a 1,000-foot-long connection capable of handling approximately 1,630 cfs. A new transmission line would connect the pumping plant with the existing CAP power system. The aqueduct and transmission line together would require a single 200-foot-wide corridor and the pump station would require a 5-acre site as shown in Figure II-2. The operation of this exchange would alter flows in the Verde River. During the months of November through mid-March, flow in the Verde would be reduced, while maintaining a minimum of 50 cfs. During the months of April to September there would be increased flow in the Verde River with a maximum increase of 300 to 350 cfs over future-without-the-project flowrates during the months of July and August. However, at no time would the Verde River flow be stopped to optimize water exchange operations.

(3) Cliff Dam Flood Control Operation

Cliff Dam would be combined with Roosevelt Dam on the Salt River to form a dual reservoir flood control system. Flood control releases made from the individual reservoirs in the system would be based on the flood control space available in each reservoir, the total flood control space available, and the total release allowed to meet a given target flow. The total flood control release from the system would be based on the total inflow to the reservoir and the intervening flows.

If the water surface elevation of either reservoir is lower than the maximum conservation storage pool elevation, then there would be no flood control release from that reservoir.

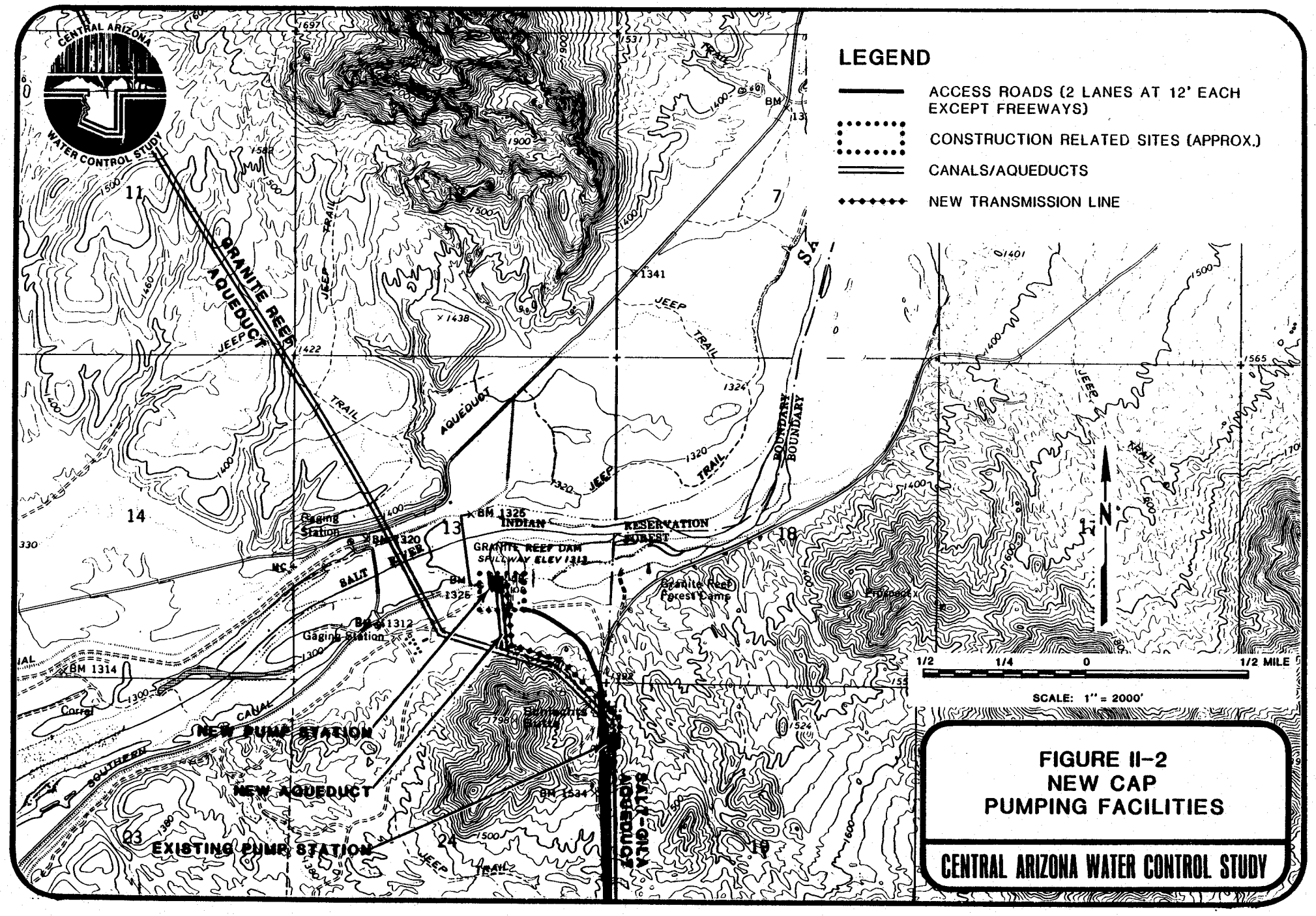

FIGURE II-2
NEW CAP
PUMPING FACILITIES

CENTRAL ARIZONA WATER CONTROL STUDY

If the water surface elevation at either or both of the reservoirs is greater than or equal to the maximum conservation storage pool elevation of that reservoir and below the maximum flood control storage pool elevation, flood control releases would be such that the total flow from the reservoir would not exceed 25,000 cfs.

Flood control releases from the reservoir system would be apportioned between the individual reservoirs because it is desirable to keep the percentage of available flood control space in each individual reservoir approximately equal. The releases from the individual reservoirs would be prorated according to the total dedicated flood control space in the reservoir, as well as the percentage of that flood control space available. However, the maximum release from either reservoir would be held to 25,000 cfs.

If the water surface rises above the top of the designated flood control space, then the flood control operation criteria would no longer be used and the reservoir would be operated to protect the dam from overtopping.

b. New/Modified Roosevelt Dam and Reservoir

The two options being considered to provide new flood storage space and make the dam at Roosevelt safe under maximum flooding and earthquake events are modification of the existing dam and construction of a new dam. Both actions would involve the same construction activities, would have the same borrow areas and haul roads, would result in the same dam height and reservoir size, and would be accompanied by the same recreation

plan. Locations of the dam, spillway, reservoir area, power transmission facilities, recreation sites, borrow and waste areas, construction staging aeas, roads, and pool levels are shown on the plate entitled "Roosevelt Site - Plans 1, 3, 6, 7" in the map pocket at the end of the document. Typical-year low and high pools are not shown because both are below the MSP level of the existing reservoir as shown on the plate.

The differences are in the treatment of the existing Roosevelt Dam, a National Historic Landmark, and in the drawdown of Roosevelt Lake during the construction period. Construction of the new dam would not require drawdown of the existing reservoir but the alternative dam modifications might require drawdown if construction occurs during years of high runoff.

Ten new and expanded recreation sites are proposed at the Roosevelt site in Plans 1, 3, 6, and 7, covering 638 acres.

(1) Modified Roosevelt Dam

Modification of existing Roosevelt Dam would include raising the dam approximately 52 feet to provide flood storage space and surcharge space for the IDF. The storage allocations and elevations would be the same as for the new dam. Modifications would take 3-1/2 years to complete.

The raised portion of the dam would be concrete, either with or without block facing to match the existing dam. Construction would include modifications to the dam, spillways, and access bridges. The existing tool house towers at each end of the dam would be left intact. The

spillways would be reconstructed with a total capacity of 150,000 cfs. Excavation would be required for the spillway foundations and for the south spillway abutment. A concrete wall would be required at the north spillway. The access bridges would also have to be raised. The old roadway and arches would be removed, but the arches could be rebuilt similar to their original appearance.

There would be drawdown of the reservoir during various stages of the construction. The reservoir would be drawn down to elevation 2,100 feet for about 6 months from about August 1 to about February 1 during the first year of construction. During this period the 14,000 cfs evacuation outlets would be added to the dam. During the second year of construction, a similar drawdown period would be experienced for emergency spillway modifications. However, between October 1 and January 1 the drawdown would be to elevation 2,065 feet for modifications to the bridges and other low elevation concrete works. There would be a 5-month drawdown to elevation 2,100 feet during the third year from September 1 to February 1 for modifications to the dam itself.

The construction drawdown periods are scheduled to coincide with periods when normal pool levels are below the 2,100-foot elevation. If that is the case, no water would have to be released to accommodate the construction. This is also true of the 3-month drawdown to elevation 2,065 feet. The period between October 1 and January 1 has historically been when the reservoir is below elevation 2,065 feet. However, if water does need to be released, it would be at a rate similar to normal summer discharges.

(2) New Roosevelt Dam

New Roosevelt Dam would be located on the Salt River 1,000 feet downstream from the existing Roosevelt Dam. The site area includes about 81,000 acres. Most of the lands, necessary easements, and rights-of-way are owned by the federal government; any additional lands required for this project would be acquired by the government.

New Roosevelt Dam would be a concrete structure and would include flood and water supply outlet works. All releases would be to the Salt River channel.

A hydropower facility would be constructed at the base of the new dam, replacing the power plant at the existing dam. A new transmission line would be required.

The existing dam carries the traffic of State Highway 188 across the top of the dam. Constructing New Roosevelt Dam would require that the access across the river be replaced. The highway traffic would be routed across a new bridge constructed over the foundation of the old dam or just upstream of the old dam.

(3) Roosevelt Dam Water Supply Operation

The new dam would be operated in the same manner as existing Roosevelt Dam has been operated. Natural runoff would be collected through late summer and released downstream when storage volume becomes available in the downstream reservoirs. The typical-year fluctuation would be 23 feet.

During the life of the project, an average of one-half of the sediment pool (134,000 af) could be used for water storage purposes, providing new conservation space.

There would be no direct connection between Roosevelt Reservoir and the CAP Aqueduct. As with Cliff Dam, CAP water would be developed through exchange with the SRP system. The same facilities near Granite Reef Dam as previously discussed under Cliff Dam and Reservoir would be used for this exchange (see Figure II-2).

This exchange would not significantly affect overall water supply operation except for minor changes in the flow rates in the Salt River below Roosevelt Dam during some months.

(4) Roosevelt Dam Flood Control Operation

Flood control operation would vary as with Cliff Dam. Cliff and Roosevelt Dams with Standard Project Flood (SPF) design storage would reduce the 200-year flood event to a flow of 92,000 cfs at the Sky Harbor Airport. At no time would the total releases at Roosevelt endanger any downstream dams. The surcharge pool would contain water very infrequently (only in events exceeding 200-year frequency).

c. New/Modified Stewart Mountain Dam

Dam safety problems at Stewart Mountain Dam necessitate that an auxiliary spillway be constructed. Modifying the existing dam or building a new dam would be required if the existing dam is found not to be stable

enough to withstand the Maximum Credible Earthquake (MCE) without a structural failure. The New/Modified Stewart Mountain site area is shown on Figure II-3.

The sole purpose of the New or Modified Stewart Mountain Dam would be to solve dam safety problems. No new flood storage space would be provided nor would CAP regulatory storage space be included. The dam would be operated in the same manner as the existing dam is operated.

(1) Modified Stewart Mountain Dam

Modification of the existing Stewart Mountain Dam would consist of construction of an auxiliary spillway located on the right abutment of the dam. The spillway, with a crest elevation of 1,496 feet, would be a gated concrete structure with a capacity of 87,000 cfs. The total capacity of the existing and auxiliary spillways combined would be 210,000 cfs.

During construction of the auxiliary spillway, earth and rock would be excavated at the site and disposed of in Saguaro Lake, reducing its capacity by about 300 acre-feet. Spillway construction material would be acquired from one or more Bureau approved commercial sources shown on Figure II-3. These materials would be hauled to the site using Bush Highway and/or Highway 87. Neither highway would need to be closed for construction purposes. Approximately 2 years would be required to build the auxiliary spillway.

During the construction period, activities in the area would include removal of vegetation at the spillway site, excavation, blasting, and heavy vehicular traffic. Approximately 10 acres of land would be required for construction of the new spillway. During and after construction, the reservoir level in Saguaro Lake would not change. Recreation opportunities at Saguaro Lake and along the Salt River downstream from Stewart Mountain Dam would not be affected.

(2) New Stewart Mountain Dam

New Stewart Mountain Dam would be constructed against the base of the existing dam, and would be a concrete gravity dam about 200 feet high with a crest length of 1,300 feet; an auxiliary spillway would be located on the right abutment of the new dam. Total capacity of the new dam and spillway would be 210,000 cfs. Outlet works in the new dam could release flows of up to 4,000 cfs to the Salt River channel. Hydropower capabilities at the existing dam would be replaced in the new structure. The existing allocated space in Saguaro Lake would not be significantly affected by replacement of the old dam. Only the sediment and replacement pools would be maintained, with no flood control or spillway surcharge space added to the reservoir.

Construction activities for the new dam and spillway would be similar to those described above for the modified dam. Ten acres of land would be required for the dam construction and 10 acres would be required for the spillway construction. Construction materials would be obtained from one or more of the commercial sources whose locations are shown

on Figure II-3. Approximately 4 years would be required for construction of the new dam and spillway.

With construction of New Stewart Mountain Dam, the maximum water surface (MWS) elevation of Saguaro Lake would be 1,533 feet, approximately 2 feet below the current MWS elevation. This change would not affect the operation of the pumped-storage facility at Mormon Flat Dam. The top of the conservation pool would remain at elevation 1,529. During contruction, Saguaro Lake would not be drained and releases to the Salt River below the dam would not be altered. No new recreation facilities or sites would be constructed at Saguaro Lake.

3. Plan 2: Cliff + Roosevelt + Stewart Mountain Dams + Nonstructural Measures

This plan limits construction to that necessary for dam safety purposes. The plan consists of construction of Cliff Dam on the Verde River, Roosevelt Dam on the Salt River, and Stewart Mountain Dam on the Salt River for dam safety purposes, and nonstructural flood damage reduction measures downstream. The general location of structures in Plan 2 is shown on Figure II-4.

This plan would provide no new conservation space for CAP, but through dual use of the sediment space at Roosevelt Dam over the life of the project, the CAP yield could be increased by 16,000 af/yr. Projected average annual CAP water yield is 1,022,000 af/yr.

Under this plan, incidental flood control provided by the use of the surcharge space at Cliff and Roosevelt Dams (no dedicated flood control

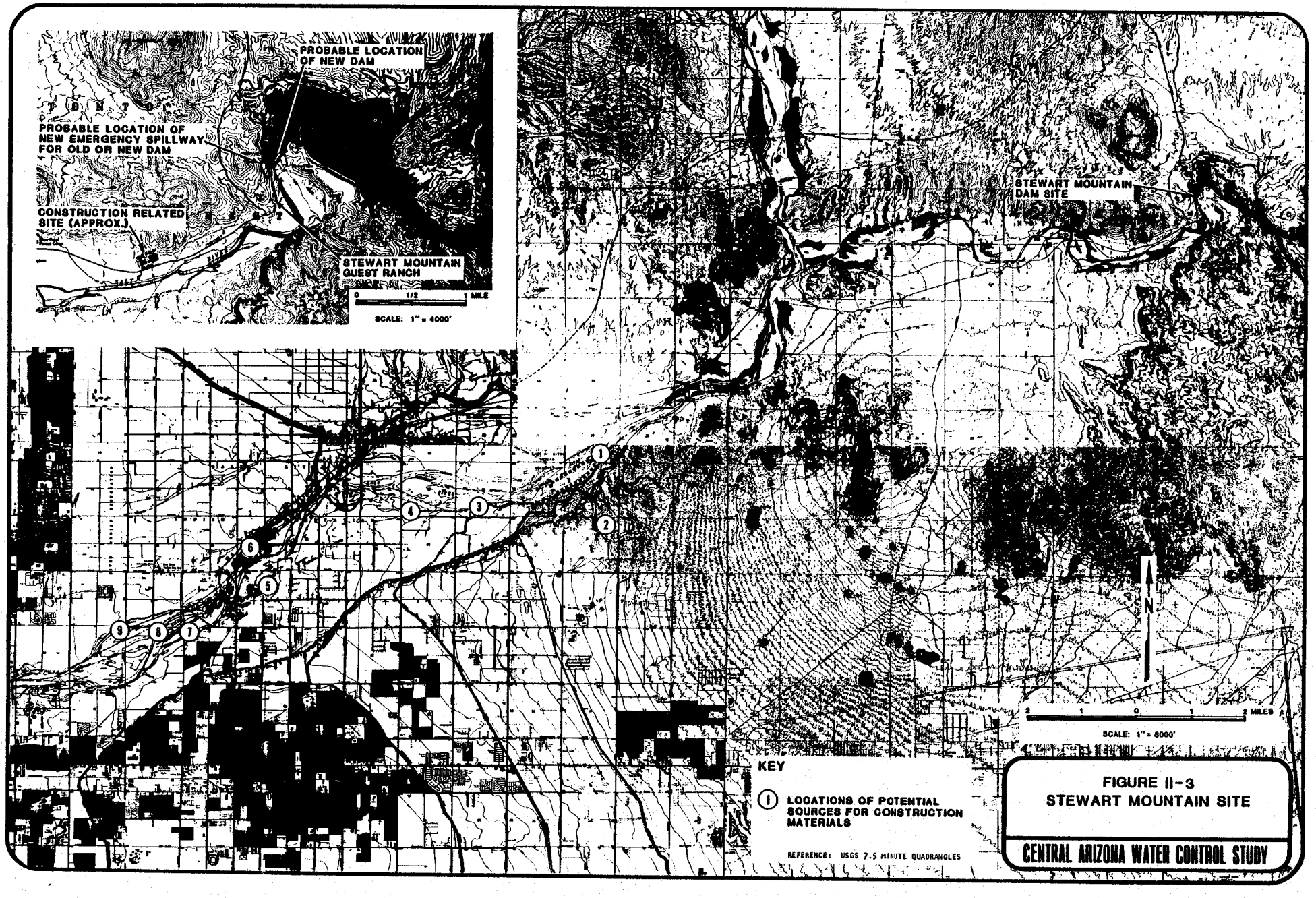

FIGURE II-3
STEWART MOUNTAIN SITE

CENTRAL ARIZONA WATER CONTROL STUDY

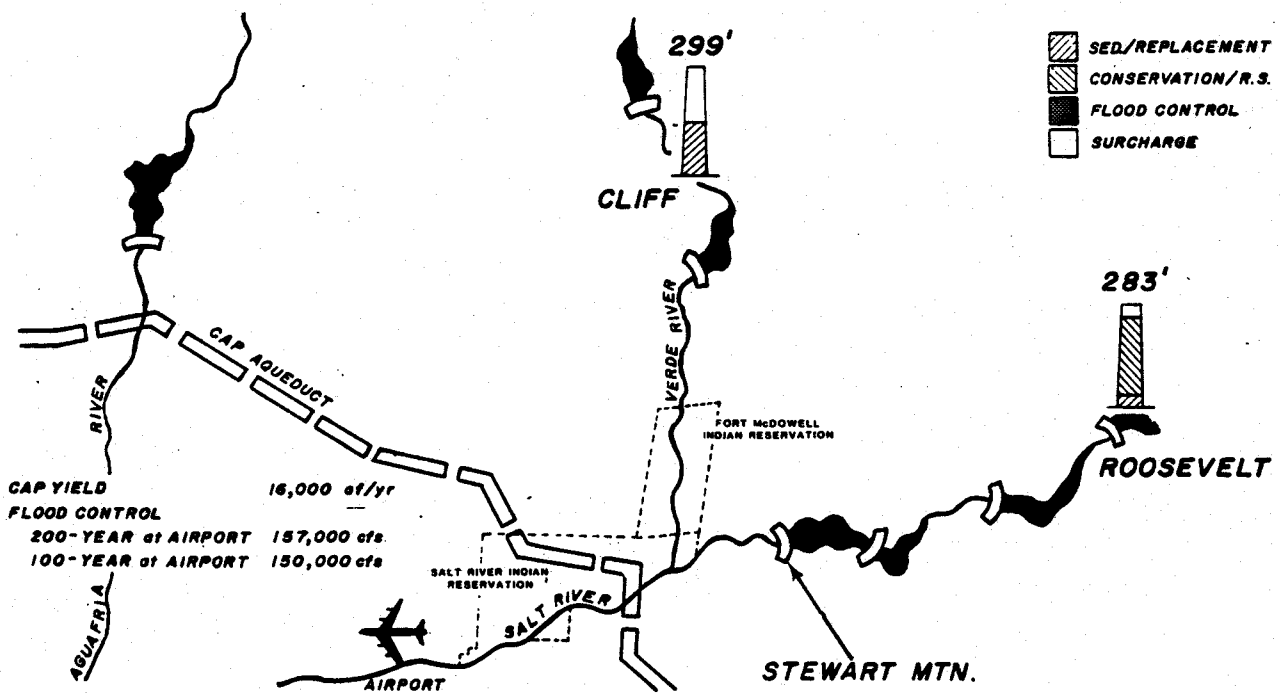

FIGURE II-4
PLAN 2
CLIFF+ROOSEVELT+
STEWART MTN. DAM+
NONSTRUCTURAL

CENTRAL ARIZONA WATER CONTROL STUDY

space) would reduce the 200-year flood to 157,000 cfs, measured at Sky Harbor Airport, and the 100-year flood to 150,000 cfs at the airport. Because of this lower level of flood control, nonstructural flood damage reduction measures may be required downstream. These measures, however, would be local actions implemented with local funds.

The hydrologic safety problems at the existing Salt and Verde River dams within the SRP system would be alleviated by the Plan 2 actions. Because this plan was developed with the objective of limiting construction and minimizing environmental and social impacts, hydropower and additional recreational facilities would not be provided, except for replacement of existing facilities. Horseshoe Dam would be breached and the storage relocated in Cliff Reservoir. An existing ranch below Horseshoe would be inundated, requiring relocation of residents. Water supply, hydropower capacity and recreation facilities at the existing Roosevelt and Stewart Mountain Dams would be maintained at the sites whether new dams are built or the existing dams are modified. If new dams are built at these sites, the existing dams would be breached. This plan would require relocation of some residents presently living near Roosevelt Lake.

Design information on the dams and related features is displayed in Table II-5. Economic characteristics of Plan 2 are shown in Table II-9.

a. Cliff Dam and Reservoir

Cliff Dam and Reservoir would be smaller than in Plan 1. The locations for the dam, spillway, reservoir area, borrow and waste areas,

TABLE II-5

DESIGN DETAILS - PLAN 2

	CLIFF
DAM STRUCTURE:	
Height	299 feet
Crest Length	2,550 feet
Embankment Volume	11,000,000 cubic yards
SPILLWAY:	(ungated)
Crest Length	125 feet
Head	44 feet
Capacity	131,000 cfs
APPURTENANT WORKS:	
Hydropower Plant	--
Pumping Plant	--
Service Outlet	4,000 cfs
Low-Level Outlets:	
Capacity at Top of Conservation	37,500 cfs
Capacity at MWS	55,000 cfs
Reversible Canal:	
Capacity	--
Length	--

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,810
Sediment	5,000	5,000	Varies	Varies
Inactive	--	--	--	--
Replacement	139,000	144,000	2,912	1,952
New Conservation	--	--	--	--
Flood Control	--	--	--	--
Surcharge	1,022,000	1,166,000	10,970	2,104
Dam Crest	--	--	--	2,109

TABLE II-5 (Continued)

	ROOSEVELT	
	New	Modified
DAM STRUCTURE:		
Height	283 feet	283 feet
Crest Length	1,230 feet	1,210 feet
Embankment Volume	310,000 cubic yards	250,000 cubic yards
SPILLWAY:		
Crest Length	200 feet	200 feet
Head	70 feet	70 feet
Capacity	150,000 cfs	150,000 cfs
APPURTENANT WORKS:		
Hydropower Plant	--	--
Pumping Plant	300 cfs	300 cfs
Service Outlet	11,000 cfs	11,000 cfs
Low-Level Outlets:		
Capacity at Top of Conservation	--	--
Capacity at MWS	--	--
Reversible Canal:		
Capacity	--	--
Length	--	--

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,902
Sediment	268,000	268,000	Varies	Varies
Inactive	--	--	--	--
Replacement	1,344,000	1,612,000	20,933	2,147
New Conservation	--	--	--	--
Flood Control	--	--	--	--
Surcharge	926,000	2,538,000	27,391	2,185
Dam Crest	--	--	--	2,185

STEWART MOUNTAIN

Same as Plan 1

construction staging areas, roads, and pool levels are shown on the plate entitled "Cliff Site - Plan 2" in the map pocket at the end of the document.

In Plan 2, Cliff Dam would be an earthfill structure with water supply and flood outlets. All releases would be to the Verde River channel.

No Conceptual Recreation Plan has been developed for this safety of dams element. Affected recreation facilities in the site area would be replaced in-kind.

(1) Cliff Dam Water Supply Operation

Since no new conservation space for CAP water would be provided at Cliff, the dam would be operated in the same manner as Horseshoe Dam has been operated. Typical-year fluctuation would be 70 feet.

(2) Cliff Dam Flood Operation and Safety of Dams

Under flood conditions, once the conservation storage pool is full, incoming floodwaters would be released through the low-level outlets. Outflow would equal inflow up to the capacity of the outlets (37,500 cfs). Should inflow exceed outflow long enough to begin to fill the surcharge pool, releases would begin over the spillway. Releases would continue over the spillway and through the outlets until the surcharge pool was emptied. The maximum combined releases from the Cliff Dam outlets and spillway could be safely passed at Bartlett Dam.

b. New/Modified Roosevelt Dam and Reservoir

For this plan, the New or Modified Roosevelt Dam would be smaller than in Plan 1. The dam, spillway, reservoir area, power transmission facilities, borrow and waste areas, construction staging areas, roads, and pool levels (except typical-year) are shown on the plate entitled "Roosevelt Site - Plan 2" at the end of the document.

With Plan 2, no Conceptual Recreation Plan has been developed for this safety of dams element. Affected recreation facilities would be replaced in-kind.

(1) Roosevelt Dam Water Supply Operation

Although no new conservation space would be provided in Roosevelt Lake, dual use of the sediment space during the life of the project would permit development of approximately 16,000 af/yr of Salt River water. As described in Plan 1, there would be no direct connection between the CAP Granite Reef Aqueduct and Roosevelt Lake (see Figure II-2). Roosevelt Dam and Reservoir would be operated in the same way that the existing dam and reservoir have been operated.

(2) Roosevelt Dam Flood Operation and Safety of Dams

Under flood conditions, once the conservation storage pool is full, floodwaters would be detained in the surcharge pool and released through the spillway at a maximum release of 92,000 cfs, a flow which could safely be passed by the downstream structures.

c. New/Modified Stewart Mountain Dam

This element would be the same as described in Plan 1 and shown on Figure II-3.

4. Plan 3: Confluence + Cliff + Roosevelt + Stewart Mountain Dams

In Plan 3, Cliff Dam on the Verde River and Roosevelt Dam on the Salt River would be constructed for flood control, additional water conservation, hydropower, and SOD. Confluence Dam would be constructed at the confluence of the Salt and Verde Rivers to provide CAP regulatory storage. Stewart Mountain Dam would be constructed on the Salt River for SOD only. The general location of the structures in Plan 3 is shown on Figure II-5.

This plan would provide 300,000 af of regulatory storage space in Confluence Reservoir, 170,000 af of new CAP conservation space in Cliff Reservoir, and would utilize one half of the sediment pool at Roosevelt Lake to increase CAP yield by 162,600 af/yr. Projected average annual CAP water yield for this plan is 1,168,600 af/yr.

Sufficient flood control space would be provided at Cliff and Roosevelt to control the 200-year flood to between 70,000 and 92,000 cfs at Sky Harbor Airport, and the 100-year flood to 50,000 cfs at the airport. Routing floodwaters through Confluence Reservoir may also provide some additional reduction in flows. This plan would alleviate the hydrologic safety problems at the existing Salt and Verde River dams within the SRP system.

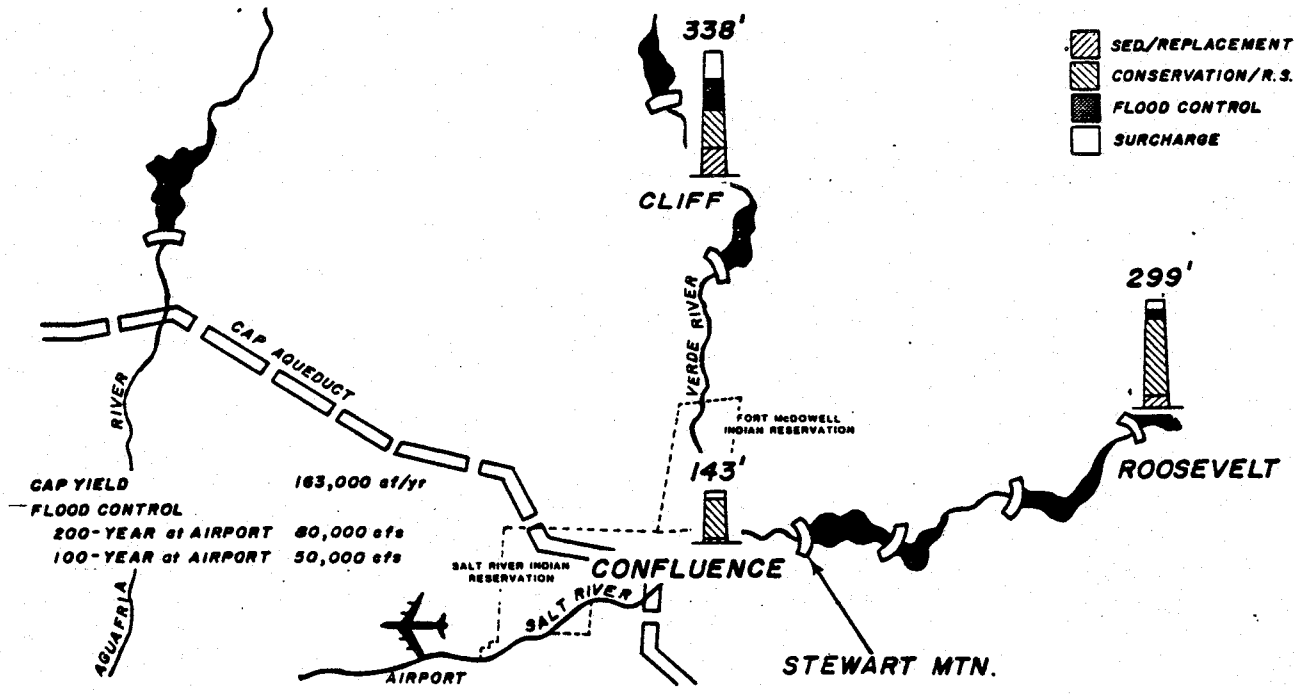

FIGURE II-5
PLAN 3
CONFLUENCE+CLIFF+
ROOSEVELT+STEWART MTN.
DAM

CENTRAL ARIZONA WATER CONTROL STUDY

This plan would also provide the potential for additional hydropower, and recreation. Cliff, Roosevelt, and Stewart Mountain Dams would be constructed as described for Plan 1. The reservoir behind Confluence Dam would inundate portions of the Fort McDowell Yavapai and Salt River Pima-Maricopa Indian Reservations, requiring relocation of people and structures. Confluence Dam would also necessitate relocation of several roads, some utilities, and construction of a new bridge over the Verde River.

Design information on the dams and related features included in Plan 3 is displayed in Table II-6. Economic characteristics of Plan 3 are shown in Table II-9.

a. Confluence Dam and Reservoir

Confluence Dam and Reservoir would be located at the confluence of the Salt and Verde Rivers, about 3.5 miles upstream of the existing Granite Reef Diversion Dam. The site area includes approximately 65,500 acres. The locations for the dam, spillway, canal, power transmission facilities, borrow and waste areas, construction staging areas, recreation sites, roads, and pool levels are shown on the plate entitled "Confluence Site - Plan 3" at the end of the document. Land required for the project, as well as necessary easements and rights-of-way, would be acquired by the federal government.

Confluence Dam would be an earthfill structure with water supply outlet works. SRP releases would be to the Salt River channel and most CAP releases would be to a new reversible canal. A minimum pool would be maintained in Confluence Reservior for fish and wildlife and recreation.

TABLE II-6

DESIGN DETAILS - PLAN 3

	CONFLUENCE
DAM STRUCTURE:	
Height	143 feet
Crest Length	4,200 feet
Embankment Volume	12,000,000 cubic yards
SPILLWAY:	(ungated)
Crest Length	520 feet
Head	26 feet
Capacity	240,000 cfs
APPURTENANT WORKS:	
Hydropower Plant	12,220 KW
Pump Generator	3,000 cfs
Service Outlet	4,700 cfs
Flood Outlet:	
Capacity in Flood Pool	--
Capacity at MWS	--
Reversible Canal:	
Capacity	3,000 cfs
Length	4 miles

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,320
Sediment	50,000	50,000	Varies	Varies
Inactive	7,000	57,000	2,731	1,378
Replacement	--	--	--	--
Regulatory Storage	300,000	357,000	8,853	1,431
Flood Control	--	--	--	--
Surcharge	279,000	636,000	12,975	1,457
Dam Crest	--	--	--	1,463

CLIFF

Same as Plan 1

ROOSEVELT

Same as Plan 1

STEWART MOUNTAIN

Same as Plan 1

A new hydropower facility would be constructed at the base of the dam. A new transmission line would connect the power plant and the pump-generation facility to the CAP power transmission system.

Recreation plans for the Confluence site have been prepared for those lands which are on the Salt River Pima-Maricopa Indian Reservation and within the boundaries of the Tonto National Forest. No new recreation facilities are included as part of this plan for the Fort McDowell Indian Reservation lands. Eight recreation sites would cover 454 acres and include picnicking, boating, camping, hiking, equestrian, and swimming facilities.

(1) Confluence Dam Water Supply Operation

The regulatory storage pool would begin filling whenever the demand for CAP water is less than the flow in the Granite Reef Aqueduct. The regulatory storage pool would contain the most water in the late spring, and would be nearly empty from late summer to late fall when it starts filling again. Typical-year fluctuation would be 46 feet.

CAP water would be delivered to and returned from the reservoir through a new 4-mile-long reversible canal, at an approximate elevation of 1,494 feet. Since this elevation is higher than the top of the regulatory storage pool, the water would flow from the Granite Reef Aqueduct through a pump-generation facility before it enters the regulatory storage pool of the reservoir. The pump-generation facility would produce electrical power as water is placed into the regulatory storage pool. When CAP water from the regulatory storage pool is returned to the aqueduct, the pump-

generation facility would be used to pump the water from the reservoir into the reversible canal, where it would flow back to the aqueduct.

SRP requirements would be met by releasing the required water into the river channel, from which the water would then be diverted into the Arizona and Southern Canals at the Granite Reef Diversion Dam.

(2) Confluence Dam Flood Operation

When flooding occurs, normal operations would change because Confluence Reservoir would not have space allocated for flood control. Pumping of CAP water would be halted, and, when the regulatory storage pool was filled with the inflowing floodwaters, the water supply outlets would be opened as long as the inflow continued. If the surface of the reservoir rose high enough, water would flow over an ungated spillway to the Salt River channel.

b. Cliff Dam and Reservoir

Cliff Dam and Reservoir would be as described in Plan 1, except that the typical-year low and high pools would be different, as shown on the plate entitled "Cliff Site - Plans 3 and 6" at the end of the document.

(1) Cliff Dam Water Supply Operation

Cliff Dam would be operated for water supply similar to that described under Plan 1. However, in Plan 3, no water exchanges would occur, and water captured in the new conservation space at the Cliff Reservoir would be delivered to Confluence Reservoir from which it could be

pumped to the Granite Reef Aqueduct. Typical-year water fluctuations would also differ from those in Plan 1 and would be 130 feet.

(2) Cliff Dam Flood Control Operation

Flood control operations at Cliff would be as described in Plan 1.

c. New/Modified Roosevelt Dam and Reservoir

Roosevelt Dam would be as described in Plan 1 and as shown on the plate entitled "Roosevelt Site - Plans 1, 3, 6, 7".

(1) Roosevelt Dam Water Supply Operation

Water supply operations at Roosevelt Dam would be similar to that described under Plan 1. However, no water exchanges would occur, and water yield from new conservation space, provided by dual use of the sediment space for water storage, would be delivered to Confluence Reservoir from which it could be pumped to the CAP aqueduct.

(2) Roosevelt Dam Flood Control Operation

Roosevelt Dam would be operated for flood control as described in Plan 1.

d. New/Modified Stewart Mountain Dam

Stewart Mountain Dam would be as described in Plan 1 and shown on Figure II-3.

5. Plan 6 (Agency-Proposed Action): New Waddell + Cliff + Roosevelt + Stewart Mountain Dams

In this plan, Cliff Dam on the Verde River and Roosevelt Dam on the Salt River would be constructed for flood control, additional water conservation, hydropower, and SOD. New Waddell Dam on the Agua Fria River would be constructed for regulatory storage purposes and would provide incidental flood control. Stewart Mountain Dam on the Salt River would be replaced or modified for SOD only. The general location of the structures is shown on Figure II-6.

This plan would provide 660,000 af of regulatory storage space at New Waddell Reservoir, 200,000 af of new conservation space at Cliff Reservoir, and would use one half of the sediment pool at Roosevelt Lake to increase CAP yield by 142,500 af/year. Projected average annual CAP water yield for this plan is 1,176,900 af/yr.

Sufficient flood control space would be provided to control the 200-year Salt/Verde River flood event to a flow of 92,000 cfs at Sky Harbor Airport, and the 100-year event to 55,000 cfs at the airport. This plan would also alleviate the hydrologic safety problems at the existing Salt and Verde River dams within the SRP system, and would provide the potential for additional hydropower and recreation.

Cliff, Roosevelt, and Stewart Mountain Dams would be as described in Plan 1. Water storage capacity and recreation facilities at existing Waddell Dam would be replaced in the new reservoir.

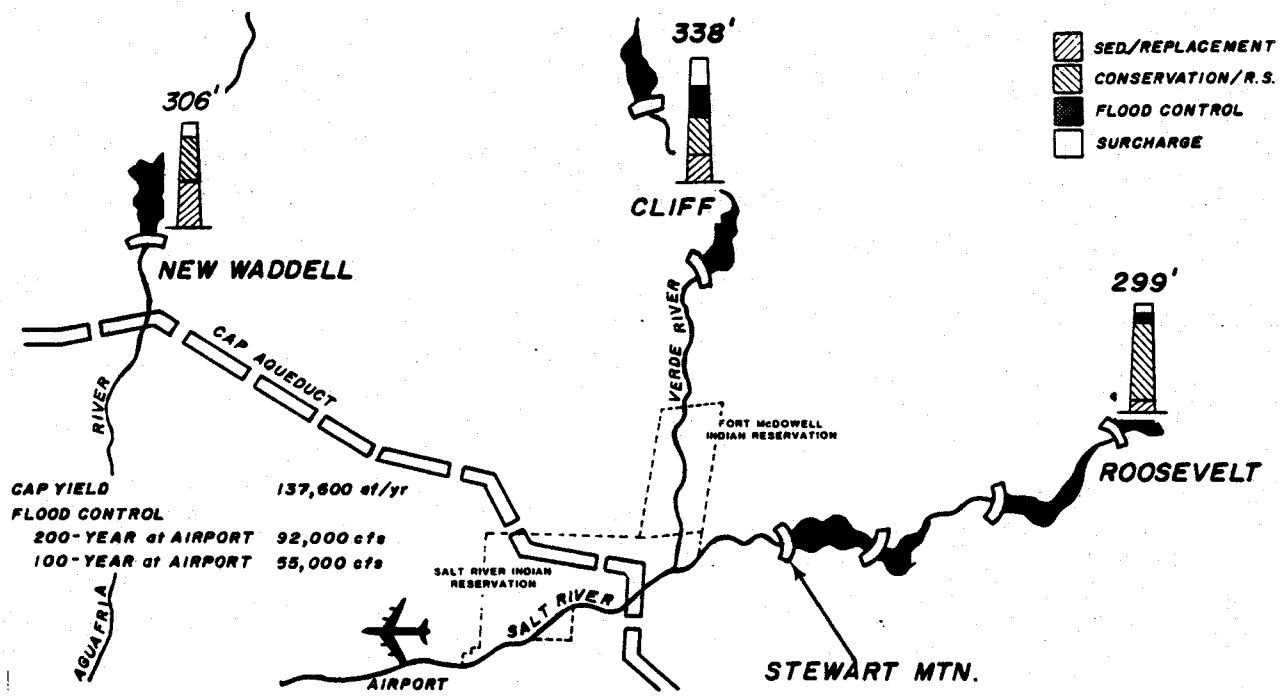

FIGURE II-6
PLAN 6
NEW WADDELL+CLIFF+
ROOSEVELT+STEWART MTN.
DAM

CENTRAL ARIZONA WATER CONTROL STUDY

Design information on the dams and related features included in this plan is displayed in Table II-7. Economic characteristics of Plan 6 are shown in Table II-9.

a. New Waddell Dam and Reservoir

The New Waddell Dam would be located approximately one-quarter mile downstream from the existing Waddell Dam within the Lake Pleasant Regional Park. The site area includes 41,080 acres. The dam, spillway, reservoir area, canal, pump station, and transmission facilities, as well as roads, borrow aeas, areas for other construction-related activities, recreation sites, and pool levels are shown on the plate entitled "New Waddell Site - Plans 6 and 7" at the end of the document. Typical-year pools are not shown; the typical-year low pool is below the current water level of Lake Pleasant, and the typical-year high pool is nearly the same as the MSP level shown on the plate. Lands, necessary easements, and rights-of-way for the project would be acquired by the federal government.

New Waddell Dam would be an earthfill structure, with an ungated spillway. Discharges from the spillway would be to the Agua Fria River channel. Incidental flood control would be provided through the operation of the conservation pool.

Two water supply outlet works would be part of the dam. Maricopa County Municipal Water Conservation District #1 (MCMWCD#1) presently uses water storage in Lake Pleasant. One service outlet would be required for MCMWCD#1 releases to Lower Lake Pleasant for diversion into the existing

TABLE II-7

DESIGN DETAILS - PLAN 6

	NEW WADDELL
DAM STRUCTURE:	
Height	306 feet
Crest Length	5,000 feet
Embankment Volume	24,000,000 cubic yards
SPILLWAY:	
Crest Length	500 feet
Head	26 feet
Capacity	250,000 cfs
APPURTENANT WORKS:	
Pump Generator	3,000 cfs
Hydropower Plant	--
Service Outlet	600 cfs
Flood Outlet:	
Capacity in Flood Pool	--
Capacity at MWS	--
Reversible Canal:	
Capacity	3,000 cfs
Length	5 miles

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,430
Sediment	68,800	68,800	Varies	Varies
Inactive	5,000	73,800	2,298	1,566
Replacement	157,600	231,400	4,692	1,611
Regulatory Storage	660,000	891,400	10,238	1,702
Flood Control	--	--	--	--
Surcharge	297,200	1,188,600	12,680	1,728
Dam Crest	--	--	--	1,736

CLIFF

Same as Plan 1

ROOSEVELT

Same as Plan 1

STEWART MOUNTAIN

Same as Plan 1

Beardsley Canal, and a direct connection to the Granite Reef Aqueduct would be constructed to deliver CAP water into and out of the new reservoir.

A minimum pool would be provided for fisheries and recreation.

Four recreation sites are proposed for New Waddell Dam. These include a total of 270 acres and are all located on the west side of the reservoir.

(1) New Waddell Dam Water Supply Operation

The regulatory storage pool would allow the maximum pumping of Colorado River water through the Granite Reef Aqueduct to New Waddell Dam over the six-month winter season (October to March). The regulatory storage pool would be filling during this period at the aqueduct capacity of 3,000 cfs less the amount being delivered from the system for water demands. During the remainder of the year, CAP would release water from the regulatory storage pool to supplement the aqueduct flow being imported at a low, uniform rate. Typical-year fluctuation would be 123 feet.

A 25,600-foot-long reversible canal with a capacity of 3,000 cfs would be constructed with a pumped generation facility to deliver CAP water into and out of the new reservoir. Diversions from the Granite Reef Aqueduct would be made into the reversible canal from which the water would be pumped into the reservoir at the pump station. CAP diversions from the reservoir back into the Granite Reef Aqueduct would be made through the pumped generation facility and reversible canal, producing power. The canal

would be located on the east side of the Agua Fria River. The pumped generation station would be located near the left abutment of the dam. Approximately 1.5 miles of transmission line would be required to connect the pumped generation station to existing transmission lines.

Delivery of water to MCMWCD#1 would be into the Beardsley Canal, via Lower Lake Pleasant, as is currently done.

(2) New Waddell Dam Flood Operation

New Waddell Reservoir will not have space allocated for flood control. Normal operations would call for storage of all inflows up to the limits of available capacity, providing incidental flood control. Spillway flow would begin when the reservoir was full and outflow would equal inflow until the water level was back down to the spillway crest elevation of 1,702 feet. Spillway flows would be released to the Agua Fria River through Morgan City Wash.

b. Cliff Dam and Reservoir

Cliff Dam and Reservoir would be as described in Plan 1 and as shown on the "Cliff Site - Plans 3 and 6" plate, except there would be no water exchanges. The typical-year fluctuation would be 48 feet.

c. New/Modified Roosevelt Dam and Reservoir

The Roosevelt Dam would be the same as in Plan 1 and as shown on the "Roosevlet Site - Plans 1, 3, 6, 7" plate, except there would be no water exchanges.

d. New/Modified Stewart Mountain Dam

Stewart Mountain Dam would be as described in Plan 1 and shown on Figure II-3.

6. Plan 7: New Waddell + Cliff + Roosevelt + Stewart Mountain Dams (environmental enhancement)

This plan is the same as Plan 6, except 1.) water would be made available to maintain minimum flows (enough water to sustain fish populations) in the Salt River between Stewart Mountain and Granite Reef Diversion Dams and in the Verde River below Bartlett Dam, and 2.) water would also be made available to provide the potential for recreation and fish and wildlife enhancement on the Salt River through the Phoenix area by providing approximately 30,000 af of water for the proposed Rio Salado development. The method of delivery of this Rio Salado water from the CAP system is yet to be determined.

This plan provides for a minimum pool of 10,000 af to be maintained at Cliff Reservoir for fish and wildlife and recreation purposes. Typical-year fluctuation would be 39 feet. This is shown on the plate entitled "Cliff Site - Plan 7" at the end of the document.

Design information on the dams and related features in Plan 7 is displayed on Table II-8. Economic characteristics of Plan 7 are shown on Table II-9.

TABLE II-8

DESIGN DETAILS - PLAN 7

	CLIFF
DAM STRUCTURE:	
Height	338 feet
Crest Length	2,900 feet
Embankment Volume	15,000,000 cubic yards
SPILLWAY:	(ungated)
Crest Length	125 feet
Head	47 feet
Capacity	150,000 cfs
APPURTENANT WORKS:	
Pumping Plant (for combined Cliff and Roosevelt)	1,000 cfs
Service Outlet	4,000 cfs
Flood Outlet:	
Capacity in Flood Pool	25,000 cfs
Capacity at MWS	36,000 cfs

STORAGE ALLOCATION:

	Increased Storage (af)	Total Storage (af)	Surface Area (acres)	Elevation (feet)
Conservation:				
Streambed	0	0	0	1,810
Sediment	41,300	41,300	Varies	Varies
Inactive	10,000	51,300	1,443	1,909
Replacement	131,400	182,700	3,472	1,965
New Conservation	170,000	352,700	5,421	2,003
Flood Control	445,000	797,700	8,773	2,067
Surcharge	851,000	1,648,700	14,246	2,143
Dam Crest	--	--	--	2,148

NEW WADDELL

Same as PLan 6

ROOSEVELT

Same as Plan 1

STEWART MOUNTAIN

Same as Plan 1

C. Comparative Analysis of Alternatives

1. Economic Costs and Benefits of Plans

The economic characteristics of the six alternative plans are shown on Table II-9.

2. Environmental Impacts and Effects

A comparative display of environmental consequences of all candidate plans, including the agency proposed action, is shown on Table II-10. The environmental factors shown in the table have been identified by the Bureau of Reclamation through the scoping process as significant issues to be addressed in the EIS. Other factors, such as air quality, visual quality, noise, effects on future and existing land use, and geological resources, were also assessed in the evaluation of plans. These factors were determined not to be significant environmental issues and, therefore, are not included in this comparative table. They are, however, described later in the EIS.

Issues are grouped by major categories. The factors listed under each issue are those used to measure the impact. Impacts are the measured difference between the future-without and future-with-the-project conditions. Effects are the interpretation of the significance of the impacts. Mitigation (action to reduce or eliminate environmental and social impacts) recommendations are also shown. The unmitigated and mitigated effects are displayed as:

- Insignificant (I): a small change, or one involving a low-quality resource

- Significant Beneficial (SB): major improvement in a condition, usually long-term and affecting high-quality resources
- Significant Adverse (SA): major degradation of a condition, usually long-term and affecting high-quality resources
- Beneficial Flag (BF): extraordinary beneficial change in a unique, protected, or very high-quality resource
- Adverse Flag (AF): extraordinary adverse change in a unique, protected, or very high-quality resource

Environmental impacts are generally quantified as a range--from losses or gains associated with construction and typical-year inundation, to losses and gains associated with IDF inundation. The range is expressed by two numbers separated by a slash (i.e., -1/-21). Further discussion of the methodology and of the impacts and effects of plans is found in Chapter IV.

TABLE II-9

ECONOMIC COSTS AND BENEFITS OF PLANS

Plan Options	Total Construction Cost[a,b] ($)	Total Annual Cost[a,c] ($)	Total Annual Benefits[a] ($)	Net Economic Benefits[a] ($)
Plan 1				
Cliff + Modified Roosevelt + Modified Stewart Mountain	694,940,000	58,060,000	89,040,000	30,980,000
Cliff + New Roosevelt + New Stewart Mountain	874,230,000	71,300,000	89,040,000	17,740,000
Cliff + New Roosevelt + Modified Stewart Mountain	788,340,000	69,960,000	89,040,000	24,080,000
Cliff + Modified Roosevelt + New Stewart Mountain	780,830,000	64,400,000	89,040,000	24,640,000
Plan 2				
Cliff + Modified Roosevelt + Modified Stewart Mountain	541,570,000	41,870,000	53,310,000	11,440,000
Cliff + New Roosevelt + New Stewart Mountain	713,840,000	54,590,000	53,310,000	- 1,280,000
Cliff + New Roosevelt + Modified Stewart Mountain	627,950,000	48,250,000	53,310,000	5,060,000
Cliff + Modified Roosevelt + New Stewart Mountain	627,460,000	48,210,000	53,310,000	5,100,000
Plan 3				
Confluence + Cliff + Modified Roosevelt + Modified Stewart Mountain	1,116,250,000	93,970,000	125,970,000	32,000,000
Confluence + Cliff + New Roosevelt + New Stewart Mountain	1,295,540,000	107,200,000	125,970,000	18,770,000
Confluence + Cliff + New Roosevelt + Modified Stewart Mountain	1,209,650,000	100,860,000	125,970,000	25,110,000
Confluence + Cliff + Modified Roosevelt + New Stewart Mountain	1,202,140,000	100,310,000	125,970,000	25,660,000
Plan 6				
New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain	978,430,000	82,710,000	174,290,000	91,580,000
New Waddell + Cliff + New Roosevelt + New Stewart Mountain	1,157,720,000	85,450,000	174,290,000	78,350,000
New Waddell + Cliff + New Roosevelt + Modified Stewart Mountain	1,071,830,000	89,600,000	174,290,000	84,690,000
New Waddell + Cliff + Modified Roosevelt + New Stewart Mountain	1,064,320,000	89,050,000	174,290,000	85,240,000
Plan 7				
New Waddell + Cliff + Modified Roosevelt + Modified Stewart Mountain	978,430,000	82,710,000	168,160,000	85,450,000
New Waddell + Cliff + New Roosevelt + New Stewart Mountain	1,157,720,000	95,940,000	168,160,000	72,220,000
New Waddell + Cliff + New Roosevelt + Modified Stewart Mountain	1,071,830,000	89,600,000	168,160,000	78,560,000
New Waddell + Cliff + Modified Roosevelt + New Stewart Mountain	1,064,320,000	89,050,000	168,160,000	79,110,000

[a]Costs and benefits are shown in January 1982 dollars. Annual equivalents are calculated at 7 3/8%.
[b]Includes interest during construction (IDC).
[c]Includes operation, maintenance, and replacements costs (OM&R).
Source: Economics Supporting Document, USBR, 1982.

Table II-10

COMPARATIVE EVALUATION OF PLANS

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
BIOLOGICAL RESOURCES[a]						
Threatened/Endangered Plants and Wildlife						
Loss of acres of preferred habitat in typical year (bald eagle in all plans and Yuma clapper rail in Plan 3)	+300 (2,260 acres in site areas)	-390	-350	-850	-290	-340
Number of bald eagle breeding areas with disrupted productivity	0 (5 breeding areas in site areas of which 3 most productive are at Confluence; 6 breeding areas in CAWCS area; 13 breeding areas in southwestern U.S.)	1	1	3	1	1
Typical Year Unmitigated/ Mitigated Effect		SA/I	SA/I	AF/AF	SA/I	SA/I
Riparian/Wetland Biotic Communities						
Loss or gain of acres of habitat in typical year	-2,350 (11,910) acres in site ares)	-290	-270	-2480	-270	-40
Typical Year Unmitigated/ Mitigated Effect		SA/SA	SA/SA	AF/AF	SA/I	SA/SA

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
BIOLOGICAL RESOURCES Cont'd						
Perennial Stream/ Riverine Communities						
Loss of miles of perennial stream in typical year	0 (68 miles in site areas; 137 miles in CAWCS area)	-3	+1	-16	+1	-2
Change in flow characteristics of Salt and Verde Rivers	No change (on average, 106 days/ year ≤ 50 cfs in Salt, 61 days/year ≤ 50 cfs in Verde)	No change	No change	No change	No change	Guaranteed minimum flows of 200 cfs in Salt and Verde
Typical Year Unmitigated/ Mitigated Effect		I/I	I/I	AF/AF	I/I	SB/SB
Reservoir Aquatic Communities						
Gain or loss of surface acres of habitat in typical year	0 (13,640 acres in site areas; 30,000 acres in CAWCS area)	+400	-360	+3,080	+1,900	+3,690
Gain of guaranteed minimum pool(s)	0 (no guaranteed minimum pools at SRP lakes or Lake Pleasant)	0	0	+1 minimum pool at Confluence	+1 minimum pool at New Waddell	+2 minimum pools at Cliff and New Waddell
Drawdown rates greater than 2 inches/day during spawning season	No change (drawdown rates 1.3 in/day at Roosevelt, 9.2 in/day at Horseshoe, 1.6 in/day at Lake Pleasant)	> 2 in/day at Cliff	> 2 in/day at Cliff	> 2 in/day at Cliff and Confluence	> 2 in/day at Cliff and New Waddell	> 2 in/day at Cliff and New Waddell
Typical Year Unmitigated/ Mitigated Effect		I/SB	I/SB	SA/SB	SA/SB	SA/BF

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
WATER QUALITY[a]						
Constituents	CAP water in local systems at locations and times chosen by users. Local surface water sources maintain quality independent of CAP influence	Average of 70,000 af of SRP (Verde River) water exchanged w/CAP each year Comparison of Water Sources (mg/l) D Ca 42.5 / 85.0 T Fe 0.192 / 0.159 T Hard 212. / 339. D Mg 25.7 / 30.8 D Na 30.5 / 107. D Pb 0.00300 / 0.00144 T Pb 0.0714 / 0.0408 D SO_4 52.9 / 309. TDS 314. / 722. After-exchange maximum concentrations reach new highs for numerous constituents. Degradation of some SRP water during period when only Verde River water is normally delivered. Possible short-term impacts to M&I and agricultural users. Short exchange period affects only 8% of SRP surface water	No change from future-without condition	Annual average of 845,000 af of SRP surface water mixed with 250,000 af of CAP water at Confluence site. 30-35% of SRP water treated for M&I use Changes in Average Verde River Concentrations (mg/l) D Ca 42.5 to 61.1 (+44%) T Fe 0.192 to 0.178 (-7%) T Hard 212. to 268. (+26%) D Mg 25.7 to 27.9 (+9%) D Na 30.5 to 64.0 (+110%) D Pb 0.00300 to 0.00232 (-23%) T Pb 0.0714 to 0.0580 (-19%) D SO_4 52.9 to 165. (+212%) TDS 314. to 493. (+57%) After-mix maximum SRP concentrations reach new highs for numerous constituents. All of SRP surface water degraded and possible increased M&I treatment costs with short-term maximum CAP concentrations. Possible changes in agricultural operation only during period when Verde River water is normally delivered	Annual average of 25,000 af of MCMWCD#1 surface water mixed with 701,800 af of CAP water at Waddell site. None of the MCMWCD#1 water treated for M&I uses Changes in Average MCMWCD#1 Concentrations (mg/l) D Ca 50.8 to 83.8 (+65%) T Fe 2.04 to 0.223 (-89%) T Hard 215. to 335. (+56%) D Mg 21.8 to 30.5 (+40%) D Na 37.8 to 105. (+178%) D Pb 0.00200 to 0.00146 (-27%) T Pb 0.00425 to 0.0396 (+832%) D SO_4 85.0 to 301. (+254%) T DS 358. to 710. (+98%) After-mix maximum MCMWCD#1 concentrations reach new highs for numerous constituents with no significant effect on agricultural users	
Typical Year Unmitigated/ Mitigated Effect		I/I	No effect	SA/SA	I/I	I/I

Note: Prefix D means dissolved fraction while T means total recoverable. T SO_4 was used for CAP water to estimate impacts. All values shown rounded to three significant figures. Constituents shown on this table were selected to show some significant impacts; a more complete list of constituents and their impacts is included in Chapter IV.

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
WATER QUALITY Cont'd						
Eutrophication						
Potential for eutrophic conditions to occur	Low potential for SRP and MCMWCD#1 water. High organics in CAP water may produce trihalomethane in existing water treatment plants which receive CAP water	No eutrophication problems caused by project implementation. Increased potential for trihalomethane production at existing treatment plants served by SRP during exchange period	No eutrophication problems caused by project implementation	Confluence Reservoir has high potential for eutrophication with high probability for blue-green algal dominance. Probable aesthetic impacts on Verde arm in most years. Increased potential for trihalomethane production at water treatment plants served by SRP	New Waddell Reservoir has low to moderate potential for eutrophication with no projected problems	
Typical Year Unmitigated/ Mitigated Effect		I/I	No Effect	SA/I	I/I	I/I

Note: Eutrophication potentials were computed using the Canfield and Bachman equations described in the USBR Technical Memorandum titled "Guidelines for Studies of Potential Eutrophication" Denver, CO, 1981. Risk of eutrophication under normal operating conditions is based on phosphorus concentration which is assumed uniform over the studied area. Reservoir surface area and depth contribute but are not directly involved in calculation of risk.

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
CULTURAL RESOURCES[a]						
Prehistoric Cultural Resources						
Number of sites destroyed by construction activities/total number of sites potentially affected in dam site areas	0 (3,350 sites in site areas)	130/2,949	70/2,949	154/3,212		156/3,087
Acres of archaeological deposits affected	0 (12,027 acres of deposits in site areas)	4,141	4,141	11,884		4,284
Effects Factor (for total sites affected)		-5,585	-4,538	-14,048		-5,846
Unmitigated/ Mitigated Effect		AF/AF	AF/AF	AF/AF		AF/AF
Historic Cultural Resources						
Total Number of Sites		103	103	177		118
Number of sites destroyed by construction and related activities/ total number of sites potentially affected in dam site areas	0 (192 sites in site areas)	29/64	29/64	73/90		39/74
Effects Factor (Range)		-173 to -320	-173 to -370	-438 to -798		-225 to -422
Unmitigated/ Mitigated Effect		AF/AF	AF/AF	AF/AF		AF/AF

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
RECREATION[a]						
Stream-Oriented Recreation						
Net loss of miles of perennial stream/ loss of tubing miles in typical year	0/0 (68 stream miles in site areas; 986 miles in 5-county region)	-3/0	+1/0	-16/17	+1/0	-2/0
Net loss or gain in maximum annual recreation days for stream-oriented activities in typical year	0/0 (2,280,000 stream-oriented recreation days in site areas; 8,236,000 in 5-county region)	+10,475	+696	-1,500,177	+12,617	+11,011
Typical Year Unmitigated/ Mitigated Effect		I/I	I/I	AF/AF	I/I	I/I
Reservoir-Oriented Recreation						
Net loss or gain in usable surface acres in typical year	0 (16,600 acres in site areas; 35,000 in 5-county region)	+683	-853	+5,243	+4,222	+5,095
Net loss or gain in maximum annual recreation days for reservoir-oriented activities in typical year	0 (822,000 reservoir-oriented recreation days in site areas; 6,479,000 for 5-county region)	+670,520	-48,647	+3,537,383	+986,860	+1,006,728
Typical Year Unmitigated Effect		SB	I	SB	SB	BF

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
SOCIAL IMPACTS[b]						
Indian Relocations (Fort McDowell Indian Community)						
Changes affecting individuals	1. Normal mortality and illness rates 2. High levels of personal autonomy 3. High satisfaction with way of life 4. High potential for increased financial self-sufficiency	No change from future-without condition		1. Substantial increase in illness and mortality rates 2. Extreme decline in levels of personal autonomy 3. Extreme decrease in satisfaction with way of life 4. Substantial decrease in potential for sustained financial self-sufficiency	No change from future-without condition	
Changes affecting families and small groups	1. High levels of extended family ties 2. Normal incidence of family problems	No change from future-without condition		1. Substantial decrease in extended family ties 2. Substantial increase in incidencew of family problems	No change from future-without condition	
Changes affecting the community	1. High community cohesion and viability 2. High potential for increased tribal economic self-sufficiency; moderate levels of unemployment 3. High potential for sustaining Yavapai culture	No change from future-without condition		1. Extreme decrease in community cohesion and viability 2. Substantial decreae in potential for tribal economic self-sufficiency; substantial increase in unemployment 3. Extreme decrease in potential to sustain Yavapai culture	No change from future-without condition	
Number of people relocated	0 (374 people in community)	0	0	290	0	0
Unmitigated/ Mitigated Effect		No Effect	No Effect	AF/AF	No Effect	No Effect

Table II-10 (Continued)

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
SOCIAL IMPACTS Con't						
Non-Indian Relocations (Roosevelt Lake)						
Changes affecting individuals	1. Normal mortality and illness rates 2. High levels of personal autonomy 3. High satisfaction with way of life 4. High potential for financial self-sufficiency	---------- 1. Slight increase in mortality rates and increased illness rates 2. Substantial decrease in personal autonomy 3. Substantial decrease in satisfaction with way of life 4. Moderately reduced financial capacity				----------
Changes affecting families and small groups	1. Low levels of informal support networks in all communities except Roosevelt Gardens at Roosevelt Gardens	1. Moderate decrease in informal support networks	1. Slight decrease in informal support networks	----------	1. Moderate decrease in informal support networks. Slight decrease in informal interactions between familial households	----------
Changes affecting the community	1. Low to moderate community cohesion in all communities except Roosevelt Gardens 2. Community development likely to remain at present low level	1. Moderate decrease in community cohesion 2. Substantial decrese in community viability	1. Slight decrease in community cohesion 2. Moderate decrease in community viability	----------	1. Moderate decrease in community cohesion and slight decrease in social organization 2. Substantial decrease in potential for sustained community viability	----------
Number of people relocated	0 (596 people in affected communities)	347	247	347	347	347
Unmitigated/ Mitigated Effect		SA/I	SA/No Effect	SA/I	SA/I	SA/I

III. AFFECTED ENVIRONMENT

III. AFFECTED ENVIRONMENT

A. Determination of Significant Resources

Scoping occurred throughout the Central Arizona Water Control Study, so that the range of alternatives and issues was progressively narrowed as the study went on. The scope of the study was finally limited to the candidate plans, and the issues were sharpened so that only the most significant ones were treated in depth. Significant issues were those recognized as being institutionally, publicly, or technically important to people.

In August 1981, a special edition of the CAWCS newsletter was published describing the candidate plans and the proposed significant issues to be discussed in detail in the EIS. The public was asked to comment on the range of alternatives and issues using a response form provided. The resulting areas of concern and factors within each issue are as follows:

Biological Resources - including impacts to endangered species, riparian wetland communities, lake communities, and perennial stream/riverine communities.

Water Quality - including changes in concentrations of constituents in local surface water mixed with CAP water and eutrophication potential in the New Waddell and Confluence reservoirs.

Cultural Resources - including impacts to prehistoric sites and artifacts and historic sites and properties which are on or are eligible for inclusion on the National Register of Historic Places.

Recreation - including changes in stream-oriented and lake-oriented recreation resources, facilities, and activities.

Social Impacts - including impacts of relocation on people living in project areas and impacts of flooding on transportation, health, and safety.

Economics - including costs, benefits, and economic justification of the candidate plans.

The affected resources related to these issues are described in detail in this chapter. Other resources judged not to be significant as a result of the scoping process are also described, but not in as much detail. These other resources are: air quality, noise, aesthetics, land use, and geology/soils.

Chapter III B describes the affected resources in the general CAWCS area. Section C describes the affected site areas (Cliff, Roosevelt, Stewart Mountain, Confluence, New Waddell, downstream). The affected site areas shown in Figure III-1 are areas around the proposed dams and reservoirs in the candidate plans. The downstream segment of the Salt and Gila Rivers from Granite Reef Dam to Gillespie Dam is also shown as a site area for impact analysis. Descriptions of affected resources are excerpted from the EIS supporting document, Second Level Environmental Inventory, CAWCS, 1982, which contains detailed descriptions of all affected resources in the CAWCS area and in affected site areas. All information in this chapter is based on the Second Level Environmental Inventory unless otherwise indicated.

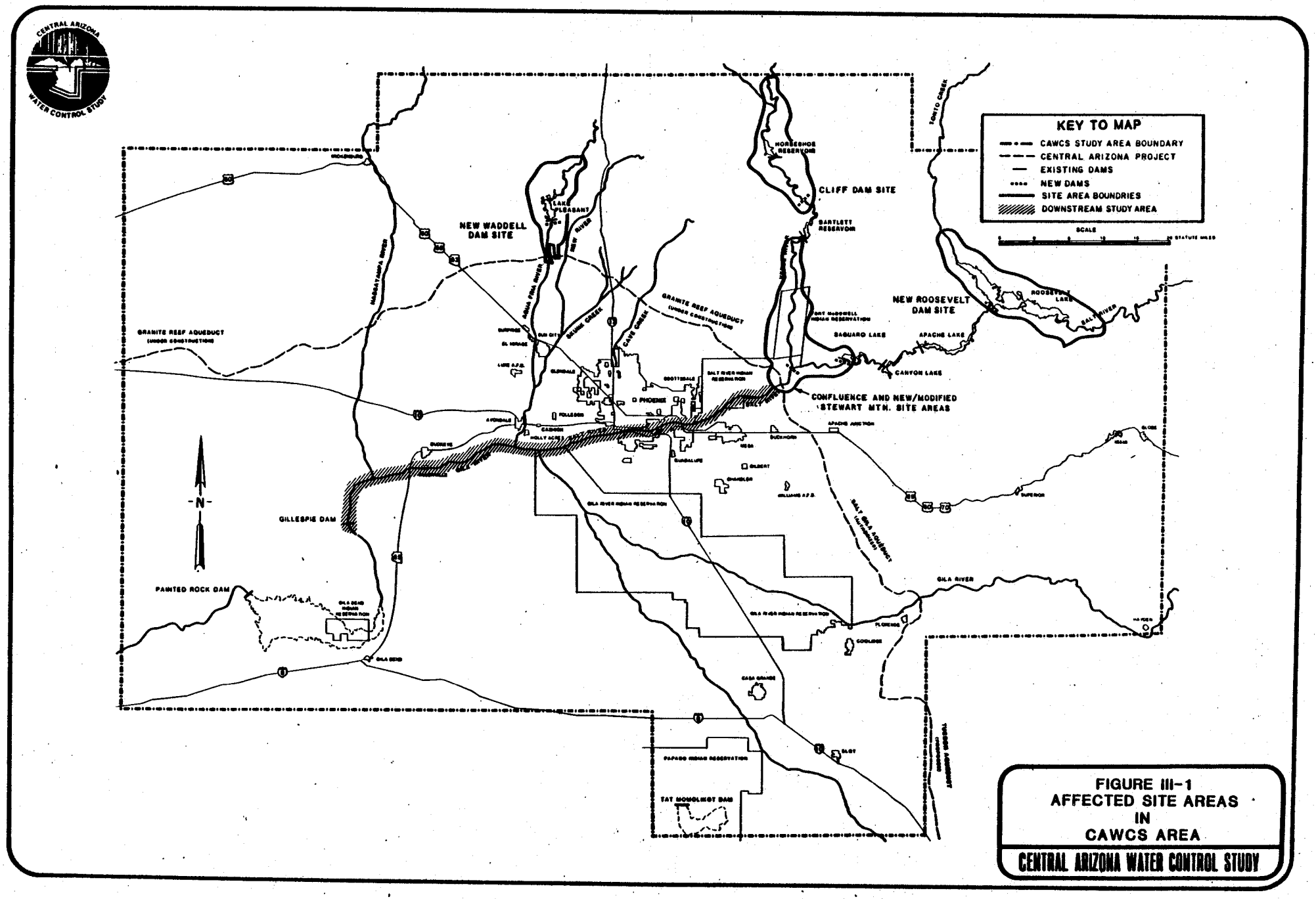

FIGURE III-1
AFFECTED SITE AREAS
IN
CAWCS AREA

CENTRAL ARIZONA WATER CONTROL STUDY

B. General Description of Area Resources

1. Significant Resources

a. Biological Resources

Within the study area there is an extreme elevation gradient of approximately 1-1/4 mile, a diverse microclimatic regime, an extensive drainage pattern, and a variety of landforms and soils. These factors contribute to diverse ecosystems, of which many biotic communities can be identified based on vegetation and associated vertebrate wildlife. The description of the biological resources focuses on the major biotic communities of the study area including their dominant flowering plants and wildlife.

Six resource factors have been identified as having the greatest importance with respect to action-related impacts:

1. Riparian/Wetland Biotic Communities
2. Other Terrestrial Biotic Communities
3. Perennial Stream/Riverine Aquatic Communities
4. Other Aquatic Communities (Lakes and Lacustrine Communities)
5. Threatened and Endangered Plants and Wildlife
6. Management and Special Use Areas

Of these, riparian/wetland communities, perennial stream/riverine communities, and threatened and endangered plants and wildlife have been identified through the scoping process as most important.

Acreage and percent range of the major biotic communities (factors 1-4 above) occurring within the CAWCS study area vary considerably, as shown in Table III-1.

The community types which occur in the CAWCS affected site areas include lake and river aquatic communities, riparian and wetland communities, and desert upland communities. The temperate upland communities occur at higher elevations within the study area, but do not occur within the site areas. Human-dominated community types are essentially urban and farmlands and are nearly absent from the site areas.

The biotic communities identified within the site areas are representative of the southwestern Sonoran Desert and are either upland desert-communities that directly rely on precipitation or are riparian and quasi-riparian communities that depend on soil moisture which is more readily available along drainages. The floral composition varies accordingly between these two community groups and lends to the conspicuous contrast of open cacti-desert shrubland and the more verdant riparian woodland and wetland life forms occurring as green vegetation corridors along washes and perennial streams.

(1) Riparian and Wetland Communities

Riparian/wetland biotic communities, although they occupy less than 1 percent of the CAWCS area, have been given high priority both in the EIS scoping process and by wildlife management agencies, mainly because they are used by numerous wildlife species including the bald eagle, black hawk, osprey, snowy egret, great egret, javelina, and raccoon.

Table III-1

ACREAGE AND PERCENT RANGE OF BIOMES AND BIOTIC SERIES IN THE STUDY AREA

Biotic Community	Acres	Percent
Temperate Uplands:		
Montane conifer forest	82,200	1.0
Pinyon-juniper series	189,000	2.2
Oak-pine series	24,700	0.3
Interior chaparral	756,100	8.8
Sonoran savanna grassland	115,000	1.3
Riparian and Wetland Communities:[a]		
Warm temperate and tropical-subtropical and riparian forests	59,000	0.7
Desert Uplands:		
Creosotebush-bursage series	2,037,000	23.7
Paloverde-mixed cacti series	3,509,000	40.9
Saltbush series	411,000	4.8
Aquatic Communities:		
Lakes, rivers, reservoirs	75,000	0.9
Human-Dominated Communities:		
Agricultural lands	1,055,000	12.3
Developed urban lands[b]	263,000	3.1
Total	8,576,000	100.0

[a]The series within riparian and wetland communities were not segregated due to scalar resolution. However, the inclusive series are elaborated in the text.

[b]Developed urban lands refer to lands modified for human occupation and may not necessarily conform to jurisdictional boundaries.

Source: Second Level Environmental Inventory, CAWCS, 1982.

The riparian-wetland biotic communities within the CAWCS study area are primarily confined to the main Gila drainage. Of the 59,000 acres of riparian/wetland community types in the CAWCS study area, the following six community types have been identified.

Mixed-broadleaf forest consists of stands of large sycamore, ash, and walnut trees intermixed with cottonwood and willow. Only about 100 acres of mixed-broadleaf forest occur in the affected site areas. Specifically all of this community occurs upstream of Horseshoe Dam along cobble and gravel alluvial benches adjacent the Verde River and perennial-flowing tributaries.

Cottonwood-willow series consisting of pure stands and intermixed stands of cottonwood and willow also occur along perennial streams. The larger stands of cottonwood-willow forest within the CAWCS study area occur at the Salt-Verde confluence, near Horseshoe Reservoir on the Verde River, near the Blue Point Ranger Station and Coon Bluff on the Salt River, and upstream of Ashurst-Hayden Dam on the Gila River.

Mesquite bosques ("river forests") are somewhat different than the mixed-broadleaf and cottonwood-willow communities. Mesquite forests generally are less than 50 feet tall and are more "acacia-like", forming rather large stands of pure mesquite to mesquite intermixed with other riparian and quasi-riparian communities including cottonwood-willow and saltcedar. The largest mesquite bosque occurs near the Salt-Verde confluence, where some 6,000 acres are found, varying from dense woodland adjacent the rivers to more open savanna adjacent the desert.

Cattail marsh represents a community type almost exclusively confined to backwater pools of the Salt-Verde-Gila Rivers and downstream of Waddell Dam. Usually this vegetation consists of pure to mixed stands of cattail and rushes in shallow waters.

Mixed scrub consists of degenerated or newly established vegetation associated with disturbed sites adjacent lakes and rivers. The vegetation composition consists of a conglomerate of seep willow, saltcedar, arrow weed, and seedling and sapling species of the aforementioned communities.

Saltcedar communities are dominated by the Asiatic exotic species, saltcedar. The saltcedar communities are the predominant woodland-shrubland habitat downstream of the Salt-Verde confluence and along the Gila River in the CAWCS area.

(2) Other Terrestrial Communities

Desert communities are the predominant communities of the study area, and represent about 69 percent of the area (Table III-1). Three upland desert communities occur within the study area. These are creosotebush-bursage, saltbush, and paloverde-mixed cacti series. The first two are open scrubland desert vegetation and occur at lower elevations than the affected site areas.

The paloverde-mixed cacti series occurs within affected site areas. This series, also referred to as the Arizona upland subdivision of the Sonoran Desert, occurs on bajadas, foothills, and steep slopes of

desert mountains at 800-3,500 foot elevations. It supports a diverse plant species complex including such trees as foothills paloverde, blue paloverde, ironwood; cacti such as saguaro, cholla, pricklypear; and shrubs such as triangle bursage, ratany, and Mormon tea.

The fauna of the paloverde-mixed cacti series is abundant and diverse and includes Gila woodpecker, cactus wren, elf owl, phainopepla, black-tailed jackrabbit, javelina, coyote, and kangaroo rat.

(3) Perennial Stream/Riverine Communities

There are 137 miles of perennial stream community in the CAWCS area. This represents about 30 percent of the original perennial rivers in the study area due to the construction of water storage dams along the Verde, Salt, Agua Fria, and Gila Rivers. Approximately 70 miles of perennial streams occur within specific site areas.

Riverine fishes include such native species as longfin dace, desert sucker, and round-tailed chub, as well as introduced species such as bass, catfish, carp, and rainbow trout.

(4) Other Aquatic Communities

Other aquatic communities are primarily represented by the approximately 35,000 surface acres in reservoirs on the Agua Fria, Verde, and Salt Rivers. Introduced game species dominate the fish fauna within these impoundments. Largemouth and smallmouth bass, black crappie, threadfin shad, channel catfish, and sunfish are all common in reservoirs along the

rivers. The success of these species is somewhat compromised by fluctuating lake levels resulting from operation of these reservoirs.

(5) Threatened and Endangered Plants and Wildlife

Descriptions of threatened and endangered species occurring in the CAWCS study area are excerpted from the EIS supporting document, Preliminary Draft Biological Assessment, CAWCS, 1982.

The U.S. Fish and Wildlife Service, through Section 7 of the Endangered Species Act, has issued a list of proposed and designated threatened and endangered species that are known to occur in or whose ranges overlap the study area. Two endangered plant species and four endangered vertebrates which are known or suspected to occur in the study area come under this designation. The Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*) and the Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*), though occurring in or near the study area, are not known to occur in any affected site area.

The peregrine falcon (*Falco peregrinus anatum*) is a wide-ranging endangered transient species which may use major segments of the Salt-Verde drainage, but which has not been reported in the affected site areas during the CAWCS. The Gila topminnow (*Poeciliopsis o. occidentalis*) is listed as endangered and is a species of interest to the State because it may be in jeopardy in Arizona in the foreseeable future. This species was reintroduced into Tule Creek upstream of Lake Pleasant; the population was recently found to be in good condition. Other topminnow are known to occur at Seven Springs and Hidden Water; both areas are in the CAWCS study area but outside of the specific site areas.

The bald eagle (Haliaeetus l. leucocephalus) and the Yuma clapper rail (Rallus longirostris yumaensis) occur at affected site areas. There are six bald eagle breeding areas in the CAWCS study area, of which five are within affected site areas. Bald eagle preferred habitat includes cliffs and large trees near flowing segments of the Salt-Verde drainage where the species feeds primarily on fish. Preferred foraging perches are in mesquite, cottonwood, and willow trees along the rivers, and cliffs above the rivers. The Yuma clapper rail has been observed in the Confluence site area. Immature birds and as many as four adults have been reported in cattail marsh habitat at the Salt-Verde Confluence. Several sightings have also been reported for the Gila drainage downstream of Phoenix and at Picacho Reservoir.

In addition, species occurring in the study area which are recognized as threatened or unique by the Arizona Game and Fish Department include: river otter, black-crowned night heron, osprey, black hawk, zone-tailed hawk, and Gila monster.

(6) Management and Special Use Areas

Major special use and protected areas in the study area are managed by the U.S. Forest Service, U.S. Fish and Wildlife Service, U.S. Bureau of Land Management, and Arizona Game and Fish Department. These include: USFS habitat rehabilitation sites along the Salt and Verde Rivers; designated wintering areas for bald eagles and peregrine falcons; restricted access priority areas located in vicinities of bald eagle territories, and marsh habitat which may harbor the Yuma clapper rail; 14 game management

units and the Three Bar Research area, and fisheries of the major reservoirs and perennial streams maintained by the Arizona Game and Fish Department; and the Lower Salt River Recreation Area managed by the U.S. Forest Service in the Salt-Verde confluence area.

b. Water Quality

There is a wide range in the quality of the various sources of water in the study area. For example, a 1979 Maricopa Association of Governments publication (Groundwater Quality in the Major Basins of Maricopa County) reports a total dissolved solids (TDS) level of 243 mg/l in an Aguila area well and a TDS level of 22,300 mg/l in an Agua Caliente-Hayden area well. Pumped average groundwater quality in the service area is documented in the Bureau's EIS Water Allocations & Water Service Contracting, INT 82-7. Surface water quality records show TDS ranging from 110 mg/l in the Verde River below Bartlett Dam to over 4,300 mg/l in the Gila River near Kelvin, Arizona. Generally, however, the quality of CAP Colorado River water delivered to users in central Arizona will be of poorer quality than most local surface supplies that are presently being used and will be of better quality than currently used groundwater.

Since the CAP intake is located on the Bill Williams arm of Lake Havasu, CAP water is assumed to be similar in quality to water quality of the Colorado River at Parker Dam until influenced by regulatory storage mixing with local surface waters. Water quality data for the Colorado River at Parker Dam is presented on Table III-2.

Table III-2

SURFACE WATER QUALITY, COLORADO RIVER BELOW PARKER DAM[a]
(mg/l, unless otherwise noted)

	Constituent	No. of Samples	Minimum	Average	Maximum
T	Alkalinity as $CaCO_3$	156	98.0	128.	150.
D	Arsenic	1	0.00400	0.00400	0.00400
T	Arsenic	56	0	0.00284	0.00500
D	Barium	1	0	0	0
T	Barium	57	0	0.135	0.500
	Bicarbonate	145	120.	156.	177.
T	Boron	65	0.0500	0.196	0.360
D	Cadmium	7	0	0.000286	0.00100
T	Cadmium	65	0	0.00462	0.0130
D	Calcium	166	73.0	85.0	100.
	Carbonate	139	0	0.0288	4.00
T	Chloride	166	75.0	94.5	140.
	Chromium (Hexa)	1	0.00100	0.00100	0.00100
T	Chromium	58	0	0.00357	0.0200
D	Copper	1	0	0	0
T	Copper	57	0	0.00793	0.0290
T	Cyanide	58	0	0.000862	0.0200
D	Oxygen	109	5.10	8.53	11.7
	Fecal Coliforms (cols/100 ml)	49	0.990	4.78	41.9
D	Fluoride (84.7°)	127	0.200	0.378	0.500
T	Hardness (as $CaCO_3$)	166	290.	339.	380.
	Hardness (noncarbonate)	165	170.	211.	243.
T	Iron	57	0.0300	0.159	0.550
D	Lead	9	0	0.00144	0.00400
T	Lead	57	0	0.0408	0.100
D	Magnesium	166	26.0	30.8	40.0
T	Manganese	58	0	0.0208	0.0400
T	Mercury	58	0	0.0000431	0.000600
T	Nitrate (as N)	1	0.170	0.170	0.170
	pH (pH units)	202	7.10	7.95	8.80
T	Phosphorus (as P)	66	0	0.0258	0.100
D	Potassium	139	4.50	5.21	6.80
D	Selenium	1	0.00300	0.00300	0.00300
T	Selenium	58	0	0.00279	0.00500
	Specific Conductance (μ℧/cm)	700	950.	1120.	1720.
D	Silver	1	0	0	0
T	Silver	58	0	0.00350	0.0100
D	Sodium	139	90.0	107.	120.
	Sodium Adsorption Ratio (no units)	166	2.20	2.53[b]	3.00
T	Sulfate	167	240.	309.	380.
T	Dissolved solids (180°C)	636	602.	722.	848.
	Turbidity (JTU)	43	1.00	2.58	10.0
D	Zinc	9	0	0.00889	0.0200
T	Zinc	57	0	0.0239	0.310
	Phenolics	62	0	0.00127	0.00700

Note: D = Dissolved Fraction; T = Total Recoverable

[a]Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981. All constituent levels shown rounded to three significant figures. Some zero values may represent "below detection levels".

[b]Average SAR was computed using average values for dissolved sodium, calcium, and magnesium.

The acceptability of water quality is ultimately determined by the designated use. The majority of water currently used in the study area is for either agricultural or municipal and industrial (M&I) use.

Much of the CAP water will be used to reduce groundwater pumping for irrigation purposes. Recently groundwater levels have been dropping 3 to 8 feet per year in the service area. By importing about 65 million acre-feet of additional water into central Arizona over the life of the project, CAP deliveries will slow this rate of decline. In many cases the groundwater used for crop irrigation is higher in TDS than the imported CAP water. The infiltration of irrigation water may carry dissolved minerals that could reach the water table and raise the TDS level of the groundwater. The general effects associated with salt accumulation in groundwater is documented in Water Allocations & Water Service Contracting (INT 82-7). Due to limited research, and the complexity of groundwater recharge and movement of dissolved minerals, site-specific technical analysis is not practical over an area as large and diverse as the CAP service area; however, no adverse impact on soil productivity from application of Colorado River CAP water is expected (INT 82-7).

The major water quality impacts of the proposed regulatory storage alternatives will result from the reservoir mixing or exchanges of CAP and local sources of water. These impacts involve changing the concentrations of constituents in the CAP and local source waters, and increasing the potential for artificial eutrophication downstream from or in the storage reservoir. Risk of eutrophication as computed for this study is documented in Chapter VI Hydrology Appendix, Stage III Report, USBR 4-82.

Tables III-3, III-4, III-5, and III-6 present the water quality data referenced during CAWCS for local surface water sources which might be affected by regulatory storage mixing. The Agua Fria River water quality data have fewer sample analyses and, therefore, are not as representative as the information on the other water sources; these data were obtained from the U.S. Geological Survey which conducts regular sampling and laboratory testing.

Trihalomethane (THM) is produced when water which is high in dissolved organic materials undergoes normal disinfection with chlorine at domestic water treatment plants. THM is carcinogenic in nature and the U.S. EPA has established a limit of 0.1 mg/l for treated domestic water. CAP water is known to be high in dissolved organics; therefore, the potential exists for producing THM at M&I water treatment facilities. This potential will exist for any CAP M&I users regardless of which plan is implemented.

c. Recreation

Within the CAWCS study area, water-oriented recreation opportunities are extremely popular among residents, as is evident by the intense use of existing reservoirs and streams. Stream- and reservoir-oriented recreation resources and facilities in a five-county region of central Arizona were inventoried so that project-related impacts could be determined. The five-county region of Maricopa, Pima, Pinal, Gila, and Yavapai Counties was defined as the affected area to assess recreation impacts.

Table III-3

SURFACE WATER QUALITY, AGUA FRIA RIVER AT ROCK SPRINGS[a]
(mg/l, unless otherwise noted)

	Constituent	No. of Samples	Minimum	Average	Maximum
T	Alkalinity as $CaCO_3$	4	140.	175.	190.
D	Arsenic[b]	2	0.00900	0.0100	0.0110
T	Arsenic	4	0.00900	0.0133	0.0160
D	Barium[b]	2	0.0650	0.0730	0.0810
T	Barium	4	<0.100	<0.100	0.100
	Bicarbonate	0	--	--	--
T	Boron	4	0.0900	0.165	0.230
D	Cadmium[b]	2	<0.00300	<0.00300	<0.00300
T	Cadmium	4	<0.00100	<0.00150	0.00200
D	Calcium	4	39.0	50.8	58.0
	Carbonate	0	--	--	--
D	Chloride	2	32.0	36.0	40.0
	Chromium (Hexa)	0	--	--	--
T	Chromium	4	0.00300	0.00725	0.0190
D	Copperb	2	0.00700	0.00750	0.00800
T	Copper	4	0.00700	0.0138	0.0290
T	Cyanide	4	<0.0100	<0.0100	<0.0100
D	Oxygen	4	8.60	8.88	9.10
	Fecal Coliforms (cols/100 ml)	4	4.00	36.3	120
D	Fluoride (84.7°)	4	0.300	0.325	0.400
T	Hardness (as $CaCO_3$)	4	160.	215.	240.
	Hardness (noncarbonate)	4	23.0	41.3	54.0
T	Iron	4	0.0600	2.04	6.40
D	Lead[b]	2	0.00200	0.00200	0.00200
T	Lead	4	0.00100	0.00425	0.00800
D	Magnesium	4	16.0	21.8	25.0
T	Manganese	4	0.0100	0.0850	0.270
T	Mercury	4	<0.000100	<0.000100	<0.000100
T	Nitrate (as N)	2	3.20	3.85	4.50
	pH (pH units)	4	8.30	8.43	8.60
T	Phosphorus (as P)	4	0.0900	0.150	0.180
D	Potassium	4	1.60	1.98	2.30
D	Selenium[b]	2	<0.00100	<0.00100	<0.00100
T	Selenium	4	<0.00100	<0.00100	0.00100
	Specific Conductance (μ℧/cm)	4	420.	582.	676.
D	Silver[b]	2	<0.00100	<0.00100	<0.00100
T	Silver	4	<0.00100	<0.00100	<0.00100
D	Sodium	4	25.0	37.8	45.0
	Sodium Adsorption Ratio (no units)	4	0.900	1.20	1.40
	Sulfate	4	53.0	85.0	100.
T	Dissolved solids (180°C)	4	257.	358.	401.
	Turbidity (NTU)	4	0.600	31.6	110.
D	Zinc[b]	2	<0.0120	<0.0120	<0.0120
T	Zinc	4	0.0200	0.0325	0.0600
	Phenolics	0	--	--	--

Note: D = Dissolved Fraction; T = Total Recoverable; -- Data Not Available

[a]U.S. Geological Survey from U.S. Bureau of Reclamation unpublished data, 1982; period of record January-April 1982. All constituent levels shown rounded to three significant figures.

[b]Samples taken below Lake Pleasant.

[c]Average SAR was computed using average values for dissolved sodium, calcium, and magnesium.

Table III-4

SURFACE WATER QUALITY, VERDE RIVER BELOW BARTLETT DAM[a]
(mg/l, unless otherwise noted)

	Constituent	No. of Samples	Mininimum	Average	Maximum
T	Alkalinity as $CaCO_3$	328	0	185.	350.
D	Arsenic	16	0.00500	0.0121	0.0180
T	Arsenic	15	0.00700	0.0133	0.0210
D	Barium	6	0	0.0550	0.100
T	Barium	6	0	0.100	0.200
	Bicarbonate	521	0.148	235.	427.
T	Boron	1	0.190	0.190	0.190
D	Cadmium	16	0	0.00156	0.0140
T	Cadmium	16	0	0.00619	0.0100
D	Calcium	540	19.0	42.5	75.0
	Carbonate	399	0	1.57	15.0
D	Chloride	352	2.00	18.8	130.
	Chromium (Hexa)	0	-	-	-
T	Chromium	16	0	0.00375	0.0100
D	Copper	16	0	0.00275	0.00700
T	Copper	16	0.00300	0.00888	0.0200
T	Cyanide	0	-	-	-
D	Oxygen	21	8.60	11.6	17.8
	Fecal Coliforms (cols/100 ml)	31	1.00	8.35	99.0
D	Fluoride (84.7°)	210	0	0.340	0.800
T	Hardness (as $CaCO_3$)	540	79.0	212.	413.
	Hardness (noncarbonate)	519	0	18.9	182.
T	Iron	71	0	0.192	3.50
D	Lead	16	0	0.00300	0.0120
T	Lead	16	0.00400	0.0714	0.100
D	Magnesium	540	6.40	25.7	55.0
T	Manganese	16	0	0.0900	0.380
T	Mercury	16	0	0.000263	0.00260
T	Nitrate (as N)	3	0.0200	0.0967	0.140
	pH (pH units)	512	6.80	8.01	8.80
T	Phosphorus (as P)	53	0	0.206	0.400
D	Potassium	219	1.30	3.39	7.40
D	Selenium	16	0	0.000750	0.00300
T	Selenium	15	0	0.000600	0.00100
	Specific Conductance (µ℧/cm)	543	0.700	472.	929.
D	Silver	6	0	0	0
T	Silver	6	0	0	0
D	Sodium	501	4.20	30.5	290.
	Sodium Adsorption Ratio (no units)	510	0.200	42.5	677.
D	Sulfate	350	11.0	52.9	107.
T	Dissolved solids (180°C)	482	109.	314.	550.
	Turbidity (JTU)	39	1.00	83.3	2800.
D	Zinc	16	0	0.00700	0.0300
T	Zinc	16	0.0100	0.0356	0.200
	Phenolics	0	-	-	-

Note: D = Dissolved Fraction; T = Total Recoverable; -- Data Not Available

[a]Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979. All constituent levels shown rounded to three significant figures. Some zero values may represent "below detection levels".

[b]Average SAR wass computed using average values for dissolved sodium calcium, and magnesium.

Table III-5

SURFACE WATER QUALITY, SALT RIVER BELOW STEWART MOUNTAIN DAM[a]
(mg/l, unless otherwise noted)

	Constituent	No. of Samples	Mininimum	Average	Maximum
T	Alkalinity as $CaCO_3$	323	1.00	130.	189.
D	Arsenic	16	0.00200	0.00338	0.00600
T	Arsenic	15	0.00387	0.00100	0.00700
D	Barium	7	0	0.0771	0.200
T	Barium	7	0	0.100	0.200
	Bicarbonate	386	1.59	160.	230.
T	Boron	2	0.140	0.185	0.230
D	Cadmium	16	0	0.00813	0.00400
T	Cadmium	16	0	0.00669	0.0100
D	Calcium	405	36.0	50.4	420.
	Carbonate	162	0	0.358	35.0
D	Chloride	303	70.0	234.	610.
	Chromium (Hexa)	0	-	-	-
T	Chromium	16	0	0.00188	0.0100
D	Copper	16	0	0.00250	0.00600
T	Copper	16	0	0.00868	0.0200
T	Cyanide	0	-	-	-
D	Oxygen	20	1.60	6.61	13.7
	Fecal Coliforms (cols/100 ml)	28	1.00	22.0	470.
D	Fluoride (84.7°)	182	0.200	0.380	1.10
T	Hardness (as $CaCO_3$)	404	121.	180.	270.
	Hardness (noncarbonate)	400	0	49.4	113.
T	Iron	27	0	0.187	2.10
D	Lead	16	0	0.00663	0.0600
T	Lead	16	0	0.0743	0.100
D	Magnesium	405	5.50	13.7	28.0
T	Manganese	16	0	0.0625	0.170
T	Mercury	16	0	0.0000438	0.000400
T	Nitrate (as N)	3	0	0.0533	0.160
	pH (pH units)	396	4.50	7.74	9.10
T	Phosphorus (as P)	46	0.0100	0.223	8.30
D	Potassium	185	2.40	5.83	42.0
D	Selenium	16	0	0.000188	0.00100
T	Selenium	15	0	0.000267	0.00200
	Specific Conductance (μ℧/cm)	404	511.	1140.	2340.
D	Silver	7	0	0	0
T	Silver	7	0	0.00171	0.0100
D	Sodium	376	47.0	161.	382.
	Sodium Adsorption Ratio (no units)	404	1.70	5.54	70.0
D	Sulfate	299	32.0	51.4	360.
T	Dissolved solids (180°C)	362	316.	635.	1300.
	Turbidity (JTU)	33	1.00	2.91	10.
D	Zinc	16	0	0.0160	0.120
T	Zinc	16	0.0100	0.0331	0.100
	Phenolics	0	-	-	-

Note: D = Dissolved Fraction; T = Total Recoverable; -- Data Not Available

[a]Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979. All constituent levels shown rounded to three significant figures. Some zero values may represent "below detection levels".

[b]Average SAR was computed using average values for dissolved sodium, calcium, and magnesium.

Table III-6

SURFACE WATER QUALITY, SALT RIVER PROJECT WATER[a]
(mg/l, unless otherwise noted)

	Constituent	No. of Samples[b]	Minimum[c]	Average[d]	Maximum[c]
T	Alkalinity as $CaCO_3$	323	0	154.	350.
D	Arsenic	16	0.00200	0.00761	0.0180
T	Arsenic	15	0.00387	0.00682	0.0210
D	Barium	6	0	0.0676	0.200
T	Barium	6	0	0.100	0.200
	Bicarbonate	386	0.148	192.	427.
T	Boron	1	0.140	0.187	0.230
D	Cadmium	16	0	0.00530	0.0140
T	Cadmium	16	0	0.00648	0.0100
D	Calcium	405	19.0	47.0	420.
	Carbonate	162	0	0.879	35.0
D	Chloride	303	2.00	141.	610.
	Chromium (Hexa)	0	--	--	--
T	Chromium	16	0	0.00268	0.0100
D	Copper	16	0	0.00261	0.00700
T	Copper	16	0	0.00877	0.0200
T	Cyanide	0	--	--	--
D	Oxygen	20	1.60	8.76	17.8
	Fecal Coliforms (cols/100 ml)	28	1.00	16.1	470.
D	Fluoride (84.7°)	182	0	0.363	1.10
T	Hardness (as $CaCO_3$)	404	79.0	194.	413.
	Hardness (noncarbonate)	400	0	36.3	182.
T	Iron	27	0	0.189	3.50
D	Lead	16	0	0.00507	0.0600
T	Lead	16	0	0.0731	0.100
D	Magnesium	405	5.50	18.9	55.0
T	Manganese	16	0	0.0743	0.380
T	Mercury	16	0	0.000138	0.00260
T	Nitrate (as N)	3	0	0.0720	0.160
	pH (pH units)	396	4.50	7.86	9.10
T	Phosphorus (as P)	46	0	0.216	8.30
D	Potassium	185	1.30	4.78	42.0
D	Selenium	16	0	0.000430	0.00300
T	Selenium	15	0	0.000410	0.00200
	Specific Conductance (μU/cm)	404	0.700	853.	2340.
D	Silver	6	0	0	0
T	Silver	6	0	0.000975	0.0100
D	Sodium	376	4.20	105.	382.
	Sodium Adsorption Ratio (no units)	404	0.200	3.27[e] 52.0	677.
D	Sulfate	299	11.0	52.0	360.
T	Dissolved solids (180°C)	362	109.	497.	1300.
	Turbidity (JTU)	33	1.00	37.5	2800.
D	Zinc	16	0	0.0121	0.120
T	Zinc	16	0.0100	0.0342	0.200
	Phenolics	0	--	--	--

Note: D = Dissolved Fraction; T = Total Recoverable; -- Data Not Available

[a]Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979. All constituent levels shown rounded to three significant figures. Some zero values may represent "Below Detection Levels".
[b]Minimum number of samples from Salt or Verde data.
[c]Minimum and maximum are for the Salt or Verde Rivers and could be experienced if the other river was not flowing.
[d]Weighted average based on USGS flow records resulting in a 43 percent Verde and 57 percent Salt mix at the confluence of the two rivers.
[e]Average SAR wass computed using average values for dissolved sodium, calcium, and magnesium.

Within the region, popular stream-oriented activities include stream fishing, swimming, tubing (river floating), camping, and picnicking. Reservoir-oriented activities include boat fishing, swimming, powerboating, waterskiing, non-powerboating, camping, and picnicking.

Over 9,000 campsites are found in the region, ranging from developed campsites with picnic tables, fire rings, running water, community showers, and electrical hookups to undeveloped campsites with only a cleared area to pitch a tent. Many campground facilities are located near or adjacent to study area lakes and reservoirs. Statewide, between 14 and 16 percent of all households participate in camping. Approximately 2,716,000 maximum annual recreation days[1] are associated with existing developed campsites.

A total of 11,600 picnic sites are found within the region. Statewide, over 30 percent of all households participate in picnicking activities. The total number of maximum annual recreation days associated with the picnic areas in the region is approximately 5.5 million.

Swimming in lakes and rivers in the region is for the most part a non-structured recreation activity and does not necessarily depend on a beach or other facilities. Statewide participation rates for lake and river swimming indicate that 17 percent of all households participate in this activity. According to the Arizona Outdoor Recreation Coordinating

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[1]Maximum annual recreation days are based on the carrying capacity of the resources and facilities as well as the length of the recreation season and the amount of recreation use that occurs on weekends. Maximum annual recreation days represent the capacity of the site without overcrowding.

Commission (AORCC), a total of 51 improved or developed swimming sites are found in the five-county region. An estimated 2 million maximum annual recreation days are associated with lake and river swimming.

Over 985 miles of fishable stream exist within the region. Specific shoreline facilities are not usually associated with stream fishing activities. Approximately 1 million maximum annual recreation days are associated with stream fishing in the region.

Tubing is a highly valued recreational activity along the Salt and Verde Rivers in central Arizona. In recent years, tubing has become very popular among valley residents of all ages, but especially those in the 16 to 30 age bracket. A survey conducted along the Salt River during the summer of 1981 by the Corps of Engineers estimated that visitation along the Salt River for tubing was greater than 1 million. Because of lower stream flows, tubing on the Verde River is not as intensive. A total of 34.3 miles are estimated to be available for tubing within the five-county region. Maximum annual recreation days associated with tubing miles total over 2,200,000.

A relatively small proportion of the population (about 7 percent) in the region participates in boating activities. Boating resources within the five-county region consist of eight major lakes: Apache, Bartlett, Horseshoe, Canyon, Lake Pleasant, Roosevelt, Saguaro, and San Carlos. The total number of usable surface acres for recreation associated with these lakes is approximately 35,000. Maximum annual recreation days for all boating activities including fishing, powerboating, non-powerboating, and waterskiing currently total approximately 1 million.

d. Cultural Resources

(1) Prehistoric Resources

The CAWCS study area has been occupied for the last 13,000 years, of which only the last 300 years have been recorded in written form. The earliest evidence for human populations in the study area dates to about 11000 B.C. People who lived at the time appear to have been mainly hunters who concentrated on large, and now mostly extinct, fauna such as mammoth, bison, and horse. Sites reflecting this occupation are rare, and a high priority is placed by the archaeological community on finding and excavating such remains.

At about 8000 B.C., and on into the Christian Era, the hunting emphasis was gradually replaeed by a concern for the harvesting and collection of wild plant foods. While hunting continued in importance, there was a shift to the capture of small, rather than large, fauna.

At about 300 B.C., the Hohokam cultural tradition began, marked by the addition of ceramic vessels to the artifact inventory and by the adoption of a greater emphasis on agriculture. The Hohokam core area is roughly equivalent to the combined limits of the Gila River Indian Reservation and the Phoenix metropolitan area. This area saw the development of extensive irrigation networks, higher population density, and a more complex level of political organization.

The Hohokam periphery extends to varying degrees into the mountains and deserts surrounding the core area. It includes Lake Roosevelt to the east, the Tucson Basin to the south, Horseshoe Dam and

Waddell Dam to the north, and Gila Bend to the west. The social and cultural development of the periphery was influenced to varying degrees by that of the core, although during latter times (post A.D. 1100), the situation appears to have reversed.

Other related cultural groups recognized in the CAWCS study area include the Patayan, Sinagua, and Salado. These groups are less well defined than the Hohokam.

By about A.D. 1400, the Hohokam tradition disappears from the archaeological record. When Spanish explorers arrived in the American Southwest, they reported large villages of Piman Indians living along the Gila River. These people were possibly the descendants of the Hohokam.

The Hohokam tradition, which dominated the CAWCS study area, provides an opportunity to examine different models for the development of complex social and political systems. The close proximity of the Hohokam core and periphery areas provides a rare opportunity to examine the interrelated effects of trade and irrigation agriculture on the growth of political elites. The Hohokam irrigation network is unusual in the New World due to its large size and complexity.

Archaeologists emphasize the study and/or preservation of large Hohokam sites, because they occur in relatively small numbers and there is considerable internal variability. Large Hohokam sites, such as Tonto National Monument, Casa Grande, and Pueblo Grande, make impressive tourist attractions and contain a wealth of information on the rise and fall of the Hohokam social system.

(2) Historic Resources

Historic cultural resources or sites within the CAWCS study area reflect the general patterns and historic trends of land use which characterized the region. In order to describe regional history, it is useful to recognize three historical periods to which the majority of study area historic sites may be attributed.

Many of the historic sites which have been recorded within the study area are of major importance as evidence of a dynamic state and local cultural heritage. Several of the sites have been recognized at a national level through their entry in the National Register of Historic Places, an inventory of sites considered significant at a local, regional, or national level. Numerous other sites have been identified which are eligible for nomination to the National Register.

(a) Pre-Territorial (to 1863) Period

Non-Indian intrusions into the study area before 1863 were both sporadic and temporary in nature. Fur trappers worked along the Verde and Gila Rivers during the period before about 1850; explorers and other travelers traversed the area using the river courses as travel routes through central Arizona. While sites representing this period exist in the CAWCS area, no sites from this period have been identified in affected site areas.

(b) Territorial-Settlement Period (1863-1912)

Permanent settlement within the study area began with the establishment of Camp McDowell, later Fort McDowell, on the Verde

River in 1865. Fort McDowell was abandoned in 1890, and in 1903 the military lands were allocated for use as a reservation for Yavapai Indians. By the 1870s, Salt River Valley communities such as Phoenix, Mesa, Tempe, and Lehi were established as the area in general was explored, settled, and developed. By 1880, homesteads, farms, and ranches had been located along most of the major drainages. With the construction of major canals during the 1880s and 1890s, and of Roosevelt Dam between 1905 and 1911, the groundwork was established for extensive irrigation agriculture. The development of a railroad transportation system during the period from about 1880 until 1910 contributed a final stimulus to the area's development. Historic sites characteristic of these events and activities are present at each of the affected site areas.

(c) Statehood-Early Modern Development (1912-1930)

Activities within the area during the first two decades after Arizona statehood (1912) were, by and large, a continuation and elaboration of existing and developing trends. Agricultural activities increased throughout this period due to a series of dam construction projects, including the Ashurst-Hayden Diversion Dam (1922), Mormon Flat Dam (1925), Horse Mesa Dam (1927), Carl Pleasant Dam (now Waddell Dam) (1927), and Stewart Mountain Dam (1930). New towns, such as Litchfield Park (1916), Chandler (1912), Gilbert (1910), and Tolleson (1910), which were primarily agriculture-oriented, were created during this period. A number of historic sites attributable to this period, including construction camps for the dams, have been recognized at each of the affected site areas.

e. Social Resources

CAWCS plans would affect the communities, individuals, and families, who are subject to flooding along the Salt and Gila Rivers from Granite Reef Dam to Gillespie Dam and the people who would be relocated because of construction and reservoir inundation in the site areas. The social implications of changes in recreation resources and facilities are analyzed in an EIS supporting document (Social Impacts and Effects of Plans), but social impacts of recreation were scoped out of the EIS because they were not considered significant factors.

The affected flooding area includes communities within the study area that are particularly affected by flooding. These are the Cities of Phoenix, Tempe, Mesa, the communities of Buckeye and Holly Acres, and the Salt River Pima-Maricopa Indian Community (SRPMIC) and the Gila River Indian Community (GRIC). Phoenix, Mesa, and Tempe are urban centers and residential areas, while Buckeye, Holly Acres, SRPMIC and GRIC are rural agricultural communities.

Action plans described in this EIS would require relocations in three locations: the Fort McDowell Indian Community, Roosevelt Lake, and KA Ranch.

The Fort McDowell Indian Community is approximately 25 miles northeast of Phoenix. Established in 1903, the current population of the reservation is 374 (Fort McDowell Office of Economic Development Planning, 1980), the majority of whom are Yavapai. Residents would be required to relocate if a dam were constructed at the confluence of the Salt and Verde Rivers.

Roosevelt Lake is approximately 75 miles from the Phoenix metropolitan area. Some residents from each of the following communities would be required to relocate if a new or enlarged dam were built at Roosevelt Lake. Population of these communities is:

- North Bay Estates (approximately 60 residents)
- Roosevelt Lake Estates (approximately 360 residents)
- Rockhouse Farm (approximately 50 residents)
- Roosevelt Gardens East (approximately 130 residents)

Of the total population of these communities, approximately 50 percent are part-time residents, living at the lake only on weekends or during part of the year.

2. Other Resources

a. Air Quality

The U.S. Environmental Protection Agency (EPA) and the Arizona Department of Health Services (ADHS) have set primary and secondary standards for various air quality constituents. Primary standards define the maximum pollutant levels allowable and necessary to protect the public health with an adequate margin of safety; secondary standards define the maximum pollutant levels allowable and necessary to protect the public welfare from any known or anticipated adverse effects. The state standards, which are generally comparable to the federal standards, are maximum pollutant levels that the ADHS considers to be in the best interest of the health of the general public. Both the National Ambient Air Quality Standards (NAAQS) and the Arizona state standards deal primarily with six pollutants. An area in which any NAAQS is exceeded, as shown by monitored data, is classified as a

"non-attainment" area with regard to the offending pollutant. The state is required to reduce the ambient level of this pollutant within a specified period of time. A large portion of the study area is included in the Phoenix Metropolitan Area which has been designated a nonattainment area for carbon monoxide (CO), ozone (O_3), and total suspended particulates (TSP).

Ambient air quality data have been collected within the study area by government agencies and private industries. Most of the data, however, are from the Phoenix Metropolitan Area with only limited data from outlying areas. The following section describes the air quality of the study area in 1980 relative to each of the six designated pollutants.

Carbon Monoxide (CO): Virtually all of the CO data are from the Phoenix metropolitan area. The one-hour federal and state standard was not violated at any location. However, the 8-hour standard was violated at a number of locations. The Phoenix Metropolitan Area has been designated as nonattainment for CO.

Non-methane Hydrocarbons (NMH): The federal and state standard was grossly violated in 1980 at the one Phoenix monitoring site where data were collected. Because hydrocarbons play a key role in the chemical formation of ozone, the standard is used as a guide in devising plans to achieve the ozone standard. Therefore, although the NAAQS has been violated, the Phoenix Metropolitan Area has been designated nonattainment for oxidants (ozone) rather than NMH.

Nitrogen Dioxide (NO_2): NO_2 data were collected at two Phoenix locations in 1980. The federal and state standard was not violated at either of the sites.

Ozone (O_3): The federal and state standard was violated at approximately half of the locations monitored. The majority of the locations are within the Phoenix Metropolitan Area, which has been designated non-attainment for O_3.

Total Suspended Particulates (TSP): Numerous violations of the federal and state standards occurred in 1980. The EPA has classified the Phoenix Metropolitan Area as nonattainment for TSP.

Sulfur Dioxide (SO_2): None of the federal or state standards were violated in the Phoenix area in 1980.

b. Aesthetics

The visual landscape of the CAWCS area includes the city and suburbs of Phoenix, lush green irrigated farmland, and the Arizona desert.

The terrain of the study area can be characterized by mountain ranges and steep barren slopes. Frequently, these slopes become massive, exotically shaped cliffs formed from rocks of various colors. The rugged terrain is often separated by broad, gently sloping, alluvium-filled valleys. Flowing rivers and intermittent streams meander through the desert landscape. Along the rivers, riparian vegetation adds a contrast with the earth colors and sparse vegetation of the desert. Visually these rivers and the shade of riparian vegetation are strong elements of the central Arizona landscape. Several large man-made lakes also provide a pleasing visual experience.

c. Noise

Typical background ambient sound levels (in decibels) for various study area land uses are displayed in Table III-7.

Table III-7

AMBIENT SOUND LEVELS BY LAND USE TYPE

Land Use	Day-Night Ambient Sound Level (L_{dn}) in dB
Urban Residential Near to Highway	75-85
Urban Residential Hi-Rise	65-85
Urban Shopping Center	55-70
High Density Single Family Urban Residential	50-65
Suburban Residential	35-60
Suburban Residential at City Outskirts	45-60
Small Town Residential	40-55
Farm	30-45
Open Lands (except agricultural)	15-45

The U.S. Environmental Protection Agency has suggested an annual Day-Night sound level (L_{dn}) of less than 55 dB as being requisite to protect public health and welfare.

d. Geology/Soils

Most of the study area is included in the Basin and Range physiographic province. The northeastern part of the area is in the

Transition Zone which separates the Basin and Range province from the Colorado Plateau. The Basin and Range is characterized by mountain ranges that are distinctly longer than they are wide, generally parallel to other ranges, with steep slopes and rugged topography. The mountain ranges are usually separated by near-flat to gently sloping valleys or basins which have been filled with alluvium. The Transition Zone is characterized by a topography which is more rugged than that of the Plateau; however, altitudes are generally lower in the Transition Zone.

Various igneous, sedimentary, and metamorphic rocks ranging in age from Precambrian to Quaternary are exposed within the study area. The area has been subjected to a number of geologic processes including folding, faulting, intrusions, deposition, and erosion. Modern landforms are, in part, a result of the Basin and Range orogeny which extended from early or middle Miocene time into the Pliocene.

Historic seismic activity in Arizona has ranged from moderate in some areas to virtually nonexistent in others. Of the recorded epicenters in Arizona, very few have had a magnitude of 5.0 or greater on the Richter scale.

Although there are no earth fissures known to occur at the CAWCS site areas, they do occur within the general study area and the potential for their formation is high in areas where groundwater levels continue to decline.

There are many known localities of metallic and nonmetallic minerals, nonferrous base, and precious metals throughout the study area. A

majority of the ore bodies are located within the mountainous region, but the alluvial basins contain abundant sources of sand and gravel and other minerals.

Because of their quality, growing season, and moisture supply, some of the soils in the study area are able to produce sustained high agricultural yields by modern farming methods. The Soil Conservation Service has mapped prime farmland for a portion of the study area. In 1980 there were an estimated 620,000 acres of prime farmland within the CAWCS area.

e. Land Resources

Existing generalized land use and land ownership patterns within the CAWCS study area are described below.

(1) Existing Land Use Patterns

Land use patterns within the 13,400-square-mile CAWCS study area are shown in Figure III-2. The CAWCS study area is predominantly rangeland, with approximately 76 percent of land classified in this category. Agricultural lands comprise approximately 12 percent of the total CAWCS area. They lie primarily west and southeast of the Phoenix methopolitan area.

Urban/built-up lands comprise approximately 5 percent of the total CAWCS area. The major urban and built-up lands are located within the City of Phoenix and the adjacent cities of Tempe, Mesa,

Scottsdale, Paradise Valley, Fountain Hills, Glendale, Peoria, Sun City, Surprise, El Mirage, and Youngtown.

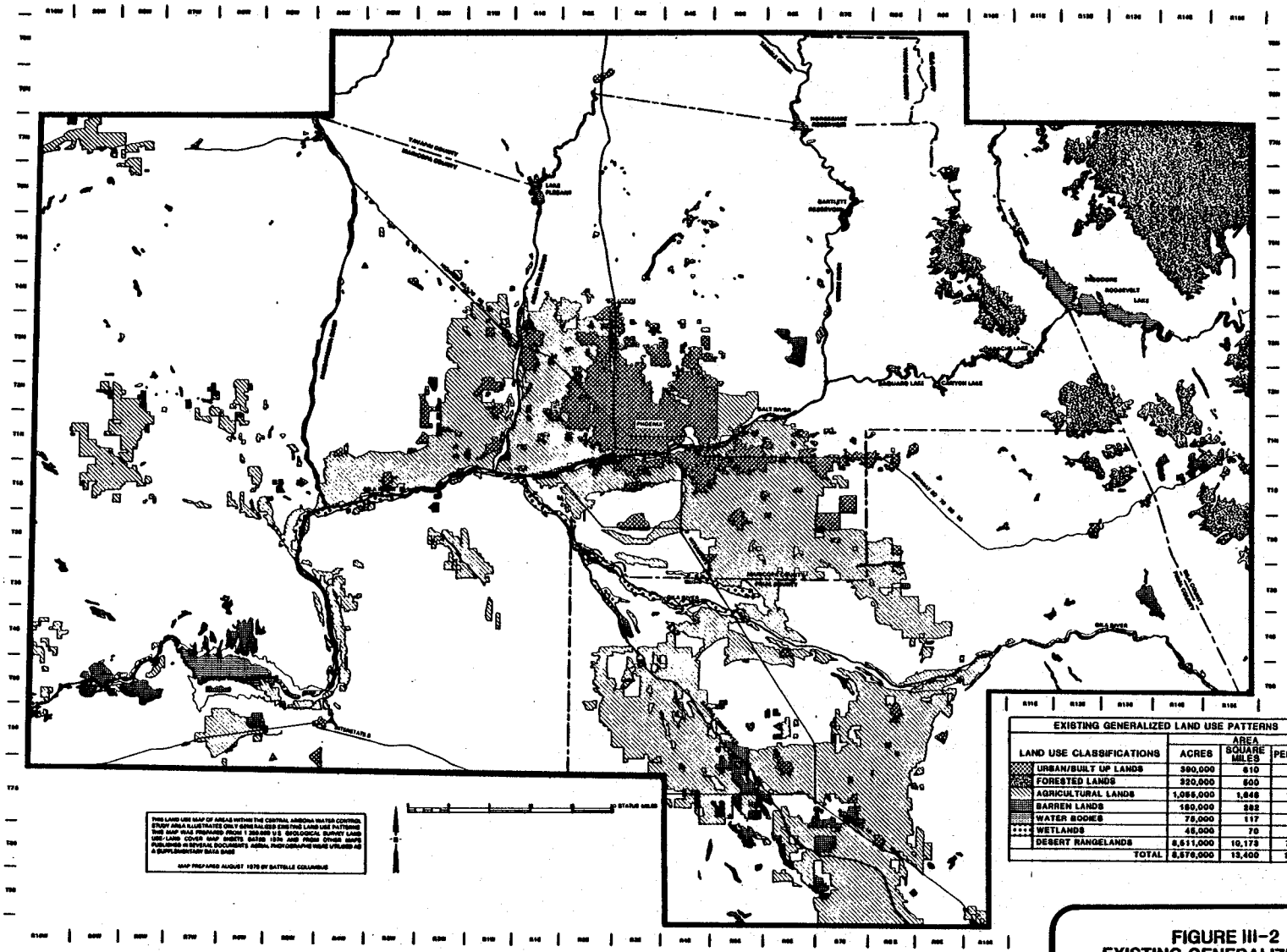
Four other minor land use/land cover classifications found within the study area include forest lands, barren lands, surface water bodies, and narrow riparian wetland areas as indicated on Figure III-2.

(2) Land Ownership Patterns

General surface land ownership patterns for the CAWCS area are shown in Figure III-3. Approximately 70 percent of lands remain in public ownership or are Indian reservations. These lands are predominantly desert rangeland. The privately-owned lands, mostly located in the central part of the study area, are predominantly urbanized or agricultural.

The U.S. Forest Service manages about 23 percent of the land within the CAWCS area, including portions of two Tonto National Forest Wilderness areas, the Mazatzal and Superstitition. National Resource Lands controlled by the Bureau of Land Management also comprise approximately 23 percent of the total study area. The majority of these lands are consolidated blocks of mountains and foothills located in the western part of Maricopa County. Williams and Luke Air Force Bases and the Florence Military Reservation controlled by the U.S. Department of Defense account for approximately 1 percent of the total CAWCS area.

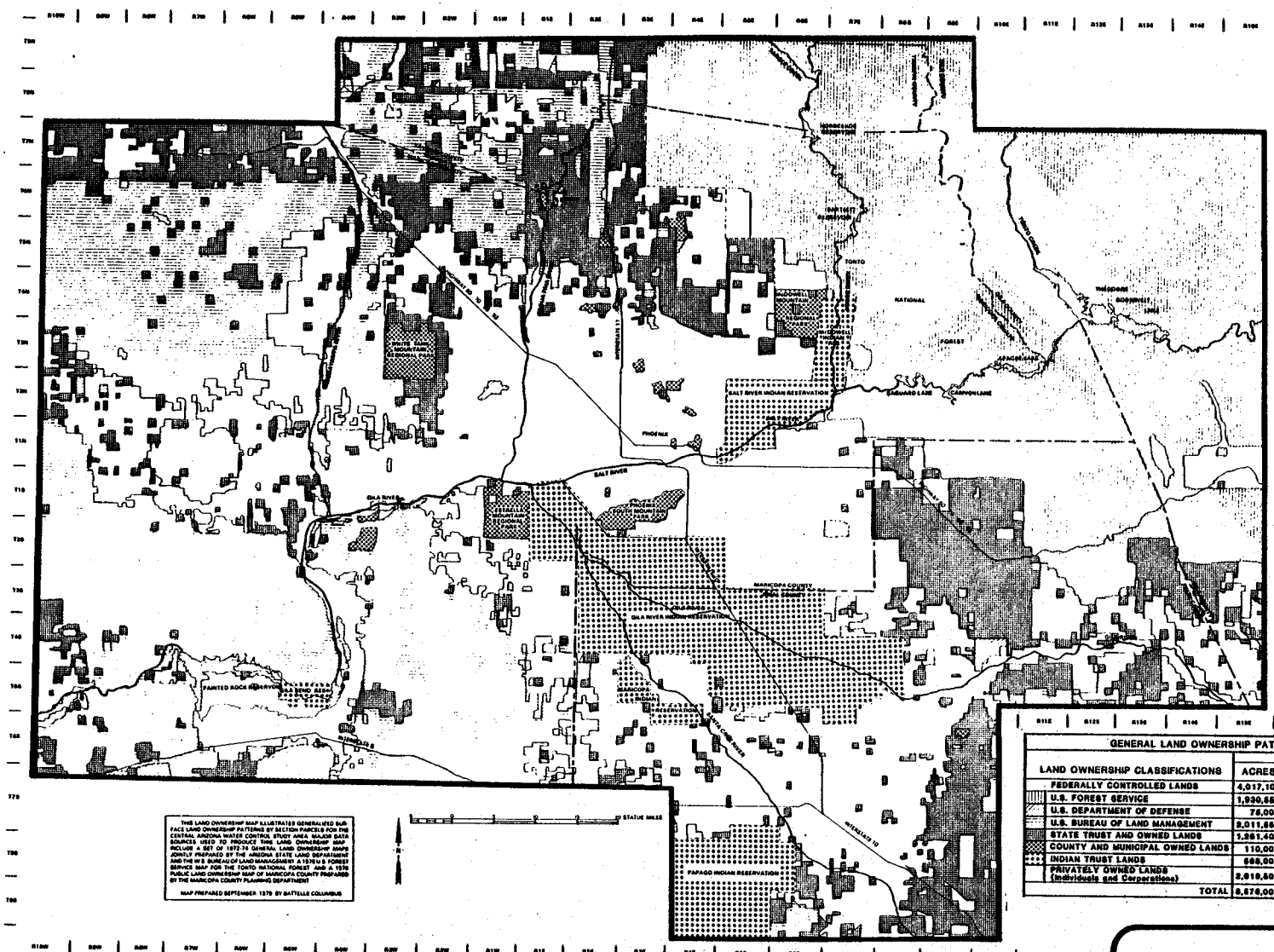
The Arizona State Land Department and several other state agencies have administrative responsibilities for managing approximately 15 percent of land within the CAWCS area. The majority of the State



EXISTING GENERALIZED LAND USE PATTERNS			
LAND USE CLASSIFICATIONS	AREA ACRES	AREA SQUARE MILES	AREA PERCENT
URBAN/BUILT UP LANDS	390,000	610	4.6
FORESTED LANDS	320,000	500	3.7
AGRICULTURAL LANDS	1,055,000	1,646	12.3
BARREN LANDS	180,000	282	2.1
WATER BODIES	75,000	117	0.9
WETLANDS	45,000	70	0.5
DESERT RANGELANDS	6,511,000	10,173	75.9
TOTAL	8,576,000	13,400	100%

FIGURE III-2
EXISTING GENERALIZED LAND USE PATTERNS

CENTRAL ARIZONA WATER CONTROL STUDY



THIS LAND OWNERSHIP MAP ILLUSTRATES GENERALIZED SURFACE LAND OWNERSHIP PATTERNS BY SECTION PARCELS FOR THE CENTRAL ARIZONA WATER CONTROL STUDY AREA. MAJOR DATA SOURCES USED TO PRODUCE THIS LAND OWNERSHIP MAP INCLUDE A SET OF 1972-74 GENERAL LAND OWNERSHIP MAPS JOINTLY PREPARED BY THE ARIZONA STATE LAND DEPARTMENT AND THE U.S. BUREAU OF LAND MANAGEMENT, A 1976 U.S. FOREST SERVICE MAP FOR THE TONTO NATIONAL FOREST AND A 1976 PUBLIC LAND OWNERSHIP MAP OF MARICOPA COUNTY PREPARED BY THE MARICOPA COUNTY PLANNING DEPARTMENT.

MAP PREPARED SEPTEMBER 1976 BY BATTELLE COLUMBUS

GENERAL LAND OWNERSHIP PATTERNS

LAND OWNERSHIP CLASSIFICATIONS	ACRES	AREA SQUARE MILES	PERCENT
FEDERALLY CONTROLLED LANDS	4,017,100	6,276	46.8
U.S. FOREST SERVICE	1,930,880	3,016	22.5
U.S. DEPARTMENT OF DEFENSE	75,000	117	0.9
U.S. BUREAU OF LAND MANAGEMENT	2,011,660	3,145	23.4
STATE TRUST AND OWNED LANDS	1,261,400	1,971	14.7
COUNTY AND MUNICIPAL OWNED LANDS	110,000	172	1.3
INDIAN TRUST LANDS	568,000	888	6.6
PRIVATELY OWNED LANDS (Individuals and Corporations)	2,618,500	4,093	30.5
TOTAL	8,576,000	13,400	100%

FIGURE III-3
GENERAL LAND OWNERSHIP PATTERNS

CENTRAL ARIZONA WATER CONTROL STUDY

Trust Lands within the study area are located north and southeast of the Phoenix urban area. The State Land Department generates revenues from these lands by leasing the lands for grazing, mineral, homesite, agricultural and other purposes. Under provisions of the recently enacted Urban Lands Management legislation, the Land Department now engages in the long-term lease of State Trust Lands near urban areas for private development (Arizona Revised Statutes, Title 37; Arizona State Land Department).

County and municipally owned lands constitute slightly over 1 percent of the total CAWCS area. Almost all of these lands are unspoiled nature preserve parklands within the Maricopa County and City of Phoenix park systems.

Six Indian reservations comprise approximately 7 percent of the study area. These are the entire Fort McDowell, Salt River, Gila River, Gila Bend, and Ak-Chin Indian Reservations, and a portion of the Papago Indian Reservation. Most Indian reservation lands are primarily open rangelands generally used for farming or grazing purposes, but increasingly, the Indian communities are leasing unused community lands to the general public for commercial, housing, agricultural, recreational, and industrial development.

Privately owned lands, totalling approximately 31 percent of the CAWCS area, are mostly located within the Phoenix urbanized area and to the southeast and west of the City of Phoenix. The smaller parcels of privately owned land located within or near urban areas are primarily used for residential, commercial, industrial, recreation, and public utility

purposes. The larger parcels of privately owned lands located outside of the urban areas are predominantly used for agriculture.

C. Description of Affected Site Areas

1. New/Modified Stewart Mountain Site Area

The existing Stewart Mountain Dam, located on the Salt River approximately 10 miles upstream from the confluence of the Salt and Verde Rivers, was constructed in 1930 as part of the SRP system for water storage and hydroelectric purposes.

The entire area which would be affected by construction of New Stewart Mountain Dam is located within the boundaries of the Confluence site area (see Figure III-1). The description of the New Stewart Mountain affected site area is, therefore, included in the description of the Confluence site area.

2. Cliff Site Area

a. Geographic Setting

The Cliff Dam and Reservoir site is located on the Verde River between two existing dams: Horseshoe Dam, constructed in 1946, and Bartlett Dam, constructed in 1939 (see Figure III-1). Horseshoe Dam was constructed by the Phelps Dodge Copper Corporation for water reclamation purposes and is currently operated by the Salt River Project.

The approximately 52,800-acre site area lies exclusively within the boundaries of the Tonto National Forest. Access is provided to this area by Cave Creek Road.

The eastern boundary of the Mazatzal Wilderness Area lies approximately 3 miles north and east of the proposed Cliff Dam site. About 14 miles downstream from the proposed Cliff Dam site is Bartlett Dam. The upper reservoir limits at maximum design capacity lie approximately 1 mile downstream from the Cliff Dam site.

b. Biological Resources

The Verde River and its tributaries drain mountainous terrain within the Cliff site area. The area borders on the transition between scrub oak chaparral and paloverde-mixed cacti desert. Temperate riparian forests occur along the Verde River floodplain. Table III-8 presents acreages and ranges for biotic community types within the Cliff site area.

(1) Riparian/Wetland Communities

Mature cottonwood/willow forests grow along the Verde River and its tributaries upsteam from Horseshoe Reservoir. These riparian forests support a full complement of wildlife species including large mammals. In addition, stands of cottonwood/willow upstream from Horseshoe Reservoir are used by the bald eagles which nest at Chalk Mountain. Mesquite woodlands also occur at the site, primarily downstream from Horseshoe Dam. A great blue heron rookery exists in cottonwood trees downstream from Horseshoe Dam near the KA Ranch.

Table III-8

ACREAGE AND PERCENT RANGE OF BIOTIC COMMUNITY SERIES AND ASSOCIATIONS AT THE CLIFF SITE AREA

	Symbol	Percent	Acres
Desert upland:			
Paloverde-mixed cacti series	PC	86.3	45,550
Blue paloverde-ironwood association	CB/RA	3.9	2,030
Riparian and wetland types:			
Fremont cottonwood-Goodding willow association	CW/PS	1.0	550
Mixed broadleaf series	MB	0.2	100
Velvet mesquite association	MS/PJ	1.7	880
Saltcedar association	SD/TC	0.02	10
Saltcedar-mixed scrub association	SD/SC	0.02	10
Human-dominated types:			
Agricultural lands	AG	0.2	130
Other resource categories:			
Lake (typical year high)		3.8	2,000
Lake (typical year low)		1.2*	610*
Flowing stream (miles)			20*
Nonvegetated lands		2.9	1,530
Total		100.0	52,790

*Not included in the total.

Source: Second Level Environmental Inventory, CAWCS, 1982.

(2) Other Terrestrial Communities

The paloverde-mixed cacti community type is the predominant habitat of the surrounding hillsides throughout the site. North-facing slopes of many washes support dense stands of shrubs and desert trees such as acacia and hackberry. Ten springs occur in the Cliff site area. The Chalk Mountain area provides nesting habitat for bald eagles and hawks.

(3) Perennial Stream/Riverine Communities

The Verde River is an unregulated stream upstream from Horseshoe Reservoir and is subject to wide fluctuations in flow. There are few deep pools or riffles in this reach. Native stream fishes (desert and Gila suckers, longfin dace) and introduced game species (bass, carp, catfish) occur both upstream and downstream from the dam. Approximately 20 miles of perennial stream occur within the Cliff site area.

(4) Other Aquatic Communities

Horseshoe Reservoir is subject to extensive drawdown under the current operation schedule which severely reduces fish spawning. However, during drawdowns, the river supports vegetative growth in the bed of the reservoir, creating habitat for waterfowl and shorebirds.

(5) Threatened and Endangered Plants and Wildlife

Bald eagles nest along the Verde River in the area of Chalk Mountain. The breeding pair is believed to use the riparian forest and flowing river between Horseshoe Resevoir and Tangle Creek. The Chalk

Mountain breeding area is the least productive of five bald eagle breeding areas in CAWCS site areas due to frequent inundation of nest sites.

Among Arizona special status wildlife, black hawk, osprey, and black-crowned night heron have been noted in the Cliff site area. The Arizona Game and Fish Department has recently reintroduced the river otter in the Tangle Creek vicinity.

(6) Management and Special Use Areas

The Cliff site area is used for grazing administered by the Tonto National Forest. The Forest Service will also establish approximately 180 acres of cottonwood habitat at four rehabilitation sites along the Verde River. Public access is restricted in the vicinity of the Chalk Mountain bald eagle territory, and riparian habitat upstream from Horseshoe Reservoir is considered wintering area for both bald eagles and peregrine falcons.

c. Recreation

(1) Stream-Oriented Recreation

Existing stream-oriented recreation resources and facilities in the Cliff site area are within the Tonto National Forest and are managed by the U.S. Forest Service. Stream-oriented resources include 19.7 miles of stream on the Verde River, approximately half of which are above Horseshoe Dam. One stream-oriented recreation area is located just below Horseshoe Dam. Based on Forest Service estimates of visitation, approximately 12,100 visitor-days were associated with this site in FY 1980.

The total number of maximum annual recreation days attributed to stream-oriented activities at the Cliff site is 19,468. Fishing, camping, and picnicking are the primary recreation activities.

(2) Reservoir-Oriented Recreation

Existing reservoir-oriented resources within the Cliff site area center around Horseshoe Reservoir. Horseshoe Reservoir has water storage for irrigation as its primary function. Because of this, the level of the reservoir fluctuates widely. The reservoir-oriented recreation condition at the Cliff site was evaluated based on a surface area of 1,327 acres at Horseshoe Reservoir. This acreage represents the average level of the reservoir during the recreation season (April to October) of a typical year.

Access to Horseshoe Reservoir is limited to an unimproved dirt road, thereby restricting the types of boats that can reach the reservoir. Almost no waterskiing and very little powerboating occur on the lake. According to the U.S. Forest Service, almost 25,700 visitor-days were spent at Horseshoe Reservoir during FY 1980. Over 60 percent of these were for fishing purposes. There are currently no physical facilities for reservoir-oriented recreation within the Cliff site area (Horseshoe Reservoir). The total number of maximum annual recreation days for reservoir-oriented recreation at the Cliff site area is 59,464.

d. Cultural Resources

(1) Prehistoric Resources

Within the Cliff site area boundaries there are approximately 1,454 prehistoric archaeological sites which cover a combined area of roughly 1,479 acres.

Several categories of site types were used to describe the archaeological resources in the CAWCS area. The first type of site is the artifact scatter of which 486 are predicted to occur. This type of site is characterized by the presence of pottery fragments and/or lithic fragments or tools on the surface of a site. Surface architecture is generally absent; in a few cases, these sites are found to be Hohokam pithouses indicating the presence of subsurface architecture. These sites functioned as habitation units occupied by families of different sizes for varying lengths of time. In the majority of cases, however, these scatters are referred to as limited activity sites: areas where specialized tasks were performed such as plant and/or animal procurement or processing, raw material extraction, or tool manufacturing. These types of sites would have been occupied for a shorter time period than were the pithouses.

The second type of site is one which has evidence of surface architecture. These are commonly called pueblos and reflect more permanent occupations than do limited activity sites. This class of sites was divided into five groups based on the number of rooms found at each site. Each of these different sized pueblo sites served a different function in the prehistoric settlement hierarchy. Sites with only one room (347 predicted) are the most common in the Cliff site area followed by sites with 2-5 rooms

(464 predicted), 6-20 rooms (136 predicted), 20-100 rooms (8 predicted), and greater than 100 rooms (3 predicted). The very large sites, greater than 100 rooms, are the least common at the Cliff site area, and were no doubt of special significance. These sites also contain higher numbers of nonlocal materials such as decorated pottery from the north and worked shell from the south.

Two other types of sites include petroglyph sites (2 predicted to occur) and agricultural sites (8 predicted to occur). Petroglyph sites refer to sites consisting only of rock art and which lack artifacts or surface rooms. Agricultural sites include those sites consisting only of water and soil control systems such as terraces, check dams, or gridded gardens. These sites are not directly associated with any other class of site and often lack surface artifacts and architecture.

Occurring with sites in the Cliff site area are a number of special features such as trash mounds (75 predicted), ball courts (1 predicted), and water and soil control devices (1,801 predicted). Trash mounds are extremely valuable to archaeologists, as they provide an enormous amount of information on subsistence, trade goods, nutrition, and prehistoric environmental conditions. Ball courts are very rare (only one is known to exist in the Cliff site area) and are associated with the larger pueblo sites.

There is some evidence documenting human occupation in this area as early as 2000 B.C. with continual occupation up through historic times. Previous research has suggested that the groups which occupied this area prehistorically established trade networks with people living farther

north and south. Evidence also exists for the presence of at least two different cultural groups in the Cliff site area during prehistoric times. Thus, the resources in this area present the opportunity to study patterns of both local and regional exchange and interaction.

Some of the sites in this area have been vandalized, but as an archaeological district the prehistoric sites in the Cliff site area have significant information potential.

(2) Historic Resources

Seventeen historic sites and structures are located within the Cliff site area. Nine of the 17 sites have significant scientific or historic value. Three of the nine sites are related to water control functions and six sites have an agricultural function.

Relatively early initial intrusions by non-Indians in the Cliff site area were transitory in nature. The earliest known was that of a fur trapping party led by Ewing Young who trapped along the Verde River in 1829. The military presence was only occasional and troops traveled along the Verde River through the Cliff site area on a relatively infrequent basis. Generally, the Verde River seems to have been used very little as a north-south transportation or communication route during the historic period.

Agricultural interest was limited, primarily because of the rugged terrain and the creation of the Tonto National Forest in 1905 which restricted access to suitable land for farming. Only two homesteads, both part of the KA Ranch (now Johnson Ranch), were patented, one in 1919 and one in 1922. The 1919 homestead was patented by J. Marion Sears and includes

the ranch buildings of the KA Ranch. Although the homestead was patented in 1919, it was first occupied in 1887. The 1922 homestead was patented by Frank Lopez and eventually acquired by the KA Ranch. The remnants of two buildings related to apparently unpatented homesteads situated on Ister Flat were identified. They may date to the World War I period.

Sheepherding in the Horseshoe Dam area had its roots in the late nineteenth century. Two relatively late manifestations of this activity are located within the Cliff site area. Near the north end is the Verde River Sheep Bridge built in 1940 by Dr. R. O. Raymond, who began grazing sheep in the area in 1926. The bridge was listed on the National Register of Historic Places in 1978. Associated with the bridge is a small cluster of ranch buildings now in ruin.

Construction of Horseshoe Dam brought substantial change to the area in the mid-1940s. The dam was designed, along with Bartlett Dam, to store water from of the Verde River. The immediate environs of the dam contain a number of sites associated with the main structure. Construction took place during the years 1944-1946 and was financed by the Defense Plant Corporation, a federal agency, for the Phelps Dodge Copper Company. Associated with the dam are extensive remains of a large and complex construction camp.

e. Social Resources

There are no communities in the Cliff site area.

KA Ranch, located 1 mile south of the existing Horseshoe Dam, would be inundated by Cliff Reservoir. The ranch has been farmed continuously since 1887. It includes 117 acres of leased land used for grazing

cattle and 212 acres of family-owned land used for growing feed and for other ranching operations. Additionally, the family has grazing permits for use of Tonto Forest land in the vicinity of the ranch. Two people live on the ranch year round. In addition, five to seven ranch hands reside there part-time. During the summer months, nine additional family members live at the ranch. Nearest services are 20 miles away in Cave Creek.

f. Other Resources

(1) Air Quality

No air quality data are available from the vicinity of the Cliff site area. A combination of dust from recreation-related traffic and the relatively high potential for wind erosion make an occasional violation of total suspended particulates (TSP) standards a possibility.

(2) Aesthetics

The Cliff site area extends southward to include a portion of the Bartlett Reservoir and northward to 7 miles upstream from Horseshoe Reservoir. The Verde River in the area between the two reservoirs has clusters of mature cottonwoods and other riparian vegetation along the river banks. On the west shore, approximately 2 miles below Horseshoe Dam, are green fields, grazing cattle, large mature trees, and buildings of the KA Ranch. With the river as a foreground, this ranch enhances the visual quality of the site area by creating a strong contrast to the surrounding desert landscape. The Horseshoe Reservoir often has a large drawdown leaving only a very small lake with a steep unvegetated shoreline. The general terrain of the Cliff site area is characterized by rough mountains and steep

valleys. Other than the KA Ranch, little evidence of human habitation is evident.

(3) Noise

Day-night sound levels in the Cliff site area are typically below 55 dB. The day-night sound level of 55 dB is compatible with the U.S. Environmental Protection Agency's long-term goal for residential areas. Jeep and motorbike activities along local trails contribute to the maximum sound levels within the area.

(4) Geology/Soils

The topography of the Cliff site area is steep, very rugged, and highly dissected by drainages which join with the Verde River. The area includes Precambrian granite and pyroxenite, Tertiary lake deposits and volcanics, and Quaternary basalt and alluvium. The dam site is underlain by Precambrian granite. The granite is extensively fractured and faulted, and varies from coarse to relatively fine grained with no distinct contact between the two. The Cliff Dam site is located in a region of low seismicity so a large damaging earthquake is not expected in this area. However, a potentially active fault has recently been located to the west of Horseshoe Reservoir. Uranium occurrences have been noted at Chalk Mountain, Lime Creek, and near Horseshoe Dam, and there has been limited mineral exploration in the area; however, development of claims is not known to have occurred.

The soils of the site area vary from clayey, sandy, loamy, gravelly to rocky. Within the site area, there are approximately 130 acres of prime farmland located at the KA Ranch.

(5) Land Resources

Except for the KA Ranch, all of the lands in the vicinity of the Cliff site are Tonto National Forest lands controlled and managed by the U.S. Forest Service for wildlife habitat, water storage, recreation, and livestock grazing. The major land use features currently located within the Cliff site area are the Horseshoe Dam and the 2,800-acre Horseshoe Reservoir which would be replaced by Cliff Dam and Reservoir. No other significant developments have occurred in the vicinity of the Cliff site area given the predominantly public land ownership pattern.

3. New/Modified Roosevelt Site Area

a. Geographic Setting

The New/Modified Roosevelt Dam site area encompasses the existing Roosevelt Dam and Reservoir, located at the confluence of Tonto Creek and the Salt River about 80 miles east of Phoenix (see Figure III-1). Roosevelt Dam was constructed in 1911 for water storage and is currently operated by the Salt River Project. Roosevelt Lake has an approximate 17,000-acre surface area and an 88-mile shoreline at maximum design capacity. Primary access routes to the Roosevelt dam site area are State Routes 88 (Apache Trail), 188, and 288. The affected site area for construction of New/Modified Roosevelt Dam includes approximately 81,000 acres.

b. Biological Resources

The Roosevelt site area has two somewhat dissimilar drainages feeding into Roosevelt Lake. The Salt River flows from the east through a deeply incised, narrow canyon, while Tonto Creek flows from the north through a broader valley where riparian forests are well developed. The surrounding hillsides are part of the paloverde-mixed cacti community. Table III-9 presents acreages and ranges for biotic community types within the Roosevelt site area.

(1) Riparian/Wetland Communities

Riparian forests and woodlands are primarily confined to Tonto Creek and the Salt River. Tonto Creek supports stands of mature cottonwood, willow and mesquite which harbor many resident and migrating bird species. Saltcedar is prevalent along the Salt River within the site area.

(2) Other Terrestrial Communities

The upland habitat type is the paloverde-mixed cacti community; the blue paloverde-ironwood association occupies large washes in the site area and several alluvial benches on the perimeter of Roosevelt Lake. Wildlife is abundant; coyote, deer and javelina have been noted in the site area during CAWCS surveys. Springs are present along the perimeter of the lake and in the Salt River channel downstream of Roosevelt Dam. The abundant cliff habitat along the Salt River harbors localized populations of specialized plants, and animals.

Table III-9

ACREAGE AND PERCENT RANGE OF BIOTIC COMMUNITY SERIES AND ASSOCIATIONS AT THE ROOSEVELT SITE AREA

	Symbol	Percent	Acres
Desert upland:			
Paloverde-mixed cacti series	PC	69.3	56,130
Blue paloverde-ironwood association	CB/RA	4.4	3,540
Riparian and wetland types:			
Fremont cottonwood-Goodding willow association	CW/PS	0.5	380
Velvet mesquite association	MS/PJ	2.0	1,650
Saltcedar association	SD/TC	1.1	880
Saltcedar-mixed scrub association	SD/SC	0.2	170
Human-dominated types:			
Agricultural lands	AG	0.2	120
Other resource categories:			
Lake (typical year high)		17.9	14,520
Lake (typical year low)		14.7*	11,930*
Flowing stream (miles)			15*
Nonvegetated lands		4.4	3,580
Total		100.0	80,970

*Not included in the total.

Source: Second Level Environmental Inventory, CAWCS, 1982.

(3) Perennial Stream/Riverine Communities

The Salt River and Tonto Creek constitute 15 miles of perennial stream within the site area when Roosevelt Lake is at 2,094 foot elevation. Riverine fishes occurring on the Salt River include native and introduced species. The reach upstream of Roosevelt Lake has been studied by the Arizona Game and Fish Department as a site for reintroduction of the razorback chub. Tonto Creek is subject to occasional cessation of flow. Fish that occur are essentially the same species that occur in Roosevelt Lake.

(4) Other Aquatic Communities

Roosevelt Lake is a large and important self-sustaining fishery resource in central Arizona. The reservoir is relatively stable in that it is only occasionally subjected to severe drawdown conditions. The fish population is predominantly introduced species. As in many other central Arizona impoundments, the lake bed is made up of rocky substrates overlain by silt conveyed by the main feeder streams.

(5) Threatened and Endangered Plants and Wildlife

A bald eagle breeding area is located near the confluence of Pinal Creek and the Salt River, upstream of Roosevelt Lake. The eagles are known to forage upstream of the nest site and downstream from the Medler Point vicinity to Roosevelt Lake.

The osprey, black-crowned hight heron, desert tortoise, and Gila monster which are State of Arizona special status species, occur in the vicinity of Roosevelt Lake.

(6) Management and Special Use Areas

Grazing allotments around Roosevelt Lake are managed by the Tonto National Forest. The Tonto Creek end of the lake and vicinity are considered wintering areas for the bald eagle and peregrine falcon. A variety of waterfowl is known to winter at the lake, and portions of the shoreline are closed to public access in the winter. Access to the Pinal Creek nesting area will be curtailed in the future, and habitat improvement such as planting cottonwood trees is being considered.

The Arizona Game and Fish Department manages a waterfowl refuge located on the northeast and west shorelines of the Tonto arm of the lake primarily for migratory waterfowl. The Three-Bar Wildlife area also borders the lake and the Salt River downstream of Roosevelt Dam providing excellent habitat for wildlife.

c. Recreation

(1) Stream-Oriented Recreation

Existing stream-oriented recreation resources and facilities in the Roosevelt site area are within the Tonto National Forest and are managed by the U.S. Forest Service.

Within this area are a total of 14.9 stream miles. The Salt River accounts for 9.5 miles of stream and Tonto Creek represents the remaining 5.4 stream miles. No stream-oriented facilities have been developed by Tonto National Forest in the Roosevelt site area. Stream fishing

activity within the Roosevelt site area accounts for 7,979 annual recreation days.

(2) Reservoir-Oriented Recreation

The recreation use potential of Roosevelt Lake is somewhat diminished by fluctuating water levels and inaccessibility. For the purposes of impact assessment, the surface area of the lake that exists at least 50 percent of the time during the recreation season has been used. This area equals 13,341 surface acres.

Ten recreation areas are managed by Tonto National Forest at Roosevelt Lake. A total of 290,000 visitor-days were spent at these sites in FY 1980. Most visitor-days were associated with camping and fishing.

The total number of annual recreation days for reservoir-oriented recreation at Roosevelt is 349,477.

d. Cultural Resources

(1) Prehistoric Resources

At the Roosevelt site area there are approximately 1,495 prehistoric archaeological sites which cover a combined area of roughly 2,662 acres (Arizona State University, 1981; Arizona State Museum; Tonto National Forest).

Sites predicted to occur in the area include 487 artifact scatters. Pueblo sites at Roosevelt include one room sites (492 predicted to

occur), 2-5 room sites (299 predicted to occur), 6-20 room sites (175 predicted to occur), 21-100 room sites (38 predicted to occur), and sites with greater than 100 rooms (2 predicted to occur). Many of the one room sites are small (4 square meters) and have a very low artifact density indicating they were probably not used as permanent living quarters. The larger sites (20-100 rooms and greater than 100 rooms) at Roosevelt tend to be located along the larger drainages which flow into the Salt River.

Two other types of sites include petroglyph (1 predicted to occur) and agricultural sites (1 predicted to occur). Special features include an estimated 166 trash mounds and 1,476 individual water and soil control devices.

There is evidence indicating the earliest occupation in Tonto Basin occurred between 5000 B.C. and 1000 B.C. (Huckell, 1973). The major occupation seems to have started with the Colonial Period of the Hohokam which dates from A.D. 500 to A.D. 900. This period marks the start of the sedentary occupation of Tonto Basin. The next major occupation ranges from A.D. 1100 to A.D. 1400 and is attributable to the Salado (Fuller et al., 1976). Less is known about the time period from A.D. 900 to A.D. 1100. Some sites have been recorded which date to this time interval, but the Hohokam-Salado transition is poorly understood. Work by Doyel (1977), however, supports a continual occupation of the basin. Between A.D. 1400 and A.D. 1450, the Salado abandoned the area for reasons which are still unclear.

The current condition of the archaeological resources in the Roosevelt site area is considered fair to poor. Sites with noticeable

architectural features have been vandalized with equipment ranging from shovels to bulldozers and front-end loaders. Certain sites have also been disturbed by recreation activities, fluctuations in the water level, and permanent inundation.

The sites in the Roosevelt site area form a data base which is one of the most complex and at the same time poorly understood in central Arizona. Located strategically between the Hohokam core area to the southwest and the Mogollon core area to the north, the prehistoric occupants of this area served a crucial function in regional economic and socio-political activities. Of equal importance, intra-regional indicators such as site size, number of rooms at a site, and artifact diversity suggest a network of independent competing communities internally organized. These sites also reflect a wider diversity of architectural styles than is usually observed in the Southwest.

The prehistoric cultural resources in the Roosevelt site area, as an archaeological district, have significant information potential.

(2) Historic Resources

Sixty historic period sites are recorded within the Roosevelt site area. All but three of these are considered significant because of their scientific or historic value. Agricultural, irrigation, and water control sites, mainly from the Roosevelt Dam construction period, constitute 75 percent of the historic resources at Roosevelt. Irrigation and water control functions can be assigned to 22 sites and structures. These include Roosevelt Dam (a National Historic Landmark), the power canal and

its several related sites, Government Hill, and a number of construction camps and their appurtenant trash disposal areas. Twenty sites are associated with agricultural pursuits, primarily ranching and both patented and unpatented homesteading. Five transportation-related sites and structures include an 1881 road, Highway 188 constructed in 1905-1907, and a 1920 truss bridge.

Today only two historically important unincorporated villages remain. Cline exists totally as an archaeological site, and Roosevelt is still a functioning settlement. Religion-related sites are a church site and the Cline family and Roosevelt cemeteries. Finally, four sites consist of trash deposits, the origin of which is uncertain.

The Roosevelt area is characterized by a long and eventful history beginning with the Apachean occupation. It is not known when the first non-Indians entered the region, but fur trappers traveled along the Salt River on at least two separate occasions in the early 1800s. Military excursions occurred at numerous times, but only one permanent camp, Camp Reno, was established. It was built in 1867 and abandoned in 1870. During the same period, prospectors began searching for gold and other valuable minerals, but with little apparent success. No major travel routes or roads went through the area; it was bypassed by the large exploration and mapping expeditions of the mid-1800s. No sites of these early occupants and users have been discovered within the Roosevelt site area.

The first homesteader-rancher to enter the area was a hog rancher who settled in Greenback Valley in 1875. Soon, the area was

blanketed with ranches and homesteads. The last patent for a homestead is dated 1924, although the site was initially settled in the 1890s.

The isolated, remote character of the Roosevelt area changed abruptly beginning about 1903 with the construction of Roosevelt Dam. The dam not only brought better roads, better communication facilities, electricity, and other amenities, but also inundated homesteads and ranches, farmlands, buildings, roads and trails, and familiar landscape. The dam construction project also brought the government and tourists.

Preparation for construction of Roosevelt Dam began in 1903. Brick and lime kilns were established, a cement mill was erected, and construction of the power canal began. The canal was not ready for use until 1906. Work on features directly related to the dam began in 1903 and work on the actual dam began in 1906. During this period, the now submerged town of Roosevelt developed. It provided hotels, cafes, a post office, and recreation facilities for management personnel, labor, government officials, and visitors during the construction period. In addition to the town of Roosevelt, large housing complexes for laborers were developed near the cement mill and by the dam contractor at Hotel Point. Nearly 2,000 individuals are said to have occupied Roosevelt during the construction period.

Upon completion of the dam in 1911, the camps broke up, construction facilities were dismantled and moved or sold, and in 1917 the Bureau of Reclamation turned over the dam and all of its facilities to what is now known as the Salt River Project.

Roosevelt Dam is listed on the National Register of Historic Places and is a National Historic Landmark. One reason for being so designated is that it is the highest masonry dam in the world.

e. Social Resources

Four communities at Roosevelt Lake would be directly affected by relocation: Rockhouse Farm, Roosevelt Lake Estates, Roosevelt Gardens East, and North Bay Estates. A large number of the people in each of these communities are part-time residents.

People living at Roosevelt Lake are geographically divided into two distinct populations: those living on the east (Globe) side and those living on the west (Payson) side of Roosevelt Lake. Residents living on the same side of the lake share facilities and participate in the same social events and community projects. Very little social interaction occurs between east- and west-side residents. Rockhouse Farm and Roosevelt Lake Estates are located on the east side, while Roosevelt Gardens and North Bay Estates are on the west side of the lake. Three ranches on the east side and ten ranches on the west side would be affected by the project.

The east-side communities differ from the west-side communities in two important ways. First, the east side is more developed than the west side. The population is denser and neighborhoods appear more residential. Second, there are more businesses on the east side and they cater primarily to the tourist trade. Lakeview Marina, located near the dam on the east side, provides a place to dock and service boats. Roosevelt Lake

Resort is also located on the east side. A small gas station is located near the resort, and Spring Creek Store, a large grocery store, is about 1 mile away. In addition to these businesses, a small store is located at Rockhouse Farm.

The formal organizations on the east side are the Women's Club and the Roosevelt Community Association. Most members of both organizations are from Roosevelt Lake Estates, the oldest and most stable community. However, residents from the other communities frequently participate in projects and events sponsored by either organization.

The communities on the west side are not as developed as those on the east side of Roosevelt Lake. There are more uncleared lots and more lots without buildings, houses, or trailers. There are also fewer businesses.

There are only two small stores in the vicinity: Punkin Center Store and Angler's Inn. The Punkin Center Store, besides stocking groceries and some fishing and camping supplies, contains a lunch counter and a small bar. It serves as a central meeting place for west-side residents; however, residents generally travel to Payson for most supplies and services.

The only formal organization on the west side is the Homemaker's Club. Nonetheless, residents do support community activities.

(1) Rockhouse Farm

The rural desert community of Rockhouse Farm is located on the southeast side of Roosevelt Lake, near where the Salt River enters the

lake. The community and the Rockhouse general store which serves it were initially established about 17 years ago. The property at Rockhouse Farm has been owned by the same family since the early 1930s. Forty-seven people reside at Rockhouse Farm. Of these, 31 are full-time residents and 16 live there part-time. All of the residents of Rockhouse Farm live in mobile homes, virtually all of which are leased. Nearly all of the 31 full-time residents are retired persons living on fixed incomes (pensions and/or social security). Four children live in the community, as well as a few nonretired persons, most of whom work in the Globe-Miami area.

No formal social structure exists in the community. There is no formal decision-making group, and the residents do not think such an organization is needed. Informal support networks are minimally developed. Although people see each other frequently, their interaction is primarily a consequence of their proximity.

(2) Roosevelt Lake Estates

The community of Roosevelt Lake Estates on the southeast side of the lake is located on 156 acres of private land surrounded by the Tonto National Forest. The population is estimated to be 359 of which about 60 percent (215) are full-time residents and 40 percent (144) are part-time residents. Approximately 200 of the residents are retired persons, most of whom live on fixed incomes with limited resources. Children comprise about 24 percent (87) of the population, and those school-aged children who are permanent residents are bused to the Globe-Miami area for school.

The average length of residency is about 6 years for full-time residents. About half of the residents live in houses, and half live in mobile homes. Of those who live in mobile homes, many have made them more permanent by building additions to them.

Interaction on an informal basis is both frequent and meaningful for residents. Formal organization and decision-making processes are not highly developed in Roosevelt Lake Estates. The Community Homeowners Association acts as a representative of the community. While the community has a large proportion of part-time residents and does not have well-developed formal organizations, it remains a cohesive community.

(3) Roosevelt Gardens East

Roosevelt Gardens East is located about 7 miles southeast of Punkin Center on the eastern boundary of Tonto Creek. It is a private residential community which has been developed since 1970. There are about 72 permanent and 58 part-time residents living in the community, although population numbers fluctuate. Most of the permanent residents live in houses; part-time residents live primarily in mobile homes. Of the permanent residents, most are retired individuals living on fixed incomes. The young children who are permanent residents attend school at the Punkin Center School 7 miles away. High school age children attend school in Payson.

There is no formal decision-making process in the community, and the Homemakers Association is the only official organization.

However, residents do support community projects and interact frequently on an informal level.

None of the roads in the area are paved; the community is accessible only by crossing Tonto Creek. When the creek rises, residents of Roosevelt Gardens (and North Bay Estates) are temporarily cut off from the other communities.

(4) North Bay Estates

North Bay Estates is a small, relatively new community located approximately 2 miles south of Roosevelt Gardens East on the northwest side of Roosevelt Lake. Approximately 60 residents live in the community, 20 of whom are full-time. Half live in houses and half live in mobile homes, many with additions that make them more permanent. Homes in the area are typically quite large. Almost all of the 20 full-time residents are elderly, retired individuals in good health with moderate-to-high incomes. There are no children living in North Bay Estates.

The development of a formal social structure is minimal. There are no official organizations in the community. However, people informally interact with each other frequently, and help each other when needed, especially during emergencies.

There was concern by all residents that if they were relocated, there would be considerable expenses for which they would not be reimbursed. However, if relocations were necessary, they wished to remain in the area close to their current neighbors, where they could enjoy the independence and privacy that originally attracted them to the community.

(5) Profile of Roosevelt Lake Residents

While each of the four affected communities have unique features, generalizations can be made about all of the Roosevelt Lake residents. Collectively, their most distinguishing characteristic is their commitment to a rural, independent lifestyle. They relish their isolation and the peacefulness of the rural, desert setting. Residents spend a great deal of time out-of-doors. The area is very scenic, and residents have a deep appreciation of nature. The lake is an important feature of the residents' lifestyle and their primary source of recreation.

f. Other Resources

(1) Air Quality

No air quality data other than TSP data are available from the vicinity of Roosevelt Dam. Although the data are based on a very limited number of samples, they indicate that the federal and state primary standard was probably not violated in 1980. There is no particular reason to expect that any federal or state ambient air quality standards are currently being violated in the area.

(2) Aesthetics

Visitors to the Roosevelt site area initially receive two dominant visual impressions. The first is a striking view of the 300

foot high, stone faced Roosevelt Dam anchored in a deep rock canyon. The second is a large, attractive lake with a recreation pool of over 13,000 acres. From the dam, this placid body of water, approximately 2 miles wide, stretches 10 miles to the east and a similar distance to the west. At the east end of the lake cottonwoods and other types of riparian vegetation grow in abundance. Most of the remainder of Roosevelt Lake is surrounded by sparse vegetation creating a bold distinct pattern of blue water contrasting with the various earth tone colors of the desert.

(3) Noise

Day-night sound levels are typically below 55 dB. Jeep and motorbike activities along local trails, traffic on Apache Trail (State Route 88) and the perimeter lake roads, and motorboat activities on the lake contribute to the maximum sound levels within the area.

(4) Geology/Soils

The topography of the Roosevelt site area varies from near-flat or gently sloping in the floodplains of Tonto Creek and the Salt River, to gently rolling hills adjacent to the floodplains, to very steep and rugged terrain in the mountains. Drainage of the site area is into Tonto Creek, a tributary of the Salt River, and into the Salt River from numerous washes, gullies and creeks which dissect the surrounding hills. The area includes Precambrian granite, limestone, quartzite, conglomerate, and shale; Precambrian to Tertiary diabase; Cambrian sandstone and quartzite; Carboniferous to Devonian limestone, shale, and sandstone; Tertiary dacite, gravel, sand, and conglomerate; and Quaternary to Tertiary gravel, sand, and

silt. The foundation of the existing dam consists of hard, thickly bedded, fine grained, dense, lightly jointed Cambrian quartzites and sandstones. Although several faults have been noted in the area, there is no evidence of Quaternary movement. A large damaging earthquake is not likely in this area; however, rockslides are possible in areas with steep rock slopes if there is a seismic event. Although there are several mineral deposits within the site area boundary, current information indicates that they are abandoned. There are numerous oil and gas leases in the area but there has been limited activity and no oil or gas has been found as yet.

The soils of the site area vary from silty to clayey to sandy to gravelly in composition. There is no prime farmland within the Roosevelt site area.

(5) Land Resources

Roosevelt Dam and Lake Roosevelt are the dominant land use features in the site area. Since the construction of the existing Roosevelt Dam in 1911, some recreational facilities have been developed on public lands on the periphery of Roosevelt Lake and limited urban/built-up areas have occurred on some small private land holdings in the general vicinity. These include the U.S. Forest Service's Horse Pasture, Porter Springs, and Windy Hill Recreational Areas and the small residential communities of Roosevelt Lake Estates, North Bay Estates, and Roosevelt Gardens. Except for these developments, the land area within the Roosevelt site area is open space desert rangeland which is passively used for wildlife habitat, water storage, recreation, and livestock grazing purposes.

The 80,970-acre Roosevelt site area lies exclusively within the boundaries and under the administrative control of the Tonto National Forest, Tonto Basin Ranger District. Exceptions to public land ownership include inholdings of privately owned lands, lands which have been withdrawn by the U.S Bureau of Reclamation for the existing Roosevelt Dam and Lake, and lands similarly withdrawn along the Salt River corridor for water reclamation purposes by the Salt River Project. Three other parcels within the Roosevelt site area have also been set aside as publicly-managed special use areas: the 1,120-acre Tonto National Monument, the 38,897-acre Three Bar Wildlife Management Area, and the 7,680-acre land/11,500-acre water Salt River Natural Wildlife Goose Refuge Management Area. Additionally, the segment of the Salt River immediately upstream of Roosevelt Lake has been determined to meet criteria for possible Congressional designation as a wild and scenic river.

4. Confluence Site Area

a. Geographic Setting

The Confluence Dam site is located at the confluence of the Salt and Verde Rivers, approximately 3.5 miles upstream from the existing Granite Reef Diversion Dam, and approximately 25 miles northeast of Phoenix (see Figure III-1). Primary access to the site area is provided by Beeline Highway (State Highway 87), Bush Highway, and Usery Pass Road. The affected site area of Confluence Dam and Reservoir includes 70,400 acres.

b. Biological Resources

The Confluence site area, with the juxtaposition of five different riparian habitats and the convergence of two perennial streams, is considered highly important in the southwestern United States because of its wildlife habitat diversity. Three breeding areas of the endangered bald eagle occur in the area. The endangered Yuma clapper rail and several species of Arizona listed-threatened and unique wildlife also occur at the Confluence area. Table III-10 gives acreages and ranges for biotic community types within the site area.

(1) Riparian/Wetland Communities

Cottonwood-willow forest grows on sand and gravel bars adjacent to the Salt and Verde Rivers, including a large stand called the Blue Point Cottonwoods. Mesquite woodlands occur on well-drained sandy terraces along both the Salt and Verde Rivers. These "bosques" are characterized by mature trees up to 30 feet tall and 3 feet in trunk diameter growing in savanna-like stands. Stands of saltcedar, mixed scrub, and cattail marsh make up the other riparian habitats.

(2) Other Terrestrial Communities

The paloverde-mixed cacti community forms the prevalent biotic community of hillsides and mesas, supporting essentially the full array of Sonoran wildlife. Along washes the blue paloverde-ironwood association grows in response to greater moisture availability. Rock outcrop and cliff habitat on the south side of the Salt River are important as wildlife habitats.

TABLE III-10

ACREAGE AND PERCENT RANGE OF BIOTIC COMMUNITY SERIES AND ASSOCIATIONS AT THE CONFLUENCE SITE AREA

	Symbol	Percent	Acres
Desert upland:			
Paloverde-mixed cacti series	PC	77.9	54,870
Blue paloverde-ironwood association	CB/RA	2.3	1,600
Riparian and wetland types:			
Velvet mesquite association	MS/PJ	10.4	7,290
Mixed scrub series	SC	0.5	370
Saltcedar association	SD/TC	0.5	330
Fremont cottonwood-Goodding willow association	CW/PS	1.3	880
Cattail series	CT	0.04	30
Human-dominated types:			
Agricultural lands	AG	0.4	300
Developed and urban lands	DV	2.2	1,540
Other resource categories:			
Lake		0.9	630
Flowing stream			(35 miles)*
Nonvegetated lands		3.6	2,560
Total		100.0	70,400

*Not included in total.

Source: Second Level Environmental Inventory, CAWCS, 1982.

(3) Perennial Stream/Riverine Communities

The Salt and Verde Rivers and Sycamore Creek constitute about 35 miles of perennial stream in the Confluence site area. The Salt River contains few deep pools; the reach between Stewrt Mountain Dam and the the confluence is composed mostly of broad shallow riffles over a cobble bed. The Verde River grades from a cobble bed at the north end of the site area to sands and gravel at the confluence, with long quiescent stretches on the Salt River below the confluence. Both rivers are subject to wide fluctuations in flow. Both native riverine fishes and introduced species are present. Rainbow trout are stocked in the Salt River by the Arizona Game and Fish Department.

(4) Other Aquatic Communities

A portion of Saguaro Lake and the Granite Reef diversion pool are included in the site area. No lake habitat occurs in the area which would be directly affected by a dam at the confluence.

(5) Threatened and Endangered Plants and Wildlife

The Yuma clapper rail and bald eagle are endangered species that inhabit the Confluence site area. As many as four Yuma clapper rails have been simultaneously observed about 2 miles upstream from the confluence.

Three bald eagle breeding areas have been identified within the Confluence site: 1) the Bartlett breeding area about 2 miles downstream of Bartlett Dam on the Verde, 2) the Fort McDowell breeding area

near the Sycamore Creek-Verde River confluence, and 3) the Blue Point/Stewart Mountain breeding area on the Salt River between Stewart Mountain Dam and the confluence. The eagles which use these breeding areas forage along the rivers between Stewart Mountain Dam, Sycamore Creek, and the Granite Reef Diversion Dam. According to the U.S. Fish and Wildlife Service, the Blue Point/Stewart Mountain breeding area is the most productive of the five bald eagle breeding areas present in the CAWCS study area. Arizona threatened and unique species also occur at the site. The zone-tailed hawk, black hawk, osprey, black-crowned night heron, and Gila monster have also been observed in the Confluence site area.

(6) Management and Special Use Areas

Biological resources on the Fort McDowell and Salt River Indian Reservations are controlled by the Indian communities, with priority use granted to resident citizens. The Tonto National Forest maintains grazing allotments bordering Saguaro Lake and the Salt River, and is engaged in habitat rehabilitation in the Blue Point vicinity and along the Verde River north of the Fort McDowell Reservation.

Public access is restricted in the Blue Point cottonwoods and cattail marsh areas on the north side of the Salt. Mature stands of cottonwood and mesquite are considered good birding areas by the Maricopa Audubon Society; such stands on the south side of the Salt are included in the Tonto National Forest Lower Salt River Recreation Area.

c. Recreation

(1) Stream-Oriented Recreation

Stream-oriented recreation resources at the Confluence site consist of 12.1 stream miles on the Salt River, 19.0 miles on the Verde River, and 3.8 miles on Sycamore Creek. Most recreational activity takes place on the Salt River in the Lower Salt River Recreation Area. Tubing is the primary activity along the Salt River from Stewart Mountain Dam to the confluence with the Verde River. This represents a unique and easily accessible recreation experience that is not duplicated elsewhere in central Arizona. Within the site area, tubing is found along the lower Salt River and to a lesser extent on the Verde River where low flows restrict tubing to spring months and accounts for 2,168,000 maximum annual recreation days. Stream fishing is also common along streams within the Confluence site area.

Three stream-oriented recreation areas managed by Tonto National Forest are located along the Salt River in the Confluence site area. No recreation facilities are found on either the Salt River or Fort McDowell Indian Reservations.

A total of 2,201,114 maximum annual recreation days are associated with stream-oriented recreation in the Confluence site area.

(2) Reservoir-Oriented Recreation

Reservoir-oriented resources and facilities at the Confluence site area are centered around Saguaro lake, located in Tonto National Forest. Saguaro Lake has an average surface area of 630 acres

during the recreation season (April to October) and is very intensively used for boating; over 20,000 maximum annual recreation days are attributable to fishing, powerboating, waterskiing, and non-powerboating activities.

Three major recreation sites are located within the Confluence site area at Saguaro Lake. According to the U.S. Forest Service, a total of 114,000 visitor-days were associated with these sites. Swimming and picnicking are the most frequent activities of visitors. The lake area has a parking capacity of 200 cars and is often filled on weekends during summer. A total of 89,549 maximum annual recreation days are associated with reservoir-oriented recreation at the Confluence site.

d. Cultural Resources

(1) Prehistoric Resources

It is estimated that 263 prehistoric sites are located in the site area covering a combined area of approximately 7,743 acres. About 201 artifact scatters are predicted to occur. Many of these sites are associated with trash mounds, and in such instances it is very likely that the remains of Hohokam-style pithouses can be found at such sites.

Pueblos, which are less common at the Confluence than at the Cliff or Roosevelt site areas, include one room sites (5 predicted to occur), 2-5 room sites (23 predicted to occur), and 21-100 room sites (one predicted to occur.

Two other types of prehistoric resources found in the Confluence site area include petroglyph sites (22 predicted to occur) and agricultural sites (11 predicted to occur). Several Hohokam irrigation canals have been documented in the area.

Special features include an estimated 635 trash mounds and 13 ball courts. Ball courts are more common in this area than in any of the other CAWCS site areas. They are connected with ceremonial and religious activities and have been cited as evidence of connections with parts of Mexico.

The number of sites estimated to occur in this site area is much lower than that predicted for the Cliff and Roosevelt site areas. However, while site density is between five and eight times less, the size of the sites is much larger. This is reflected in the total acreage of archaeological remains.

The current condition of the archaeological resources in the Confluence site area is fair to good. Sites have been altered as a result of vandalism, agricultural use, or erosion. Impacts resulting from recreation have been less severe than in the Roosevelt site area.

Because of their location at the confluence of two major rivers, the archaeological resources in this area are a record of unusual and unique prehistoric cultural processes. By controlling and managing trade from the east and north and implementing major irrigation projects, the prehistoric occupants of this area developed a complex level of social and political organization very different from that in other areas of central

Arizona. The prehistoric resources are considered significant as an archaeological district.

(2) Historic Resources

One hundred historic sites and structures are recorded within the Confluence site area; 97 of these are considered significant because of their scientific or historic value.

Seventy of the significant sites are connected in one way or another with agriculture; 15 of these are related to irrigation and water control, and 55 are remains of small, often isolated, Indian and non-Indian farmsteads and homesteads scattered over the area. Sites, in addition to the farmsteads, include the Government Ditch, Jones Ditch, Stewart Mountain Dam and construction camp, Granite Reef Dam and construction camp, and Arizona Dam and construction camp.

Transportation is represented by three sites, and eight sites which have their origin in governmental activities include six military and two U.S. Forest Service facilities. Recreation and mining are represented by one site each. Two lime kilns constructed for the production of lime for building purposes, represent an industrial function. An isolated grave and two cemeteries reflect a religious function. The Fort McDowell cemetery, dating to 1868, is still in use. Finally, nine very small sites consisting primarily of petroglyphs, are classed as miscellaneous.

The history of the Fort McDowell portion of the Confluence site area can be divided into four general periods: the pre-1865

Indian occupation, the 1865-1890 military establishment, the squatter-farmer period of 1890-1903, and the Indian Reservation period of 1903-present. Sites from all of these periods except the first have been located. The Yavapai Indians used the area before the permanent entry of the white man in 1865 and to a limited extent afterwards until 1903 when the Fort McDowell Indian Reservation was created. The U.S. Army constructed Camp McDowell, later Fort McDowell, in 1865 and occupied it until 1890 when the fort was permanently abandoned. In addition to the buildings and structures of the fort itself, an irrigation ditch and fields were developed.

A total of 21 squatters were farming within the old Fort McDowell Military Reservation when, in 1903, President Roosevelt signed an Executive Order transforming it into an Indian Reservation. With this action, the federal government purchased the squatters' improvements and forced them to leave. Since 1903 the reservation has been managed by the Bureau of Indian Affairs and the Yavapai Indians. Until recently, farming has been a major occupation at Fort McDowell.

South of the proposed Confluence Dam site lie the remains of the Arizona Dam, the first major dam on the Salt River. It was in operation from 1895 to 1905 when it was partially destroyed by flooding. This dam provided water for irrigation, and was replaced by Granite Reef Dam in 1906-1908. Remnants of the Arizona Dam remain, as does its construction camp and associated dam tender's facilities.

The Stewart Mountain Dam was erected on the Salt River between 1928 and 1930. Upon completion of the dam, the construction camp was

abandoned and many of the buildings were sold for local use. Some of them were used to develop the Saguaro Ranch Resort.

Along the Salt River between the historic Arizona Dam site and Stewart Mountain Dam are a number of sites reflecting the varied uses to which the area has been put. Homesteading and ranching activities, more or less contemporaneous with those at Fort McDowell, are evidenced at a number of sites on the south side of the Salt River. Very few of these were ever patented and thus very little information is available about them. All are now on the Tonto National Forest.

Mining was very limited in the area because of the lack of minerals in marketable quantities. An exception is an extensive barite mine on Coon Bluff in operation from about 1931 to 1955. Two kilns reflect a small but active business of processing limestone for the manufacture of lime on the north side of the river. Sites attributed to both the Civilian Conservation Corps and the U.S. Forest Service were recorded, including a CCC campsite, the Blue Point Ranger Station, and the Blue Point Administrative Site.

e. Social Resources

The Fort McDowell Indian Reservation encompasses 24,680 acres of land northeast of Phoenix. The Verde River runs through the reservation and converges with the Salt River about 1.5 miles from the southern boundary of the reservation. The current population of the reservation is reported to be 374, with most people identifying themselves as members of the Yavapai Tribe.

(1) History

The earliest evidence that the Yavapai lived in the area that includes the current reservation boundaries dates to 1539. It is likely that they occupied the area even long before that. For the last 100 years, Yavapai history has largely been defined by implemented or threatened compulsory relocation by the U.S. Government. Bloody Basin, Skeleton Cave, and Skull Valley are places in Arizona named following Yavapai encounters with the military, in which many Yavapai were killed. In 1872, the Yavapai were forced to move to Rio Verde Reservation near Camp Verde. After successfully establishing farming on the reservation, the Yavapai, in mid-winter 1875, were marched from Camp Verde to the San Carlos Reservation, a distance of 180 miles. During this March-of-Tears, as it is called by the Yavapai, many became ill and died or were killed. The Yavapai were allowed to leave San Carlos in 1889, and a group returned to their ancestral land, settling at Camp McDowell, an abandoned military post. In 1903, Theodore Roosevelt, by Executive Order, established Fort McDowell as a reservation. From 1910 until 1931 the U.S. Government made repeated attempts to remove the Yavapai from Fort McDowell to the Salt River Reservation. The tribe consistently opposed their relocation. Beginning in the early 1950s, the construction of a dam at the confluence of the Salt and Verde Rivers (first called Maxwell Dam, then Orme Dam, and finally Confluence Dam) was proposed and would have required the relocation of the Fort McDowell Community.

The tribe has strongly opposed relocation because of dam construction at the confluence. Because of residents' past experiences with compulsory relocation, and since many of the current Fort McDowell residents

had relatives who participated or even died in past relocation attempts, any proposed relocation remains a volatile issue.

(2) Meaning of the Land

The land at Fort McDowell has psychological, historical, religious, and economic significance for the Yavapai. Land represents stability and is crucial to transmission of Yavapai culture. The land is viewed like a trust fund which is passed on to future generations. Land also represents security since it provides a constant source of food, drink, shelter and recreation. Residents make use of its renewable resources to supplement their incomes; many cut and sell mesquite wood for firewood to supplement their incomes and basketweavers sell baskets made out of the willow, cottonwood, and devil's claw that grow on the reservation.

The land has important religious significance for the residents. There are many sites on the reservation that are considered sacred or holy, including prehistoric cultural sites. Many aspects or practices of traditional tribal religion (parts of which are incorporated into Christianity as practiced by the residents) are linked directly to specific locations on the reservation. Sacred sites are considered inviolate, and the Yavapai believe they should not be disturbed or altered in any way. One of the most sacred of known sites at Fort McDowell is the cemetery, which could be flooded or made inaccessible by plans which include Confluence Dam and Reservoir. The importance of preserving the sacredness of the cemetery was emphasized by many residents in interviews conducted by CAWCS researchers.

While many residents rely on the land to supplement their incomes, many others rely on it for their primary source of income. The Verde River, the vegetation that exists, the flat terrain and the ample space combine to make the land at Fort McDowell extremely well suited for grazing. Currently, about 600 acres are being farmed, including an experimental tribal farming operation. The economic developer for the tribe projects that by the year 2000 the tribe will be farming 4,000 acres of land along with an additional 1,000 acres devoted to experimental arid crops.

Besides agriculture and livestock, there are other land-dependent sources of revenue critical to the Fort McDowell economy. The City of Phoenix's well field on the reservation generates $100,000 per year. The sand and gravel operation has a potential for generating one-half million dollars a year, according to a University of Arizona study. The current economy as well as the tribe's economic development policy hinges on the use of the valuable resources at Fort McDowell.

The significance of the land for the Yavapai was frequently reiterated in the interviews. Residents described their land as "our mother", "our heart", "our life", "our home". They expressed deep attachment to the land and said that other land would not have the same meaning for them. Residents stated that neither money or other land would adequately compensate them for the loss of the reservation.

(3) Social Organization

Fort McDowell is an extremely cohesive community. Most residents are related to each other either by birth or marriage; they share a

distinct culture, a common identity and history. They are a remarkably stationary population. Most were born on the reservation and have lived there all their lives, some in the same house. The Fort McDowell community is characterized by extensive informal support networks. Residents interact frequently and many provide each other with daily support. The extended family is crucial to the social organization of the Yavapai community. Grandparents, siblings, grandchildren and cousins typically live with or nearby each other.

Besides well developed informal support networks, the Fort McDowell community also has extensive formal support systems. The community is an Indian chartered corporation as defined by the Indian Reorganization Act of June 18, 1934. The tribe is governed by a tribal council comprised of five members who are elected for two-year terms. Participation in the tribal government is high. In recent years much of the tribe's activity has revolved around their vehement opposition to relocation. Fort McDowell also supports a pre-school program, a center for the elderly, a hot-lunch program for the elderly, a health clinic as well as other programs and facilities for community members. There are currently four churches in the community and their services and activities are well attended and play an integral role in the community organization.

(4) Quality of Life

Residents at Fort McDowell are highly satisfied living in their community. Because of their strong attachment to the community, land and tribe, theirs is not a portable lifestyle. While most residents are

generally healthy, they have experienced an increase in physical and mental health problems attributed to the stress associated with their proposed relocation).

On the basis of educational levels, income, and occupation, most residents would not be ranked very high in social class. Unemployment is a serious problem for the community. The current unemployment rate is 43 percent. Of those employed half earn less than $5,000 annually (Annual Economic Development Report, 1979-80). The mean number of years of formal schooling is 11.3 years. Residents are currently working hard to improve the situation, despite the impediment of their proposed relocation.

(6) Summary Profile

In summary, the Yavapai of Fort McDowell are a people with strong cultural and personal ties to the land; their lifestyle, culture, and identity are dependent on it. They have little experience moving, and they are adamantly opposed to relocation. They constitute an extremely cohesive community and are very dependent on well-established support systems within the community. Because of these characteristics, they are a population for whom relocation would be extremely difficult.

f. Other Resources

(1) Air Quality

No air quality data are available from the vicinity of the Confluence site area; therefore, no accurate quantitative statements

about the local air quality can be made at this time. The Confluence site is located near the eastern boundary of the Maricopa County Urban Planning Area (MCUPA). The area comprising MCUPA has been designated by the U.S. Environmental Protection Agency as a nonattainment area for TSP, carbon monoxide, and ozone, which means that at least one national ambient air quality standard for each of these pollutants is being violated as shown by monitored data or modeling. However, there is no particular reason to expect that any federal or state ambient air quality standards are currently being violated in the immediate vicinity of the site.

(2) Aesthetics

The convergence of two major rivers, the Salt and Verde, provides a visually important component in the Confluence site area. The Salt River flows unimpeded for approximately 9 miles from the Stewart Mountain Dam to the confluence. Through relatively steep topography and prominant high rock cliffs, this stretch of the Salt River winds around bends and sharp curves. The attractive desert composition is further intensified by the mature riparian vegetation that frames each side of much of the river. Approximately 15 miles of the Verde River above the confluence is also located in this site area. Riparian vegetation flourishes along the low land on each shore of the Verde River. Adjacent to the natural riparian vegetation are many irrigated fields cultivated by the Fort McDowell Yavapai. Immediately below the confluence of the two rivers is a small lake created by the Granite Reef Diversion Dam. Mature riparian vegetation is growing on much of the shoreline of this lake.

(3) Noise

No site surveys were undertaken to determine sound levels in the area; however, based on existing literature and data, typical day-night sound levels within local undeveloped areas are estimated to be below 55 dB.

L_{dn} at recreational areas such as Coon Bluff, Blue Point, and Saguaro Lake are estimated to range from approximately 35 to 70 dB; jeep and motorbike activities on trails and roads, vehicle traffic on Bush and Beeline Highways, and motorboating on Saguaro Lake contribute to the maximum sound levels. Peak-hour equivalent sound levels along major haul roads for sand and gravel operations at Fort McDowell are estimated to range from 48 to 61 dB based on available data regarding truck volumes; L_{dn} in the area are generally below 65 dB. An L_{dn} of 65 dB is compatible with the EPA's short-term goals for residential and noise-sensitive recreational areas.

(4) Geology/Soils

The topography of the site area consists of near-flat river channel and floodplain; gently sloping but highly dissected river terraces; low and rolling, highly dissected hills; and rugged to steep mountains. Drainage of the area is into the Verde and upper Salt Rivers, and into the lower Salt River through the Phoenix area. The site area includes Precambrian granite and metamorphosed granite; Cretaceous sandstone, shale, and conglomerate; Laramide granite; Tertiary dacite, sand, gravel, and conglomerate; and Quaternary silt, sand, gravel, and conglomerate. The

foundation of the proposed dam consists of moderately to poorly indurated, weathered conglomerate with an interbed of fresh to weathered, hard to moderately hard tuff. Several faults have been mapped in the area. Recent studies indicate no evidence of Quaternary faulting near the dam site. The potential earthquake hazard is not considered serious.

There are several mineral deposits within the site area, but most mines and prospects are now abandoned. On the Fort McDowell Indian Reservation, there are an estimated 7.5 million tons of sand and gravel which could be extracted. Some of this resource is currently being mined.

The soils of the site area vary from gravelly, stony, sandy, clayey, to loamy in composition. There are approximately 680 acres of prime farmland under agricultural production on the Fort McDowell Indian Reservation. An additional 440 acres may be classified as prime farmland when a dependable water supply is made available. This is anticipated by the year 2000.

(5) Land Resources

Located within the 70,400 acre Confluence site area are portions of the Fort McDowell and Salt River Indian Reservations, McDowell Mountain Regional Park, Tonto National Forest, Arizona State Trust Lands, and the new residential communities of Fountain Hills and Rio Verde, and other privately owned parcels such as Goldfield Estates. Segments of the Granite Reef and Salt-Gila Aqueducts of the CAP, Stewart Mountain Dam/Saguaro Lake, and Granite Reef Diversion Dam/Maxwell Lake are also located in the Confluence site area.

Some small-scale residential, recreational, and other urban developments have occurred in the Confluence vicinity but public (U.S. Forest Service, State of Arizona, and Maricopa County) and Indian (Fort McDowell and Salt River) land ownership patterns are the chief reasons that more extensive urban developments have not occurred in this area. The land areas upstream from the Confluence Dam site along the Salt and Verde Rivers are almost exclusively Fort McDowell and Salt River Indian Reservation lands, and U.S. Forest Service lands within the Tonto National Forest. These lands, for the most part, are presently managed for livestock grazing, water conservation, and general recreational purposes. Limited agricultural and sand and gravel mining operations also occur on the Fort McDowell Indian Reservation. Riparian vegetation is found along most segments of the Verde and Salt Rivers within the area.

The only developments in the immediate vicinity of the Stewart Mountain Dam, other than the existing SRP-operated dam and appurtenant facilities, are the U.S. Forest Service-maintained recreational sites. The open desert rangelands found adjacent to Stewart Mountain Dam/ Saguaro Lake and the riparian vegetation found along the segment of the Salt River just below the dam are also managed by the Forest Service for multiple-use purposes.

5. New Waddell Site Area

a. Geographical Setting

The New Waddell Dam site is located approximately 1/4 mile immediately downstream from the existing Waddell Dam on the Agua Fria River

about 45 miles northwest of Phoenix (see Figure III-1). The New Waddell site area includes 41,080 acres. The primary access to the Lake Pleasant area is via I-17 and Carefree Highway.

b. Biological Resources

The New Waddell site area is characterized by hilly terrain. Biotic communities are typical of the Sonoran Desert. Table III-11 presents acreages and ranges of these communities.

(1) Riparian/Wetland Communities

Riparian habitat consists of stands of saltcedar, mesquite, and mixed scrub along the Agua Fria channel and tributary washes near the upper end of the lake, and along Morgan City wash and the Agua Fria downstream from Waddell Dam. A small stand of cattail marsh habitat grows at Lower Lake Pleasant. This riparian habitat supports wildlife including large mammals. Shorebirds and waterfowl are also known to use Lower Lake Pleasant mesquite and cattail habitats.

(2) Other Terrestrial Communities

Nearly 90 percent of the area is paloverde-mixed cacti series, with the blue paloverde-ironwood association occupying the larger washes which feed into Lake Pleasant. There are five springs in the site area. The cliffs along the Agua Fria channel upstream of the lake provide important wildlife habitat for hawks and other wildlife.

TABLE III-11

ACREAGE AND PERCENT RANGE OF BIOTIC COMMUNITY SERIES AND ASSOCIATIONS AT THE NEW WADDELL SITE AREA

	Symbol	Percent	Acres
Desert upland:			
Paloverde-mixed cacti series	PC	89.6	36,820
Blue paloverde-ironwood association	CB/RA	3.3	1,370
Riparian and wetland types:			
Velvet mesquite association	MS/PJ	0.8	310
Mixed scrub series	SC	0.1	50
Saltcedar association	SD/TC	0.5	210
Cattail association	CT	0.02	10
Human-dominated types:			
Agricultural lands	AG	0.2	70
Developed lands	DV	0.4	150
Other resource categories:			
Lake (typical year high)		4.2	1,720
Lake (typical year low)		2.0*	830*
Nonvegetated lands		0.9	370
Total		100.0	41,080

*Not included in total.

Source: Second Level Environmental Inventory, CAWCS, 1982.

(3) Perennial Stream/Riverine Communities

The Agua Fria River, Humbug Wash, and several of the springs have sufficient flow to maintain riparian vegetation, but are not stable streams for the support of fish populations except in spring-fed pools and ponds along the channel.

(4) Other Aquatic Communities

The Lake Pleasant basin is composed of a decomposed granite bed over which a silt layer has been deposited by the Agua Fria and other streams. The lake is subject to severe drawdown, but normally supports excellent populations of game fish, which also occur in Lower Lake Pleasant.

(5) Threatened and Endangered Plants and Wildlife

A raptor nest observed along the Agua Fria channel upstream from Lake Pleasant has been tentatively identified as a bald eagle nest, and unconfirmed sightings of bald eagles have been made; however, the presence of bald eagles in the site area has not been confirmed by the U.S. Fish and Wildlife Service or the Southwest Bald Eagle Recovery Team.

The Gila topminnow (a Federally listed endangered species) was introduced into Tule Creek north of Lake Pleasant in 1970. The Tule Creek population was surveyed in 1982 and found to be in relatively healthy condition.

(6) Management and Special Use Areas

Grazing in the site area is controlled by the Arizona State Lands Department, which maintains grazing allotments. There are no other specific habitat enhancement or wildlife management areas present.

c. Recreation

(1) Stream-Oriented Recreation

There are minimal stream miles of recreational value in the site area. No stream-oriented recreation facilities are associated with Waddell Dam and Reservoir (Lake Pleasant).

(2) Reservoir-Oriented Recreation

Existing reservoir-oriented resources and facilities in the New Waddell site area are located within Lake Pleasant Regional Park. The park is intensively used by Phoenix area residents.

Reservoir-oriented resources consist of two lakes, Upper Lake Pleasant and Lower Lake Pleasant. Upper Lake Pleasant, located above Waddell Dam, is a regulatory storage reservoir and therefore fluctuates considerably (from a high of 1,640 acres to a low of 747 acres). For at least fifty percent of the recreation season, Upper Lake Pleasant has a surface area of 1,280 acres. Motorized boats are permitted on the lake; however, it is used more intensively for sailboating activities. Lower Lake Pleasant has a surface area of only 75 acres. Located below Waddell Dam, this lake is used primarily for fishing and swimming, as motorized boats are not permitted.

Reservoir-oriented facilities at the upper lake consist of picnicking, camping and fishing facilities. At the lower lake, facilities include picnic tables and a beach. Construction of additional facilities is currently underway at Lake Pleasant Regional Park.

Annual recreation days for all reservoir-oriented activities at Lake Pleasant total 168,646.

d. Cultural Resources

(1) Prehistoric Resources

At the New Waddell site area, there are approximately 138 prehistoric archaeological sites covering approximately 143 acres.

The most common site type at New Waddell is the artifact scatter, of which 70 are predicted to occur. Pueblos at New Waddell include one room sites (27 predicted to occur), 2-5 room sites (13 predicted to occur), and 6-20 room sites (9 predicted to occur). Sites with puebloan architecture tend to be smaller at the New Waddell site area than those in the Cliff and Roosevelt site areas. The one exception may be the Beardsley Canal site which has been partially destroyed through a variety of cultural and natural factors.

Also occurring in the New Waddell area are 11 petroglyph sites. Special features include approximately 6 trash mounds and 82 individual water and soil control devices which are found in association with the types of sites described above.

In general, the sites in the New Waddell area reflect an adaptation to a mountainous uplands region on the northern margin of the Hohokam area. Evidence indicates that trade networks were established between this area and the Salt River Valley. While the resources in this area are not unique, they do represent a largely unstudied data base and have significant information potential as an archaeological district.

(2) Historic Resources

Fifteen historic period sites and structures are recorded within the New Waddell site area; 11 sites reflect significant scientific or historic values. These sites can be grouped into a number of categories. The Phoenix-Prescott Wagon Road is transportation related and the limekiln is associated with industrial production of lime. Nine sites and structures are related to agriculture, including the Mitchell Springs Ranch, the 1893 diversion dam, the Carl Pleasant (Waddell) Dam, the Beardsley Canal, and three associated construction camps.

The earliest historical activity in the New Waddell site area appears to have been that of prospectors and miners in the 1860s and 1870s; however, the level of mining endeavor was never great. Beginning in the 1870s, transportation routes to and from population centers and mining areas near Wickenburg and Prescott were gradually established. Many of these roads ran along or crossed the Agua Fria in the New Waddell site area. The most important of these were a stage route from Wickenburg to Phoenix which was in existence at least by the late 1870s and the Phoenix to Prescott Wagon Road which had been constructed by 1894. The community of Frog Tanks, also known as Pratt, was a stopping place along these north-south

transportation routes. It appears to have been established in late 1889 or early 1890 on the Agua Fria River by William Pratt, a miner. Ranching activities in the New Waddell site area began in the 1870s. Today, only one ranch, the Mitchell Springs site, is represented by physical remains located within the site area. Only four individuals filed on homesteads from about 1916 to 1928.

During the heyday of Frog Tanks, certain activities began which would ultimately come to dominate the cultural landscape of the area. These activities began as relatively small-scale schemes to provide water for irrigation purposes and ended with construction of the Carl Pleasant Dam. The first such scheme was that of the Agua Fria Water and Land Company established on November 10, 1888 by six individuals including William A. Hancock, one of the founders of Phoenix, Arizona. By 1891 the company had proposed to erect two reservoir dams and a diversion dam on the Agua Fria River; however, the project barely progressed beyond the planning stage. Later, W. H. Beardsley of Ohio arrived on the scene and obtained control of the company. In 1893 he formed the Agua Fria Construction Company to actually begin to build the dams. Work began on the diversion dam and canal in 1893 and proceeded haltingly until 1895 when the project ceased. The construction work camp, known as Camp Dyer, was situated on the east side of the dam.

After over three decades of personal struggle to finance the construction of a dam on the Agua Fria River with private funds, Beardsley formed the Beardsley Land and Investment Company in 1925 and, with the financial support of Donald C. Waddell, a financier and investor, began

construction of the dam. At the same time, the Maricopa County Municipal Water Conservation District No. 1 was formed to regulate the use of water from the dam. When the dam was completed in 1927, it was the highest multiple arch dam in the United States. It remains the key element in the largest privately funded irrigation system in Arizona.

Along with the building of the Carl Pleasant (Waddell) Dam, the 1893 diversion dam and the Beardsley Canal were finally completed. Both dams and the canal have remained essentially unmodified since construction. The diversion dam is the oldest such structure in central Arizona still in use.

e. Social Resources

No people in the New Waddell site area would be affected by relocation or flood reduction; therefore, no description of the social setting of the site area is presented.

f. Other Resources

(1) Air Quality

No air quality data are available from the vicinity of Lake Pleasant; however, a portion of the lake is included in the MCUPA which has been designated by the U.S. Environmental Protection Agency as a non-attainment area for TSP, carbon monoxide, and ozone.

(2) Aesthetics

A large portion of this site is occupied by Lake Pleasant Regional Park. Desert vegetation continues down to the shoreline of Upper Lake Pleasant except where riparian vegetation exists in the upper areas of the lake. Lower Lake Pleasant is bordered by riparian vegetation including many large cottonwood trees. Lake Pleasant is a visually-important and well used recreational facility surrounded by the interesting character of the Arizona desert.

(3) Noise

The Lake Pleasant area is minimally developed. The primary area to be affected by noise includes the residential area approximately one mile south of the dam in the vicinity of Lake Pleasant Inn, consisting of fewer than 50 acres. The secondary area consists of those lands within 3 miles of Lake Pleasant, under public ownership and not developed. Day-night sound levels are typically below 55 dB.

(4) Geology/Soils

The topography of the area varies from near-flat to the south and east of Lake Pleasant, to rolling hills and low ridges at the north end of the lake, to fairly steep and highly dissected terrain to the west. The area includes Precambrian metamorphic rocks, Tertiary volcanics and sediments, and Quaternary alluvium. The foundation of the proposed New Waddell Dam site consists of interbedded andesite, tuff, tuffaceous sandstone, and conglomerate. There are numerous faults within the site area; however, there

is no evidence of Quaternary movement near the dam site. There have been no recorded earthquakes originating from this area. A large damaging earthquake is not expected. Uranium-bearing strata are relatively widespread and have been exposed by tributaries to the Agua Fria River at the northern part of Lake Pleasant. Claims were filed in portions of this area; however, subsequent exploration programs failed to reveal unusual amounts of uranium. Recently, there has been mineral activity by groups and individuals exploring for various precious metals, and several oil and gas leases have been filed. To date (1982) no oil or gas have been found.

The soils of the site area vary in composition from loamy, clayey, sandy, to gravelly. There are approximately 70 acres of prime farmland located in the site area.

(5) Land Resources

The Waddell Dam/Lake Pleasant area is primarily an open desert rangeland area which, except for some recreational facilities and service buildings within Lake Pleasant Regional Park, is passively used for wildlife habitat, water storage, and recreational and livestock grazing purposes. The 41,080-acre New Waddell site area is primarily comprised of State Trust lands controlled by the Arizona State Land Department, with some small privately owned parcels and National Resource Lands controlled by the U.S. Bureau of Land Management (BLM). Lake Pleasant Regional Park, which is operated by the Maricopa County Parks and Recreation Department on lands leased from the Arizona State Land Department, covers approximately 14,382 acres, of which 5,686 acres are in Maricopa County and 8,696 acres are in Yavapai County.

6. Downstream Area

a. Geographical Setting

Areas downstream from CAWCS alternative dam sites on the Salt and Verde Rivers are affected by flooding. Additional development opportunities in these areas may result from the implementation of upstream flood control structures. For these reasons, the Salt and Gila River floodplain through metropolitan Phoenix is considered an affected area. The downstream area includes a 42-mile segment of the Salt River floodplain below the Granite Reef Dam extending through the City of Phoenix to the Salt/Gila River confluence, and a 32-mile segment of the Gila River floodplain between the Salt/Gila River confluence and Gillespie Dam.

b. Biological Resources

Human intervention, cessation of historic perennial flows, and subsequent ecological disturbance have greatly modified the riparian habitat within the Salt River channel in the downstream area.

(1) Riparian/Wetland Communities

In the reach from Granite Reef Dam to 91st Avenue, only a few small patches of riparian habitat exist where wastewaters are discharged to the channel. Downstream of 91st Avenue stands of cottonwood, willow, mesquite and cattail are sustained by more consistent flows from irrigation tailwaters and from the 91st Avenue wastewater treatment plant. Great blue herons and a number of waterfowl species, as well as a variety of songbirds, use these riparian habitats. Saltcedar woodlands have replaced

much of the historically more extensive mesquite and cottonwood forests along this reach.

(2) Other Terrestrial Communities

Much of the non-riparian habitat within the upstream reach of the channel is composed of sparse stands of shrub species from the blue paloverde-ironwood desert wash association. In its present degraded condition, such habitat is not conducive to supporting a viable, diverse wildlife community. The creosotebush-bursage series is the predominant desert upland type outside the channel; saltbush scrub and paloverde-mixed cacti communities also occur.

Agricultural and urban areas also occupy large parts of the upstream reach outside the main channel. A variety of rodents and insect- and grain-eating birds are attracted to the agricultural areas.

(3) Perennial Stream/Riverine Communities

Perennial flows are sustained for about 4 miles below the 91st Avenue treatment facility. Carp and mosquitofish make up the bulk of the fish population, but bass and other species are periodically carried down when releases are made from upstream impoundments.

(4) Other Aquatic Communities

Lacustrine (lake) habitat in the channel is essentially nonexistent except where water-filled depressions, like old gravel pits, exist. These small, short-lived ponds sustain few, if any, fish or other wildlife.

(5) Threatened and Endangered Plants and Animals

Numerous sightings of the Yuma clapper rail have been recorded in the reach downstream of 91st Avenue. No endangered plant or other endangered vertebrate species have been reported for the downstream area.

(6) Special Use and Management Areas

The Fred J. Weiler Greenbelt accounts for nearly all the federal land in the reach between the Salt-Gila confluence and Gillespie Dam. The Arizona Game and Fish Department manages more than 2,000 acres of land, including the 400-acre Robbins Butte Wildlife Area, as habitat for game species such as Gambel quail and dove. The reach between 91st Avenue and the Salt-Gila confluence is included in the Maricopa Audubon Society's Christmas Bird Count area.

c. Recreation

Recreation resources and facilities in the downstream area are predominantly urban in character. Very little, if any, water-oriented recreation exists in this area.

d. Cultural Resources

(1) Prehistoric Resources

Portions of the downstream area were subjected to a sample survey. All sites located on this survey were characterized by only a few surface artifacts. Surface architecture was lacking in all cases. The

records search conducted prior to the field work indicated the presence of numerous large Hohokam sites as well as smaller sites, but, in most cases, little or no evidence of these sites was present on the surface. Artifacts and structures associated with these sites are most probably buried under several feet of alluvium.

Despite the fact that these sites have been impacted by a variety of natural and cultural factors, the prehistoric resources in this area have the potential of providing information relevant to the prehistory of the Salt-Gila River Valley and to the prehistory of central Arizona.

(2) Historic Resources

A total of 123 historic sites have been identified in historical records for the downstream area. Eleven of these 123 sites are known to be present due to their notation in recent archaeological and historic site inventories; an additional 63 sites may be present. (This total number of sites which may be present is somewhat misleading since at least 6 sites consist of multiple features or dwellings of from 7 to 100 in number.) The remaining 491 sites have probably been destroyed due to flooding and historical land use activities.

The majority of sites thought to be present within the downstream area consist of houses which were occupied by early residents of Phoenix, Tempe, and Mesa. A few house sites may date from the 1870s, 1880s, and 1890s and would reflect the initial Anglo settlement of the Salt River Valley. Other site types represented include a cemetery, wells,

"Indian Huts" on the Salt River Indian Reservation, early wagon roads, irrigation canals, bridges, a horse race track, mineral prospects, stone quarries, and a dam.

e. Social Resources

The affected area comprises the portion of the metropolitan area of central Arizona which most directly experiences problems associated with flooding in the Salt and Gila Rivers. Communities located in the area have experienced flooding three times in recent years: March 1978, December 1978, and February 1980.

The current population in the 200-year flood inundation area is estimated to be 36,700 persons, which constitutes 2 percent of the 1980 Maricopa County population of 1,508,000 The eastern and western extremities are in a rural, agricultural setting. The central sector contains both residential neighborhoods and mixed residential-industrial commercial use.

Communities located in the downstream site area that have previously experienced problems associated with flooding are:

- City of Mesa
- City of Tempe
- City of Phoenix
- Holly Acres Subdivision
- Salt River Pima-Maricopa Indian Community
- Gila River Indian Community
- Buckeye Area

Mesa, Tempe, and Phoenix are urban areas, while Holly Acres, the Salt River Indian Community, the Gila River Indian Community, and Buckeye are rural areas.

(1) City of Mesa

Mesa, situated in Maricopa County immediately to the east of Tempe along the southern bank of the Salt River, is the third largest city in Arizona and one of the ten fastest growing cities in the United States. The current Mesa population within the 200-year flood inundation area is estimated to be 10,000 people, or 6 percent of the 1980 estimated population of 153,000. A portion of the area, adjacent to the southern bank of the Salt River, is agricultural land. The remaining area is characterized by diverse residential groups including "first home" families, older, established neighborhoods, and some higher cost homes.

(2) City of Tempe

The City of Tempe, home of Arizona State University (ASU), is a community of approximately 107,000 people, situated immediately east of Phoenix. Tempe lies on both banks of the Salt River and portions of the community are susceptible to flooding. The current population residing within the 200-year flood inundation area is estimated to be 1,300, or 1 percent of the total population. The area that would be affected by a 200-year flood is characterized by mixed housing types. Single-family and mobile home units account for over one-third each, and multi-family units account for the rest.

(3) City of Phoenix

The City of Phoenix, capital of the State of Arizona, had a 1980 population of 790,000 and is the largest municipality in the State of Arizona. The City of Phoenix is a very fast-growing community, and as a major urban area, is highly complex.

Phoenix is bisected by the Salt River. Major enterprises, including Sky Harbor International Airport, several large construction companies, and numerous business concerns are in the Salt River floodplain. Approximately 20,000 persons currently reside within the 200-year flood inundation area boundaries, or 3 percent of the total estimated 1980 population. Population in the 200-year flood inundation area has been decreasing, as have the number of dwelling units. Housing units in this area are predominantly rental units, and are at the lower end of the housing value scale.

(4) Holly Acres Area

Holly Acres is an area composed of residential subdivisions within an otherwise agricultural area, located approximately 20 miles southwest of downtown Phoenix in Maricopa County. The community covers 12 square miles directly adjacent to the north bank of the Gila River between 115th Avenue and El Mirage Road, near the confluence of the Salt, Gila, and Agua Fria Rivers. Five subdivisions are located in the area with approximately 400 total residential units and a population of 1,500. The general area has been settled for approximately 15 years. There are several commercial enterprises located in the area.

The subdivision of Holly Acres, containing 50 to 60 homes, has sustained the most extensive flood damage in recent years. The vast majority of dwellings located within the Holly Acres subdivision are relatively new, less than 8 years old.

(5) Salt River Pima-Maricopa Indian Community

The Salt River Pima-Maricopa Indian Community is situated in eastern Maricopa County, immediately east of Scottsdale and north of Tempe and Mesa. The community encompasses 50,000 acres of land and has a population of approximately 3,200 community members and 900 non-Indian residents. The community is divided into two districts, Salt River and Lehi. The districts are separated from one another by the Salt River. The Verde River enters at the northeast portion of the community. The southeast portion of the community (Lehi) has a population of approximately 320 persons, or 8 percent of the community's total population, and is the only area located in the 200-year flood inundation area.

(6) Gila River Indian Community

The Gila River Indian Community is a Pima-Maricopa community which straddles the Gila River and encompasses 372,000 acres of land. The population of the community is 7,500. The community is divided into seven districts. The 200-year inundation area of the Gila River Indian Community is characteristic of the agricultural setting which typifies District 7. The district has recently directed its efforts to expanding its agricultural base as part of an overall emphasis toward greater self-sufficiency.

(7) Buckeye Area (Including Towns of Arlington, Palo Verde and Liberty)

The Town of Buckeye is located 31 miles west of Phoenix in an expansive valley between the White Tank Mountains on the north and the Maricopa Mountains to the south. Buckeye is situated near the Gila River below its confluence with the Salt. The river is gradually shifting northward each time it floods, with the potential for affecting the entire community. Buckeye is a major producer of agricultural crops and cattle.

(8) Infrastructure

In addition to the seven communities described above, a number of area-wide infrastructure systems are located in the Salt River floodplain. These include automobile, air, and rail transportation routes and equipment, public utility lines and towers, telecommunication lines, and numerous business operations.

Major highways in and around the floodplain include the Beeline Highway, the Maricopa Freeway, and Interstates 10 and 17. In addition, a number of transportation routes connect Phoenix with its suburbs, running directly through the floodplain area. There are 29 road crossings in the floodplain, of which 15 are bridge crossings, and the remainder are "dip" or surface crossings.

Air and rail facilities bordering the floodplain include Sky Harbor International Airport and the Southern Pacific Railroad yard and accompanying tracks and equipment. Both facilities are located in Phoenix.

Public utilities that are in or border the floodplain include 2 wastewater treatment plants, 2 sewage treatment plants, 5 sewage lines, 6 water lines, 14 power transmission lines, 12 natural gas lines, 11 telephone lines, and numerous active landfills.

The types of businesses located in the floodplain include light manufacturing, supply houses, scrap yards, sand and gravel mining operations, and wholesale facilities.

Business, public utility, and transportation losses as a result of prior flooding have amounted to several million dollars.

f. Other Resources

(1) Air Quality

Much of the downstream area is located within the MCUPA, which has been designated a nonattainment area for carbon monoxide, ozone, and TSP. Ambient concentrations of other pollutants are expected to be below standard levels.

Site-specific data are unavailable for the remainder of the downstream area located outside the MCUPA. However, a limited amount of data from Buckeye indicate that sulfur dioxide and ozone standards are not being violated and that TSP standards are probably being violated.

(2) Aesthetics

The Salt River below the Granite Reef Diversion Dam is dry for most of the year, revealing a wide shallow riverbed of rocks and

small boulders. Bridges and dry river road crossings connect the north side with the south portion of the metropolitan area. During the spring when snow is melting in the mountains, water may flow in this section of the river. The Salt River joins the Gila River near the west end of Phoenix. This western portion of the river receives effluent from wastewater treatment plants which results in a green tangled band of low riparian vegetation that extends down the river to Gillespie Dam.

(3) Noise

Day-night sound levels for this area range from 35 dB in open areas to as high as 85 dB at areas adjacent to major arterials. Since the affected area is largely composed of urban land uses which are characterized by heavier traffic volumes than other CAWCS site areas, much of this area experiences L_{dn} exceeding the U.S. Environmental Protection Agency's long-term goal of 55 dB.

(4) Geology/Soils

The topography of the downstream area is nearly flat in the floodplains of the Salt and Gila Rivers. Throughout most of the area, the Salt and Gila Rivers are braided and have a broad floodplain; the river channel is restricted near Granite Reef Dam, at Tempe Butte, and at the southwest end of the Buckeye Hills. Rocks exposed within the site area include Precambrian granite gneiss, schist, and granite; Laramide granite; Tertiary andesite; Quaternary to Tertiary sand, gravel, and conglomerate; and Quaternary basalt, silt, sand, and gravel. There have been no recorded earthquakes originating from this area, although some earthquakes of mild

intensities have been reported in the general Phoenix area. A large damaging earthquake is not expected in the area. Because earth fissures, which are a result of ground subsidence from water table declines, have been noted near this site area, there is a possibility that some earth fissures may form.

There are numerous sand and gravel deposits which are actively mined along the Salt River, particularly in and near the Phoenix area. Some sand and gravel are also extracted from the Gila River. The mining of sand and gravel is an important industry in this site area. Maricopa County currently produces more than fifty percent of the total amount of sand and gravel mined in the state.

The soils of the downstream area vary from loamy, clayey, gravelly, to cobbly. Some of these soils are suitable for classification as prime farmland and have been mapped by the U.S. Soil Conservation Service.

(5) Land Resources

The segment of the Salt River floodplain just below Granite Reef Dam to Gilbert Road is mostly undeveloped open desert land. Several sand and gravel mining operations are located in the river channel downstream from Gilbert Road. Extensive urban development has encroached upon the floodplain in some locations within the Cities of Phoenix, Mesa, and Tempe. From approximately 23rd Avenue west to the Salt River confluence with the Gila River, the Salt River floodplain includes scattered residential and industrial uses and extensive agricultural areas, particularly on the south side of the channel.

Downstream from the confluence of the Salt and Gila Rivers, riparian and phreatophytic vegetation abound in the river channel and along the floodplain. The Maricopa County Flood Control District has initiated an interim project to develop and maintain a cleared and graded 1,000-foot-wide corridor within the floodway of the Salt and Gila Rivers from 91st Avenue to Gillespie Dam until more adequate flood control can be provided by the implementation of a CAWCS alternative and/or other measures. Segments of the floodplain have been set aside as parts of the Fred J. Weiler Greenbelt, Casey Abbott Semi-Regional Park, Robbins Butte State Game Management Area, and the Arlington State Wildlife Area. Outside of the defined river channel, irrigated agricultural croplands are the predominant land use in the Gila River floodplain from downstream of the Salt/Gila confluence through the Arlington Valley. Some clusters of residential development, such as Holly Acres, are also located within this segment of the floodplain.

IV. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

IV. ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES

This chapter includes a description of the impacts and effects of the alternative plans, mitigation measures, and conflicts and compliance with other environmental programs. Impacts and effects of CAWCS plans are described in greater detail in the following supporting documents for the EIS: Environmental Impacts and Effects of Plans (7 volumes), CAWCS, 1982; Social Impacts and Effects of Plans, CAWCS, 1982; and Economics Supporting Document, CAWCS, 1982. All information on impacts, effects, and mitigation of plans contained in Section A of this chapter is extracted from these documents unless otherwise noted.

A. Methodology

1. Impact Assessment

The procedure for assessing impacts of the plans involved aggregating impacts of the elements (Cliff, Roosevelt, Stewart Mountain, Confluence, New Waddell Dams) that compose the plans. The separate impacts for each element are not reported in this EIS, but they may be found in the environmental, social, and economic supporting documents cited above.

The impact assessment methodology consisted of a series of steps whereby environmental conditions without the project were compared to conditions with the project. The measured difference between the two conditions for a factor (i.e., stream-oriented recreation) is the impact. The baseline condition without the project is a projection of all the relevant environmental factors into the year 2000. This future-without condition would occur if

there were no project action and is therefore the condition associated with Plan 8, the No Action Alternative. The condition that would occur with each of the action alternatives (Plans 1, 2, 3, 6, 7) was compared against this future-without condition to arrive at the impact.

All aspects of project action were considered in assessing impacts, including construction, reservoir inundation, and operation. For the assessment of reservoir inundation impacts, a range of reservoir sizes was evaluated, from minimum conservation pools to flood maximum Inflow Design Flood (IDF). The typical-year pool (see page _) was used to anchor the assessment in most of the resource evaluations. The typical-year variation in pool level (from high in the spring to low in the fall) describes the annual fluctuation that impacts a number of resources, including vegetations, fisheries, recreation, prehistoric and historic remains, and water quality.

Other pool levels used in the assessment are conservation pools and flood storage pools of various kinds. The conservation pools include replacement pools, new conservation for CAP, and regulatory storage for CAP. In the CAWCS analyses, the top of all types of conservation is indicated as the Maximum Storage Pool (MSP) elevation. The flood pools vary dramatically in size depending on the amount of storage available when the reservoir begins to fill with flood waters. The Standard Project Flood (SPF) pool (roughly equivalent to the 200-year flood pool) was used to indicate the maximum flood retention pool. Finally, many of the dams in CAWCS plans have been sized to suppress extraordinarily large floods by storing flows temporarily, rather than passing the flows through enlarged spillways. The area where these flows could theoretically be stored is the IDF pool; that is

described as the IDF area, rather than pool, to reference the low probability of the rare IDF event. Impacts of the IDF are treated hypothetically in most resource evaluations.

All pools in the reservoir could conceivably affect resources, but the probability of impact decreases with pools larger than the typical-year high pool. For this reason, most impact descriptions in the EIS present typical-year impacts as the most probable and permanent of the reservoir impacts. The impacts of other pools are usually shown as a range, to indicate the potential extent of impact associated with the project.

For all resources, the same pools were used to make without- and with-project comparisons. For example, the typical-year future-without pool at Horseshoe Reservior was compared to the typical-year future-with pool at Cliff Reservoir to calculate losses and gains in stream miles and habitat acreage. The pools used in the analysis are indicated in each of the impact evaluations in Part A of this section.

2. Effects Evaluation

While the impact is the measured difference between future-without and future-with conditions for a factor, the effect is the interpretation of the significance of the impact. Effects were determined on the basis of the impact's direction (beneficial or adverse), duration (short-term or long-term), magnitude (quantification of change), and the quality of the affected resource. Depending on the characteristics of the impact, one of the following effect levels has been assigned:

- Insignificant (I): small, ephemeral change, usually affecting a low-quality resource
- Significant Beneficial (SB): major improvement in a condition, usually long-term and affecting a high-quality resource
- Beneficial Flag (BF): extraordinary beneficial change in a unique, protected, or very high-quality resource
- Significant Adverse (SA): major degradation of a condition, usually long-term and affecting a high-quality resource
- Adverse Flag (AF): extraordinary adverse change in a unique, protected, or very high-quality resource

The degree to which impacts can be mitigated is shown by unmitigated and mitigated effects levels for each factor. Mitigation is discussed only where impacts and effects are adverse.

Table II-10 in Chapter II summarizes the unmitigated (direct and indirect) and mitigated (residual) impacts and effects to significant resources considered in this EIS.

A detailed description of the methodologies used in assessing impacts and evaluating effects may be found in the EIS supporting documents, Stage III Methodology for Environmental Quality Assessment and Stage III Methodology for Social Assessment, and 1982 Addenda.

B. Impacts of Plans

1. Biological Resources

a. Types of Impacts to Biological Resources

Plan actions could directly modify biological resources through construction, inundation, and dam operation. Planned recreational

facilities, new and improved roads, and larger lakes are expected to attract greater numbers of people into the site areas with the subsequent effect of habitat loss and human encroachment on wildlife. The direct impacts represent primarily quantitative gains or losses of resources. Indirect impacts represent changes to resource quality.

(1) Construction and Inundation Impacts

Construction and inundation impacts have been evaluated for four reservoir pools and, therefore, four levels of potential impact. These are: 1) the characteristic impoundments for a typical year, 2) the impoundments at maximum storage capacity (MSP), 3) the Standard Project Flood (SPF or 200-year flood) pool, and 4) the maximum Inflow Design Flood (IDF) pool. Comparative reservoir levels and types of impacts are illustrated in Figure IV-1.

The typical-year scenario is a condition which is expected to be frequent and long in duration; therefore, the influence of lake inundation, drawdown, and release characteristics would have a direct and long-standing effect on biological resources. Reservoirs are expected to fill to the MSP level, but less frequently than storage to the typical-year level. The probability of an occurrence of the SPF in any given year is very low, so that impacts in this pool would be infrequent. Fourth, the IDF event is extremely rare, and the impact to biological resources is essentially hypothetical; therefore, impacts within the IDF are not discussed in this section.

During typical-year operation, reservoir drawdown would result from winter storage and summer releases; hence the drawdown would occur during the productive biological season and would affect fish spawning and plant growth in and near the impoundment. The phenomenon of bathtub ring (habitat hiatus) would occur at the reservoirs because of the typical drawdown operation.

(2) Dam Operation Impacts

The operation of the dams in alternative plans would affect biological resources by altering flows on the rivers. While the inundation of perennial stream represents quantitative impact, alteration of flows would affect the quality of stream aquatic communities. Cessation or reduction of flows in the river could affect fish reproduction and movement.

Dam operation would also modify flows by curtailing peak flood flows that cause channel scouring. Scouring is a rejuvenating process whereby old stands of cottonwood and willow are destroyed, but new seedlings are established in newly cleared alluvial terraces. Reduction in scouring would, therefore, diminish this dynamic process and more stands would age beyond maturity and possibly die out.

b. Conceptual Mitigation Recommendations

Conceptual mitigation recommendations for impacts to biological resource factors have been developed by the Bureau in conjunction with the U.S. Fish and Wildlife Service, the Arizona Game and Fish Department, and other involved agencies. Mitigation recommendations presented below are

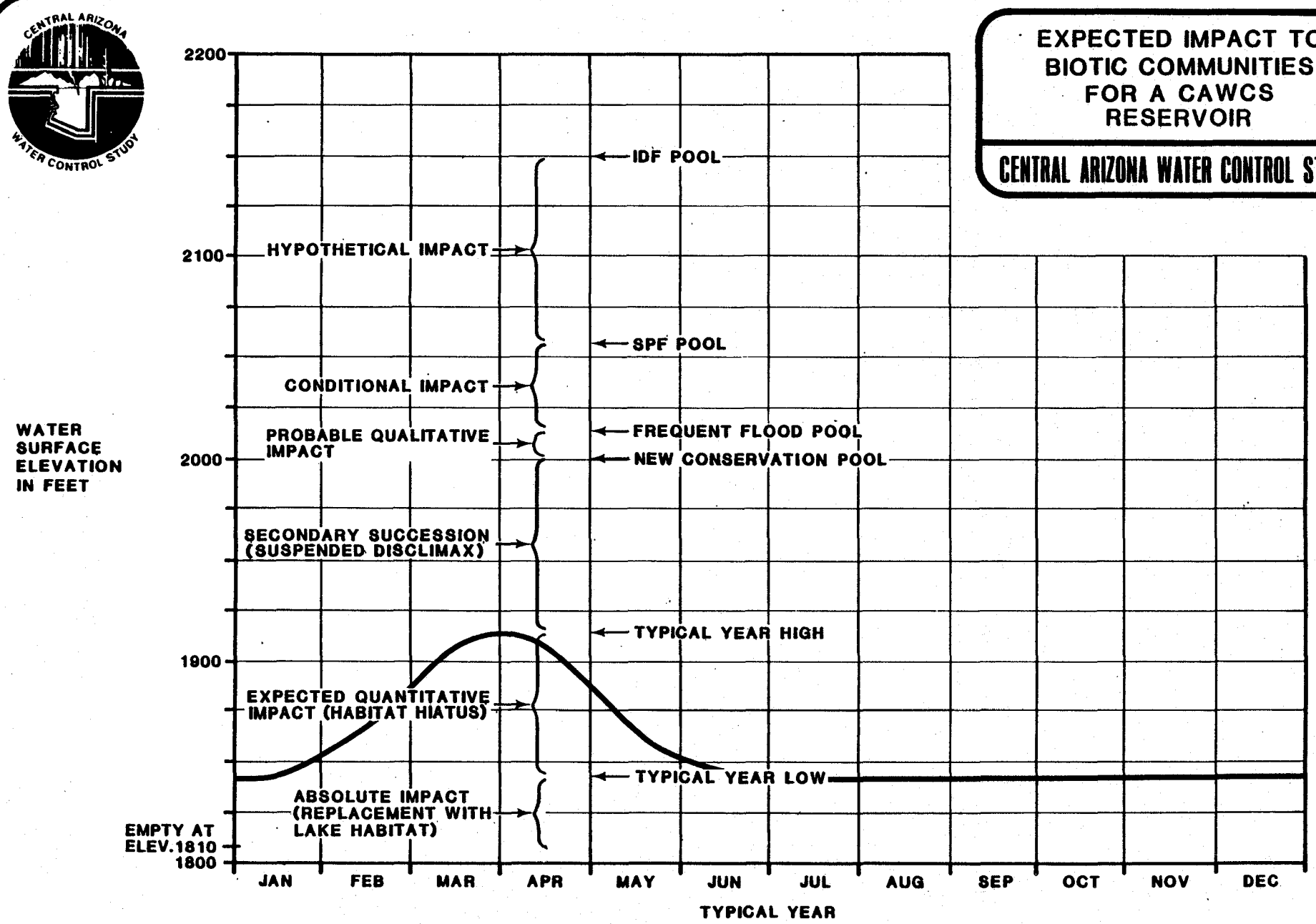

CENTRAL ARIZONA WATER CONTROL STUDY
EXPECTED IMPACT TO BIOTIC COMMUNITIES FOR A CAWCS RESERVOIR
CENTRAL ARIZONA WATER CONTROL STUDY
WATER SURFACE ELEVATION IN FEET
2200
2100
2000
1900
EMPTY AT ELEV.1810
1800
IDF POOL
HYPOTHETICAL IMPACT
SPF POOL
CONDITIONAL IMPACT
FREQUENT FLOOD POOL
PROBABLE QUALITATIVE IMPACT
NEW CONSERVATION POOL
SECONDARY SUCCESSION (SUSPENDED DISCLIMAX)
TYPICAL YEAR HIGH
EXPECTED QUANTITATIVE IMPACT (HABITAT HIATUS)
TYPICAL YEAR LOW
ABSOLUTE IMPACT (REPLACEMENT WITH LAKE HABITAT)
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
TYPICAL YEAR

FIGURE IV-1

conceptual only, and are not necessarily the measures which will be implemented; however, while conceptual, all recommendations presented are feasible and could be implemented if agreed upon by all involved agencies. The Bureau is committed to mitigating biological resources impacts of plans to the extent possible; final mitigation strategies will be developed in accordance with the federal Fish and Wildlife Coordination Act.

The Bureau has developed conceptual mitigation plans that emphasize the full array of project objectives. Direct project mitigation represents conceptual measures which focus on reducing or avoiding adverse impacts. These conceptual measures, if implemented, would modify the project design and operation to alleviate or avoid biological resource impacts. For example, reduction of planned release rates during the spawning season would reduce impact on fish reproduction in the reservoirs.

Contingent project mitigation activities are additional extrinsic measures which, if implemented, would offset impacts resulting from plan implementation. For example, revegetating the old Horseshoe Lake bottom with cottonwood, willow, and mesquite would enhance the quality of the riparian habitat over that expected through natural ecological succession.

There are a number of management programs in effect or proposed in the CAWCS study area such as the U.S. Forest Service Habitat Rehabilitation Plan and the Arizona Game and Fish Department fish and wildlife management program. The interagency management level of mitigation would emphasize coordinated and cooperative management measures between the various conservation and land-management agencies and the Bureau. The

conceptual measures proposed for this level of mitigation include support to augment existing management effort as well as new plans which could be implemented through cooperative agency effort.

Land acquisition or other forms of compensation are intended to offset impacts which cannot be mitigated through other levels of effort.

Table IV-1 summarizes the mitigation measures proposed for the six resource categories. The composite mitigation expected from these measures is presented in the following section and was used to assess residual impacts.

c. Riparian/Wetland Communities

Impacts to riparian/wetland communities, as well as mitigation and residual impacts, are shown on Table IV-2.

(1) Direct and Indirect Impacts

(a) Plan 8

The site areas will have approximately 11,760 acres of riparian habitat in the year 2000. Some currently existing riparian habitat will be lost as a result of agricultural development on the Fort McDowell Indian Community lands. Riparian habitat will probably be enhanced by development of the Rio Salado in the Salt River bed through Tempe; however, diversion of wastewater effluent downstream of 91st Avenue for the Palo Verde nuclear plant will degrade riparian habitat quality in the downstream reach. This effluent will, however, maintain saltcedar bosques. Maricopa

Table IV-1

CONCEPTUAL MITIGATION FOR BIOLGOCIAL RESOURCES

Level of Mitigation	BIOLOGICAL RESOURCE FACTOR					
	Riparian/ Wetland	Other Terrestrial	Perennial Stream	Reservoirs	Endangered Species	Special Use
Direct Mitigation	To promote growth of cottonwood-willow and wetland habitat, delay and/or reduce water releases from Cliff, Roosevelt, and Waddell Reservoirs to <2 inches/day at onset of wetland growing season and cottonwood bloom (mid-April to mid-May); applies for all plans.		To improve quality of riverine aquatic communities, assure flows in Salt and Verde Rivers ≥50 cfs for all Plans except 7; ≥200 cfs for Plan 7.	As a means to improve fish spawning habitat, when feasible reduce drawdown rate to <2 inches per day from mid-April to mid-May at Cliff Reservoir for all Plans and Waddell Reservoir for Plans 6 and 7.	To maintain foraging habitat and fish prey base, assure minimum flow described under perennial stream.	
Contingent Project Mitigation	Implement cottonwood habitat rehabilitation at Cliff site in old Horseshoe lake bed. Applies to all plans. Reclaim 20 acres cattail marsh downstream of Granite Reef Diversion Dam . Applies to all plans.	To improve quality of range habitat (paloverde-mixed cacti and blue paloverde ironwood habitat), reclaim denuded sites lying adjacent the MSP pool. Applies to sites not reclaimed during construction and involves all reservoirs in all plans.	Establish bank cover and cobble ditches for pools and riffles on Verde and Salt Rivers upstream of Cliff and Roosevelt Reservoirs and elsewhere along perennial stream in the CAWCS area. Applies to all plans.	Do not clear the conservation pool; or modify clearing and add brush piles for fish spawning of all reservoirs in all plans. Construct coffer dams for fish spawning habitat at Cliff for all Plans, at Waddell Reservoir for Plans 6 and 7.	Implement cottonwood, cattail marsh rehabilitation; as a means of protecting bald eagle breeding control public access to bald eagle breeding areas at Cliff and Roosevelt. Applies to all plans.	Substitute dispersed recreation at Cliff Reservoir to reduce disturbance to wildlife. Applies to all plans.
Inter-Agency Management	Support U.S. Forest Service cottonwood habitat rehabilitation program and range management for cottonwood/mesquite. Applies to all plans.	Cooperative range management improvements: Coordinate with BLM at Waddell, Plans 6 and 7. Coordinate with U.S. Forest Service at Cliff and Roosevelt (all plans) and Confluence (Plan 3).	Coordinate with Salt River Project on maintaining flows in Salt and Verde Rivers. Applies to all plans.	Fish stocking of all reservoirs in all plans. Support operation and management of coffer dams with Arizona Game and Fish Department.	Support the U.S. Fish and Wildlife Service Endangered Species Recovery Plans for bald eagle, peregrine falcon, Yuma clapper rail, and Gila topminnow. Applies to all plans.	Coordination with land management and conservation agencies; improve range management. Applies to all plans. Set aside Salt-Verde area same as with riparian/ wetland. Applies to all plans except Plan 3.

Table IV-1

	BIOLOGICAL RESOURCE FACTOR					
Level of Mitigation	Riparian/ Wetland	Other Terrestrial	Perennial Stream	Reservoirs	Endangered Species	Special Use
Land Acquisition and Compensation	Acquire take line easements for habitat improvement and wildlife conservation at all reservoirs. Purchase private holdings along Tonto Creek for establishing cottonwood-willow and wetland habitat. Lease land at Piccacho Reservoir for waterfowl foraging habitat. Coordinate with BLM and assist Arizona Game & Fish Dept. in developing waterfowl habitat in Fred J. Weiler Greenbelt on Gila River. Applies to all plans.	Same as with riparian/ wetland.		Support construction of a fish hatchery on the Waddell delivery canal. Assist Arizona Game & Fish Dept. with operation (Plans 6 and 7 only).	Same as with riparian/wetland land requisition.	Redelegate take line easements for special resources use at Three Bar and Roosevelt Wildlife Area (all plans). Fund management and wildlife research programs of the U.S. Fish and Wildlife Service and Arizona Game and Fish Dept.

Table IV-2

RIPARIAN/WETLAND COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (acres)	Typical Year M (acres)	Typical Year R (acres)	MSP I (acres)	SPF I (acres)
Plan 8					
Cliff	+130			+130	
Roosevelt	0			0	
Confluence/Stewart Mountain	-2480			-2480	
Waddell	0			0	
Total	-2350			-2350	
Plan 1					
Cliff	-420	(310)[a]	-420	-790	-1050
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-290	120	-170	-1230	-2220
Plan 2					
Cliff	-430	(280)[a]	-430	-330	-330
Roosevelt	+160	100	+260	-410	-410
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-270	120	-150	-740	-740
Plan 3					
Cliff	-270	(780)[a]	-270	-790	-1050
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	-2340	20	-2320	-2760	-2760
Waddell	0			0	0
Total	-2480	120	-2360	-3990	-4980
Plan 6					
Cliff	-270	(780)[a]	-270	-790	-1050
Roosevelt	+130	100	+230	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	-130		-130	-450	-450
Total	-270	120	-150	-1680	-2670
Plan 7					
Cliff	-350	(290)[a]	-350	-790	-1050
Roosevelt	+520	100	+620	-440	-1170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	-130		-130	-450	-450
Total	+40	120	+160	-1680	-2670

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact

[a]At Cliff Reservoir mitigation involves the replacement of low-quality mixed scrub habitat with cottonwood-willow and mesquite. However, at Roosevelt and Confluence/Stewart Mountain, cottonwood-willow and cattail, respectively, could be established on denuded sites resulting in a quantitative gain in habitat. Residual impact is the quantitative gain or loss of total riparian/wetland habitat and does not include changes in quality due to mitigation.

County Flood Control District will continue to clear saltcedar form a 1,000-foot-wide channel in the Salt and Gila Rivers between 91st Avenue and Gillespie Dam.

Acreages of riparian and wetland communities in the site areas in the future-without-the-project are shown in Table IV-3.

Table IV-3

ACREAGE OF RIPARIAN/WETLAND COMMUNITIES--PLAN 8

Habitat Type	Cliff	Roosevelt	Confluence/ Stewart Mountain	New Waddell	Total
Cottonwood-willow	730	380	970	0	2080
Mixed broadleaf	100	0	0	0	100
Mesquite	830	1650	4810	310	7600
Saltcedar	10	880	330	210	1430
Salt-cedar-mixed scrub	10	170	0	0	180
Mixed scrub	0	0	280	50	330
Cattail	0	0	30	10	40
Total	1680	3080	6420	580	11,760

(b) Plans 1, 2, 3, 6, and 7

The greatest quantitative loss of riparian/wetland habitat would occur under Plan 3 due to the inclusion of Confluence Reservoir, which would inundate the cottonwood-willow and mesquite forest at the Salt-Verde confluence. The quantitative gain in riparian communities in

Plans 1, 2, 6, and 7 would be primarily mixed-scrub and saltcedar-mesquite growth expected as the successional community types that would grow on the old Horseshoe Reservoir lake bed.

The habitat quality of cottonwood-willow habitat lost in Plans 1, 2, 6, and 7 would not be recovered by mixed-scrub and saltcedar growth at Horseshoe Reservoir. Recovery of cottonwood, willow, mesquite, and cattail marsh would occur only in the typical year to MSP zone where inundation would be infrequent. The amount of storage in Cliff Reservoir in Plans 1 and 7 suppresses a greater amount of mixed scrub habitat from recovering to mesquite and cottonwood-willow habitat than in other plans.

Cliff Reservoir would inundate a blue heron nest site at any proposed reservoir level. Another heron nest site at the Confluence site would be inundated under Plan 3. Other wildlife would be deprived of valuable breeding and foraging habitat through loss of cottonwood-willow and mesquite, forest of which Plan 3 represents the worse case among the plans.

Some of the existing cottonwood forest along the Salt and Verde Rivers downstream of Bartlett and Stewart Mountain Dams would be outside the modified scouring zone and would not, therefore, be susceptible to the rejuvenating scouring process previously described.

(2) Mitigation

Conceptual mitigation strategies for riparian and wetland communities are described in Table IV-1. The objectives of these mitigation measures are to recover acreage of resources lost as a result of the project

and to improve the quality of remaining riparian/wetland habitat over that which would occur through natural ecological succession. Because mitigation cannot eliminate project-induced impacts, no enhancement of the resource can be achieved.

(3) Residual Impacts

Residual impacts to riparian/wetland communities are shown on Table IV-2.

d. Other Terrestrial Communities

Impacts to terrestrial communities, as well as mitigation and residual impacts, are shown on Table IV-4.

(1) Direct and Indirect Impacts

(a) Plan 8

The site areas will have approximately 195,000 acres of other terrestrial habitat (shrubland and paloverde-mixed cacti desert) in the year 2000, as shown in Table IV-5.

Table IV-5

ACRES OF OTHER TERRESTRIAL COMMUNITIES--PLAN 8

Habitat Type	Cliff	Roose-velt	Confluence/ Stewart Mountain	New Waddell	Total
Paloverde-mixed cacti	45550	56130	47800	36770	186,250
Blue paloverde-ironwood	1950	3540	1370	1370	8,230
Total	47500	59670	49170	38140	194,480

Table IV-4

OTHER TERRESTRIAL COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (acres)	Typical Year M (acres)	Typical Year R (acres)	MSP I (acres)	SPF I (acres)
Plan 8					
Cliff	-80			-80	
Roosevelt	0			0	
Confluence/Stewart Mountain	-7300			-7300	
Waddell	-50			-50	
Total	-7430			-7430	
Plan 1					
Cliff	-2040	(50)[a]	-2040	-1350	-4020
Roosevelt	-1350	(2350)	-1350	-1480	-4600
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	0			0	0
Total	-3410	(2400)	-3410	-2850	-8640
Plan 2					
Cliff	+290		+290	+780	+780
Roosevelt	-980	(2350)	-980	-1110	-1110
Confluence/Stewart Mountain	-10		-10	-10	-10
Waddell	0			0	0
Total	-700	(2350)	-700	-340	-340
Plan 3					
Cliff	-1370	(720)[a]	-1370	-1350	-4020
Roosevelt	-1350	(2350)	-1350	-1480	-4600
Confluence/Stewart Mountain	-3580	(280)	-3580	-3860	-3860
Waddell	0			0	0
Total	-6300	(3350)	-6300	-6690	-12480
Plan 6					
Cliff	-1370	(720)[a]	-1370	-1350	-4020
Roosevelt	-1350	(2350)	-1350	-1480	-4600
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	-8600	(160)	-8600	-6590	-6590
Total	-11340	(3230)	-11340	-9440	-15230
Plan 7					
Cliff	-2040	(50)[a]	-2040	-1350	-4020
Roosevelt	-3160	(540)	-3160	-1480	-4600
Confluence/Stewart Mountain	-20		-20	-20	-20
Waddell	-8600	(160)	-8600	-6590	-6590
Total	-13820	(750)	-13820	-9440	-15230

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact

[a]Figures in parentheses represent areas peripheral to maximum storage pools in which recovery of desert vegetation could be enhanced through seeding of shrubs and/or grasses. This repesents a qualitative rather than quantitative gain in resource, and does not alter the quantitative residual impact.

(b) Plans 1, 2, 3, 6, and 7

The nonriparian communities that would be altered by construction and/or subjected to occasional flood storage inundation include mainly paloverde-mixed cacti, and blue paloverde-ironwood habitat. These community types cannot tolerate inundation of more than several days. The least impact to this factor is expected in Plan 2 and the greatest impact in Plan 7. Habitat recovery would probably not fully occur within the flood storage zone at less than the 200-year flood level due to the maturation rates of the dominant cacti. The effect in all plans, however, is considered insignificant.

(2) Mitigation

Conceptual mitigation strategies for terrestrial communities are outlined in Table IV-1. The objectives of these mitigation measures are to recover acreages of resources lost as a result of the project and to improve the quality of the remaining habitat. Opportunities to reclaim desert vegetation lost through inundation are somewhat limited, however, due to the intolerance of the dominant plant species (saguaro cactus and paloverde) to periodic inundation. No enhancement of the resource is, therefore, expected.

e. Perennial Stream/Riverine Communties

Impacts of plans to perennial steam/riverine communities, as well as mitigation and residual impacts, are shown in Table IV-6.

Table IV-6

PERENNIAL STREAM/RIVERINE COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

	Typical Year			MSP	SPF
	I (miles)	M (miles)	R (miles)	I (miles)	I (miles)
Plan 8					
Cliff	0			0	
Roosevelt	0			0	
Confluence/Stewart Mountain	0			0	
Waddell	0			0	
Total	0			0	
Plan 1					
Cliff	-3[a]	(17)[b]	-3	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	-3	(17)	-3	-6	-12
Plan 2					
Cliff	+1[a]	(21)[b]	+1	-1	-1
Roosevelt	0			-1	-1
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	+1	(21)	+1	-2	-2
Plan 3					
Cliff	+1[a]	(21)[b]	+1	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	-17	(18)	-17	-18	-18
Waddell	0			0	0
Total	-16	(39)	-16	-24	-30
Plan 6					
Cliff	+1[a]	(21)[b]	+1	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	+1	(21)	+1	-6	-12
Plan 7					
Cliff	-2[a]	(18)[b]	-2	-5	-7
Roosevelt	0			-1	-5
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	-2	(18)	-2	-6	-12

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact.

[a]At Cliff Reservoir six miles of perennial stream habitat will be lost downstream of Horseshoe Dam in all plans. However, stream habitat will be gained in the reach formerly occupied by Horseshoe Reservoir. Impacts are the combined losses and/or gains in perennial stream.

[b]Figures in parentheses represent miles of river in which qualitative improvements such as bank stabilization and flow augmentation could be made. Quantitative loss of stream miles cannot be mitigated.

(1) Direct and Indirect Impacts

(a) Plan 8

A total of 70 miles of perennial stream lie within the Confluence, Cliff, Roosevelt, and New Waddell site areas. Approximately 137 miles of perennial stream are within the CAWCS area boundaries. Present operating criteria on the SRP-controlled reaches of the Salt and Verde Rivers upstream of the confluence do not guarantee minimum flows for fish and wildlife benefits. This condition is expected to continue in the future. On average in these reaches, there are 106 days per year of flows equal to or less than 50 cfs on the Salt River, and 61 days per year on the Verde River.

Table IV-7 shows miles of perennial stream and riverine communities in the future-without-the-project.

Table IV-7

MILES OF PERENNIAL STREAM/RIVERINE COMMUNITY--PLAN 8

	Cliff	Roose-velt	Confluence Stewart Mountain	New Waddell	Total
Perennial stream, miles	20	15	35	0	70

(b) Plans 1, 2, 3, 6, and 7

Loss of perennial stream is regarded as a significant impact due to the limited amount of perennial stream in Southwestern deserts. Perennial streams support riverine aquatic communities, riparian

habitat, and wildlife including the endangered Yuma clapper rail and bald eagle.

The typical-year inundation represents the most likely recurrent event affecting stream loss. Plan 3 accounts for the greatest loss of stream due to the inclusion of Confluence Reservoir. Enlarging Lake Pleasant at the New Waddell site would not inundate perennial stream, thus the typical-year impact would be the same in Plans 2 and 6. With more storage planned at Cliff Reservoir in Plans 1 and 7, the impacts of these two plans are similar. In all plans, however, the net river mileage change at Cliff Reservoir represents loss of 6 miles of high-quality river between Horseshoe and Cliff Dams and recovery of river in the exposed Horseshoe lake bed. The quality of riverine habitat within this segment would eventually improve as channel silt and sand wash downstream, but the perennial stream initially would be subjected to erosion and high turbidity, which creates poor habitat for most riverine aquatic life.

(2) Mitigation

Conceptual mitigation for impacts to perennial stream/riverine communities is outlined on Table IV-1. Since mitigation of lost stream mileage is not feasible within the affected site areas, these conceptual mitigation measures are aimed at improving the quality of habitat in the remaining reaches of river. Stream habitat improvements as given in the conceptual mitigation table would not change the unmitigated effects. Plan 7, with sustained minimum flows, is the best option for this factor, and provides the only opportunity for fish and wildlife enhancement.

(3) Residual Impacts

Residual impacts are displayed in Table IV-6.

f. Reservoir Aquatic Communties

Impacts of plans to reservoir aquatic communities, as well as mitigation and residual impacts, are displayed in Table IV-8.

(1) Direct and Indirect Impacts

(a) Plan 8

Approximately 14,000 surface acres of habitat are available in Horseshoe Lake, Roosevelt Lake, Saguaro Lake, and Lake Pleasant; 35,000 surface acres of habitat are available within the CAWCS area. No SRP lakes or Lake Pleasant have guaranteed minimum pools for fish and wildlife and recreation but, historically, reservoirs on the Salt River have maintained some minimum pools. This condition is expected to continue in the future.

Typical-year low reservoir surface acres in the future-without-the-project are expected to be 610 acres allocated to the Cliff site area, 11,930 acres at Roosevelt, 630 acres at Confluence site area, and 830 acres at New Waddell site area.

(b) Plans 1, 2, 3, 6, and 7

The gain of lake habitat has been assessed as the increase in typical-year low-pool surface acreage which would create a

Table IV-8

RESERVOIR AQUATIC COMMUNITIES--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (acres)	Typical Year M (acres)	Typical Year R (acres)	MSP I (acres)	SPF I (acres)
Plan 8					
Cliff	0			0	
Roosevelt	0			0	
Confluence/Stewart Mountain	0			0	
Waddell	0			0	
Total	0			0	
Plan 1					
Cliff	+400		+400	+2520	+5900
Roosevelt	0			+2350	+6510
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	+400[a]		+400	+4870	+12410
Plan 2					
Cliff	-360		-360	+100	+100
Roosevelt	0			+2350	+2350
Confluence/Stewart Mountain	0			0	0
Waddell	0			0	0
Total	-360[a]		-360	+2450	+2450
Plan 3					
Cliff	+130		+130	+2520	+5900
Roosevelt	0			+2350	+6510
Confluence/Stewart Mountain	+2950	(1850)[b]	+2950	+8850	+8850
Waddell	0			0	0
Total	+3080[a]		+3080	+13720	+21260
Plan 6					
Cliff	+130		+130	+2520	+5900
Roosevelt	0			+2350	+6510
Confluence/Stewart Mountain	0			0	0
Waddell	+1770	(1540)[b]	+1770	+6390	+6390
Total	+1900[a]		+1900	+11260	+18800
Plan 7					
Cliff	+980	(1030)[b]	+980	+2520	+5900
Roosevelt	+940		+940	+2350	+6510
Confluence/Stewart Mountain	0			0	0
Waddell	+1770	(1540)[b]	+1770	+6390	+6390
Total	+3690[a]		+3690	+11260	+18800

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact.

[a]Impacts represent the net loss/gain of typical-year low pools, which are the resource for sustaining fisheries.

[b]Figures in parentheses are the surface areas of USBR design minimum pools. Moderation of drawdown rates to <2 in 1 day from mid-April to mid-May would improve fish spawning habitat in the reservoirs.

minimum pool to ensure a fish population carryover. However, the beneficial gain in lake habitat would be adversely affected where drawdown rates during the spawning season exceed 2 inches per day; rates greater than 2 inches per day are not conducive to productive fish spawning.

Plan 7 would produce significant beneficial gains in surface acreage and typical-year low-storage in excess of recommended minimum pools at Cliff and Waddell Reservoirs. Plan 3 would also increase pool acreage substantially, but only one minimum pool would be gained, at Confluence Reservoir. Cliff Reservoir in Plans 1, 2, 3, and 6 would not maintain sufficient storage to maintain a minimum pool. Drawdown rates on Cliff Reservoir would be between 4 and 9 inches per day. Drawdown on Waddell Reservoir would be approximately 5 inches per day. Roosevelt Lake drawdown would be 1.3 inches per day in all plans, the same condition which occurs in Plan 8.

(2) Mitigation

Conceptual mitigation measures for reservoir aquatic community impacts are described in Table IV-1. The objectives of these measures are to improve spawning conditions and to sustain fish populations. If the conceptual mitigation measures are implemented, particularly modification of drawdown rates, fish and wildlife enhancement would occur.

(3) Residual Impacts

Residual impacts are displayed in Table IV-8.

g. Threatened and Endangered Plants and Wildlife

Impacts of plans to threatened and endangered species, as well as mitigation and residual impacts, are displayed in Table IV-9.

(1) Direct and Indirect Impacts

(a) Plan 8

Six endangered species occur in the CAWCS study area, four of which occur in the vicinity of the site areas. These are the bald eagle, peregrine falcon, Yuma clapper rail, and Gila topminnow. Only the bald eagle and Yuma clapper rail are known to occur within the affected site areas.

There are 13 bald eagle breeding areas in the Southwestern United States, six of which are within the CAWCS area (all of these along the Salt and Verde Rivers in the study area). The three most productive of these are in the Confluence site area, as shown in Table IV-10.

Yuma clapper rails have been observed in the Confluence area and downstream of the Granite Reef Diversion Dam. Although observation data indicate that the species may breed in the area where observed, there has been no direct evidence to substantiate that breeding is in fact occurring.

Approximately 2,080 acres of cottonwood willow, which is preferred habitat for the bald eagle, currently occur within the

Table IV-9

THREATENED AND ENGANGERED PLANTS AND WILDLIFE--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

Plan/Site Area	Typical Year I (preferred habitat acres)	Typical Year M (preferred habitat acres)	Typical Year R (preferred habitat acres)	MSP I (acres)	SPF I (acres)
Plan 8					
Cliff	+180			+180	
Roosevelt	0			0	
Confluence/Stewart Mountain	+90			+90	
Waddell	0			0	
Total	+270			+270	
Plan 1					
Cliff	-300	60	-240	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-390	180	-210	-360	-650
Plan 2					
Cliff	-260	100	-160	-280	-280
Roosevelt	-90	100	+10	-20	-20
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-350	220	-130	-300	-300
Plan 3					
Cliff	-200	100	-100	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	-560	20	-540	-590	-590
Waddell	0			0	0
Total[a]	-850	220	-630	-950	-1240
Plan 6					
Cliff	-200	100	-100	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-290	220	-70	-360	-650
Plan 7					
Cliff	-250	60	-190	-340	-480
Roosevelt	-90	100	+10	-20	-170
Confluence/Stewart Mountain	0	20	+20	0	0
Waddell	0			0	0
Total	-340	180	-160	-360	-650

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact.

[a]Impacts in Plan 3 are for bald eagle preferred habitat (cottonwood-willow) and Yuma clapper rail preferred habitat (cattail) combined. Impacts for all other plans are for cottonwood-willow only. Reestablishment of 20 acres of cattail marsh below Granite Reef Dam would enhance Yuma clapper rail habitat in Plans 1, 2, 6, and 7, and would mitigate loss of marsh at the Confluence in Plan 3.

Table IV-10

PRODUCTIVITY OF BALD EAGLE BREEDING AREAS

Breeding Area	Average Productivity (number fledges)	Years Occupied
Blue Point/Stewart Mountain breeding area (Confluence)	3.00	2
Fort McDowell breeding area (Confluence)	1.40	10
Bartlett breeding area (Confluence)	1.10	10
Redmond Flat (CAWCS study area but not in a site area)	0.75	8
Pinal Creek breeding area (Roosevelt)	0.80	5
Chalk Mountain breeding area (Cliff)	0.40	10

[a]Period of breeding area occupation: 1973-1982

site areas. Also, 40 acres of cattail wetland which is preferred habitat for the endangered Yuma clapper rail occur at the Confluence.

Breeding areas and productivity for the bald eagle are expected to remain status quo or to improve slightly because of efforts of the Bald Eagle Recovery Team in conjunction with conservation management by the U.S. Fish and Wildlife Service and Tonto National Forest. By 2000, preferred habitat is expected to be increased to 2,220 acres within the site areas due to habitat rehabilitation by Tonto National Forest. Yuma clapper rail preferred habitat is expected to remain the same (40 acres).

Table IV-11 shows acreages of preferred habitat for these species in the future-without-the-project.

Table IV-11

ACREAGE OF THREATENED/ENDANGERED SPECIES PREFERRED HABITATS--PLAN 8

	Cliff	Roosevelt	Confluence/ Stewart Mountain	New Waddell	Total
Bald eagle	830	380	970	0	2180
Yuma clapper rail	0	0	30	10	40
Total	830	380	1000	10	2220

(b) Plans 1, 2, 3, 6, and 7

The impact assessment and effects evaluation focuses on impacts to the endangered bald eagle. Impacts include the quantitative loss of cottonwood-willow (preferred habitat) and the loss of productivity associated with lost stream miles. The worst case impact to this species would occur in Plan 3, due to expected loss of breeding productivity at the Fort McDowell and Blue Point/Stewart Mountain breeding areas. The proposed operation of Cliff and Confluence Reservoirs would eliminate cottonwood-willow habitat and perennial stream.

In all other plans, cottonwood-willow habitat would also be quantitatively lost. There would, however, be a net gain of stream miles in Plans 2 and 6 (6 miles inundated between Cliff and Horseshoe Dams

and 7 miles gained in the old Horseshoe Lake bed upstream of Cliff). Productivity at the Chalk Mountain breeding area may improve under these plans due to the proximity of the area to the recovered stream and the cottonwood-willow habitat that will grow on the old Horseshoe Lake bed. Other bald eagle breeding areas would not be affected by Plans 1, 2, 6, or 7.

Yuma clapper rail habitat would be eliminated in the Confluence site area under Plan 3.

(2) Mitigation

Conceptual mitigation strategies for impacts to endangered species are described in Table IV-1. The objectives of these mitigation measures are to minimize or eliminate impacts on productivity and to improve preferred habitat. Adverse impacts to the bald eagle could be alleviated in all plans except Plan 3, which represents an unmitigatable loss of productivity in the three most productive breeding areas of the Southwest bald eagle population. Opportunities exist to enhance Yuma clapper rail habitat in all plans except Plan 3.

(3) Residual Impacts

Residual impacts are displayed in Table IV-9.

h. Special Use and Management Areas

Impacts to special use and management areas are shown on Table IV-12, as are mitigation and residual impacts.

Table IV-12

SPECIAL USE AND MANAGEMENT AREAS--IMPACTS, MITIGATION, AND RESIDUAL IMPACTS BY SITE AREA AND POOL LEVEL

	Typical Year			MSP	SPF
	I (AUMs)	M	R	I (AUMs)	I (AUMs)
Plan 8					
Cliff	-2305			-2269	
Roosevelt	-2992			-2870	
Confluence/Stewart Mountain	-1669			-1669	
Waddell	-4			-5	
Total	-7049	TBD[a]	-7049	-6892	
Plan 1					
Cliff	-190			-166	-392
Roosevelt	-129			-203	-611
Confluence/Stewart Mountain	-3			-3	-3
Waddell	0			0	0
Total	-322	TBD	-322	-372	-1006
Plan 2					
Cliff	-11			+34	+34
Roosevelt	-87			-161	-161
Confluence/Stewart Mountain	-1			-1	-1
Waddell	0			0	0
Total	-99	TBD	-99	-128	-128
Plan 3					
Cliff	-127			-166	-392
Roosevelt	-129			-203	-611
Confluence/Stewart Mountain	-1010			-1129	-1129
Waddell	0			0	0
Total	-1266	TBD	-1266	-1498	-2132
Plan 6					
Cliff	-127			-166	-392
Roosevelt	-129			-203	-611
Confluence/Stewart Mountain	-3			-3	-3
Waddell	-818			-659	-659
Total	-1077	TBD	-1077	-1031	-1665
Plan 7					
Cliff	-185			-166	-392
Roosevelt	-279			-203	-611
Confluence/Stewart Mountain	-3			-3	-3
Waddell	-818			-659	-659
Total	-1285	TBD	-1285	-1031	-1665

Notes

I = Unmitigated impact; M = Conceptual mitigation; R = Residual impact;

[a]TBD = To be determined. Mitigation will involve range improvements to be negotiated with involved agencies; however, the quantitative improvement is not determind at this time. Mitigation also involves gain of new special use areas to be negotiated.

(1) Direct and Indirect Impacts

(a) Plan 8

Special use resources for livestock will include approximately 23,560 Animal Unit Months (AUM) in the site areas. Special use resources for wildlife include: wildlife areas at Roosevelt Lake and Three Bar Wildlife Area; the Fred J. Weiler Greenbelt on the Gila drainage; limited-access areas near bald eagle breeding areas; six reservoirs on the Salt and Verde Rivers for continued use as State warmwater fisheries; and the Confluence area as an area of special interest for research and wildlife diversity. There is likely to be an increase in special use sites for cottonwood rehabilitation in the Tonto National Forest, plus development of the Lower Salt River Recreation Plan in the Confluence site area.

Table IV-13 shows range resources in the future-without-the-project.

Table IV-13

SPECIAL USE AND MANAGEMENT AREAS--PLAN 8

	Cliff	Roosevelt	Confluence/ Stewart Mountain	New Waddell	Total
Range resource, AUMs	3798	6647	9486	3629	23,560

(b) Plans 1, 2, 3, 6, and 7

The greatest quantitative loss of special use and management areas would occur under Plan 3 due to the inclusion of Confluence Reservoir. Under this plan the Blue Point cottonwood area and the site for the U.S. Forest Service Lower Salt River Recreation area would be inundated along with several habitat rehabilitation sites in the Confluence and Cliff site areas. Riparian communities in the Confluence vicinity which are good birding areas would be lost in Plan 3. Under Plans 1, 2, 6, and 7, only habitat rehabilitation sites in the Ciff site area would be inundated. Implementation of recreation plans at the Roosevelt Site in Plans 1, 3, 6, and 7 would increase the number of people using areas adjacent to the waterfowl refuge maintained by the Arizona Game and Fish Department. Impacts resulting from increased human qualitative loss to special use resources.

Losses of rangeland, expressed as AUM's, would be greatest under Plan 3; however, the net effect is insignificant compared to the total range resource in the site areas, since reductions in stocking rates will be implemented by management agencies in the future-without-the-project.

(2) Mitigation

Conceptual mitigation strategies for management and special use areas are described in Table IV-11. The purpose of these mitigation measures is to replace wildlife habitat and/or range resources lost due to the project. Mitigated effects of Plan 3 are worse than for the other plans because the plan would cause inundation of special use sites at

the Confluence and preclude setting aside of additional sites there as mitigation.

(3) Residual Impacts

Residual impacts are displayed in Table IV-12.

i. Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

Construction impacts for a modified dam at Roosevelt or Stewart Mountain would be the same as the new dam option except construction activities for a modified dam would be shorter in duration and require less area. Operational impacts would be the same at Roosevelt or Stewart Mountain because lake elevations, size; and storage allocations would be identical for a new structure or modified dam. Therefore, there is no signficiant difference in impact at either location for biological resources.

g. Summary

The mitigated and unmitigated impacts and effects of Plans 1, 2, 3, 6, and 7 are summarized in Tables IV-14, IV-15, IV-16, IV-17, and IV-18. A range of impacts and effects is shown for the typical-year, MSP, and SPF pool levels.

(1) Notes on Summary Tables

The net impact is the cumulative change between the future-without project and future-with project condition.

The effect that best represents the impact significance is shown with an asterisk (*). Typical-year impacts reflect both quantitative and qualitative resource changes. Maximum conservation storage and flood events are assumed to be less frequent and shorter in duration than the typical-year condition; impacts are not as recurrent or qualitatively continuous. The effects are therefore described as conditional for the SPF pool. Flood-related impacts involve changes in resource quality but not necessarily quantitative changes since natural recovery and succession are likely.

Effects for reparian wetland are calculated for native woodland/cattail wetland types combined. Saltcedar and scrub habitats are not included.

Mitigation involves both quantitative and qualitative habitat improvements. Numbers in parentheses represent areas where gains in habitat quality could be realized, even though the quantity of the resource would not be affected.

Effects are displayed as adverse flag (AF), significant adverse (SA), Insignificant (I), significant beneficial (SB), or beneficial flag (BF).

Table IV-14

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 1

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 290 ac	*SA	120ac (310ac)	SA
	b. MSP	- 1,230 ac	SA		
	c. SPF	- 2,220 ac	Conditional SA		
2. Other Terrestrical Biotic Communities	a. typical year	- 3,410 ac	*I	(2400ac)	I
	b. MSP	- 2,850 ac	I		
	c. SPF	- 8,640 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	- 3 mi/no change in flow	*I	(17 mi)	I
	b. MSP	- 6 mi	SA		
	c. SPF	-12 mi	Conditional SA		
4. Other Aquatic Biotic Communities (reservoir lakes)	a. typical year	+ 400 ac	*I	Reduce drawdown rates	SB
	b. MSP	+ 4,870 ac	I		
	c. SPF	+12,410 ac	Conditional I		
5. Threatened/Endangered Species (bald eagle)	a. typical year	- 390 ac/1 Breeding area	*SA	180ac	I
	b. MSP	- 360 ac/2 Breeding areas	AF		
	c. SPF	- 650 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 322 AUM	*I	TBD	I
	b. MSP	- 372 AUM	I		
	c. SPF	- 1,006 AUM	Conditional I		

Table IV-15

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 2

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 270 ac	*SA	120ac (280ac)	SA
	b. MSP	- 740 ac	SA		
	c. SPF	- 740 ac	Conditional SA		
2. Other Terrestrical Biotic Communities	a. typical year	- 700 ac	*I	(2,350ac)	I
	b. MSP	- 340 ac	I		
	c. SPF	- 340 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	+ 1 mi/no change in flow	*I	(21 mi)	I
	b. MSP	- 2 mi	I		
	c. SPF	- 2 mi	Conditional I		
4. Other Aquatic Biotic Communities (reservoir lakes)	a. typical year	- 360 ac	*I	Reduce drawdown rates	SB
	b. MSP	+ 2,450 ac	I		
	c. SPF	+ 2,450 ac	Conditional I		
5. Threatened/Endangered Species (bald eagle)	a. typical year	- 350 ac/1 Breeding area	*SA	220ac	I
	b. MSP	- 300 ac/2 Breeding areas	AF		
	c. SPF	- 300 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 99 AUM	*I	TBD	I
	b. MSP	- 372 AUM	I		
	c. SPF	- 1,006 AUM	Conditional I		

Table IV-16

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 3

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	- 2,480 ac	*AF	120ac (78ac)	AF
	b. MSP	- 3,990 ac	AF		
	c. SPF	- 4,980 ac	Conditional AF		
2. Other Terrestrical Biotic Communities	a. typical year	- 6,300 ac	*I	(3,350ac)	I
	b. MSP	- 6,690 ac	I		
	c. SPF	- 12,480 ac	Conditional I		
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year	-16 mi/no change in flow	*AF	(39 mi)	AF
	b. MSP	-24 mi	AF		
	c. SPF	-30 mi	Conditional AF		
4. Other Aquatic Biotic Communities (reservoir lakes)	a. typical year	+ 3,080 ac/+1 Minimum pool	*SA	Reduce drawdown rates	SB
	b. MSP	+13,720 ac	SA		
	c. SPF	+21,260 ac	Conditional SA		
5. Threatened/Endangered Species (bald eagle) and Yuma clapper rail	a. typical year	- 850 ac/1 Breeding area	*AF	220ac	AF
	b. MSP	- 950 ac/2 Breeding areas	AF		
	c. SPF	- 1,240 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 1,266 AUM	*I	TBD	I
	b. MSP	- 1,498 AUM	I		
	c. SPF	- 2,132 AUM	Conditional I		

Table IV-17

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 6

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year b. MSP c. SPF	- 270 ac - 1,680 ac - 2,670 ac	*SA SA Conditional SA	120ac (780ac)	I
2. Other Terrestrical Biotic Communities	a. typical year b. MSP c. SPF	- 11,340 ac - 9,440 ac - 12,480 ac	*I I Conditional I	(3,230ac)	I
3. Perennial Stream/ Riverine Aquatic Biotic Communities	a. typical year b. MSP c. SPF	+ 1 mi/no change in flow - 6 mi -12 mi	*I SA Conditional SA	(21 mi)	I
4. Other Aquatic Biotic Communities (reservoir lakes)	a. typical year b. MSP c. SPF	+ 1,900 ac/+1 Minimum pool +11,260 ac +18,800 ac	*SA SA Conditional SA	Reduce drawdown rates	SB
5. Threatened/Endangered Species (bald eagle) and Yuma clapper rail	a. typical year b. MSP c. SPF	- 290 ac/1 Breeding area - 360 ac/2 Breeding areas - 650 ac/2 Breeding areas	*SA AF Conditional AF	220ac	I
6. Management/Special Use Areas	a. typical year b. MSP c. SPF	- 1,077 AUM - 1,031 AUM - 1,665 AUM	*I I Conditional I	TBD	I

Table IV-18

BIOLOGICAL RESOURCES NET IMPACT/EFFECT FOR PLAN 7

Factor	Scenario	Cumulative Net Impact	Unmitigated Effect	Mitigation	Mitigated Effect
1. Riparian/Wetland Biotic Communities	a. typical year	+ 40 ac	*SA	120ac (290ac)	SA
	b. MSP	- 1,680 ac	SA		
	c. SPF	- 2,670 ac	Conditional SA		
2. Other Terrestrical Biotic Communities	a. typical year	- 13,820 ac	*I	(750ac)	I
	b. MSP	- 9,440 ac	I		
	c. SPF	- 15,230 ac	Conditional I		
3. Perennial Stream/	a. typical year	- 2 mi/200 cfs minimum flow	*SB	(18 mi)	SB
Riverine Aquatic Biotic Communities	b. MSP	- 6 mi	I		
	c. SPF	-12 mi	Conditional SA		
4. Other Aquatic Biotic Communities (reservoir lakes)	a. typical year	+ 3,690 ac/+2 Minimum pools	*SA	Reduce drawdown rates	BF
	b. MSP	+11,260 ac	SA		
	c. SPF	+18,800 ac	Conditional SA		
5. Threatened/Endangered Species (bald eagle) and Yuma clapper rail	a. typical year	- 340 ac/1 Breeding area	*SA	180ac	I
	b. MSP	- 360 ac/2 Breeding areas	AF		
	c. SPF	- 650 ac/2 Breeding areas	Conditional AF		
6. Management/Special Use Areas	a. typical year	- 1,285 AUM	*I	TBD	I
	b. MSP	- 1,031 AUM	I		
	c. SPF	- 1,665 AUM	Conditional I		

2. Water Quality

a. Types of Impacts to Water Quality

(1) Operational Impacts

The water quality analysis has identified three types of significant operational impacts to water quality in the study area. These are salt loading impacts, impacts to water quality constituents, and impacts to reservoir eutrophication potential.

(a) Salt Loading

Because of regulatory storage, additional CAP water can be developed and imported into the study area. This additional water (the regulatory storage yield) would increase the volume of salts imported (salt loading) to central Arizona each year. Without regulatory storage, the CAP would import about 1,020,000 tons of salts each year. The salt loading impacts of the plans ranges from Plan 8 which would not change the salt loading, to Plans 3, 6, and 7 which would increase the imported salts by about 15 percent each year.

The major salt loading impacts of the CAP occur with the baseline CAP (no regulatory storage). The small increase in imported salts resulting from the addition of regulatory storage in any of the plans is considered insignificant in comparison to the salts imported by the enitre CAP system.

(b) Water Quality Constituents

Because of regulatory storage, CAP water would be mixed with or substituted for local water sources. The mixing could occur in a reservoir (New Waddell of Confluence) or in the delivery system (CAP water in a local delivery system). As a consequence of mixing, changes would occur in concentrations of various constituents in the local waters and in the CAP water. This is important because much of the natural surface water in the study area is diverted for uses which require good quality water. Significant degradation of a high quality water source would be hard to justify. It is important to note that if the constituent level of one source of water is increased by mixing, the constituent level of the other source of water will be decreased by the mixing.

The current users of the natural surface waters affected by the plans under consideration would feel the water quality impacts. The Salt River Project (SRP) currently diverts Salt and Verde River water at Granite Reef Diversion Dam, while Maricopa County Municipal Water Conservation District Number One (MCMWCD#1) controls releases from Lake Pleasant on the Agua Fria River. Water diverted at Granite Reef Diversion Dam or released from Lake Pleasant is delivered to its users in open canals. Water conveyed in open canals is subject to at least the effects of aeration, temperature change, detention time, and algal growth before delivery. Some alternative plans involve mixing of surface waters from different sources or a water exchange which would effectively occur upstream of these delivery canals. Impacts to water quality caused by these alternatives would be additionally affected by the mixing of considerable quantities of groundwater

that are pumped directly into the delivery systems, other physical or chemical processes which occur during transport, and any detention or other treatment applied by the user. For both the future-without and future-with regulatory storage conditions, the water which the majority of the users receive may be so different in quality from the water at the diversion points selected for this analysis that most differences in water quality between the two conditions may not be detectable by the user. It was determined that the impacts at the selected diversion points would, however, show the direction and general magnitude of the changes in water quality constituents.

(c) Eutrophication Potential

Eutrophication is a term that describes changes consisting of nutrient enrichment and subsequent algal growth in lakes. This assessment is concerned with eutrophication as it affects water quality. Regulatory storage mixing could produce changes in nutrient concentrations and ratios, leading to potential problems of artificial (man caused) eutrophication in the storage reservoirs or subsequently in the canal systems.

(2) Construction Impacts

For those plans which involve construction there could be water quality impacts to the existing surface water sources during the construction period. Except during severe floods, flows in the rivers would be diverted around the construction sites and otherwise controlled by the upstream dams. Potential water quality impacts, in the form of increased turbidity and sedimentation from clearing in the reservoir basin and from borrow areas, would be minimized wherever possible by holding the water in

temporary sedimentation basins before release from the reservoir area. Water quality would also be adversely affected by point sources of wastewater, such as aggregate processing, concrete batching, and foundation draining. These waters would also be temporarily stored to reduce sediment and turbidity before being allowed to enter the river. Sanitary wastes would have no impacts on water quality, since they would be removed to approved sites for disposal.

All plans (except Plan 8) would have potential for the same types of construction impacts. However, no construction impacts have been identified that could not be mitigated on site. A more detailed description of construction impacts associated with the proposed action is presented in Appendix E with the Section 404 permit discussion.

b. Water Quality Constituents

(1) Direct and Indirect Impacts

Direct impacts to water quality constituents will be the changes in constituent levels which result from the mixing or exchange of CAP and natural surface waters. The indirect impacts will be felt by the subsequent users of the affected CAP or local water.

Impacts to water quality constituents are compared with the future-without conditions in the following sections. Table IV-19 shows state and federal regulated water constituents.

Table IV-19

STATE AND FEDERAL REGULATED WATER CONSTITUENTS
Units: mg/l Unless Noted Otherwise

Constituents	Arizona State Maximum Allowable Limits for Untreated Surface Water Protected Uses[a]					Federal and State Drinking Water Regulations for Treated Domestic Water[b]	
	Domestic Water (DWS)	Recreation Full Body (FBC)	Aquatic and Wildlife (A&W)	Agricultural Irrigation (AgI)	Livestock Watering (AgL)	Primary Maximum Contaminant Level (MCL)	Secondary Maximum Contaminant Level (SMCL)
Ammonia as NH_3	--	--	0.020	--	--	--	--
Arsenic, Diss	0.050	0.050	0.050	--	--	--	--
Arsenic, Total	--	--	--	2.000	0.200	0.050	--
Barium, Diss	1.000	1.000	--	--	--	--	--
Barium, Total	--	--	--	--	--	1.00	--
Boron, Total	--	--	--	1.000	--	--	--
Cadmium, Diss	--	--	0.010	--	--	--	--
Cadmium, Total	0.010	0.010	--	0.050	0.050	0.010	--
Chloride, Total	--	--	--	--	--	--	250.[d]
Chromium, Hexa	0.050	0.050	0.050	--	--	--	--
Chromium, Total	--	--	--	1.000	1.000	0.05	--
Copper, Diss	1.000	--	0.050	--	--	--	--
Copper, Total	--	--	--	5.000	0.500	--	1.[d]
Cyanides	0.200	0.200	0.020	--	0.200	--	--
Oxygen, Diss	--	GT 6.0	GT 6.0	--	--	--	--
Fluoride	--	--	--	--	--	1.4[c]	--
Iron, Total	--	--	--	--	--	--	0.3[d]
Lead, Diss	0.050	0.050	0.050	--	--	--	--
Lead, Total	--	--	--	10.000	0.100	0.05	--
Manganese	--	--	--	10.000	--	--	0.05[d]
Mercury, Total	0.002	0.002	0.002	--	0.010	0.002	--
Nitrate as N	--	--	--	--	--	10.	--
pH (pH Units)	--	6.5-9.0	6.5-9.0	4.5-9.0	6.5-9.0	--	6.5-8.5[d]
Phenolics	0.005	0.005	0.005	--	0.005	--	--
Selenium, Diss	0.010	0.010	--	--	--	--	--
Selenium, Total	--	--	0.050	0.020	0.050	0.01	--
Silver, Diss	0.050	0.050	0.050	--	--	--	--
Silver Total	--	--	--	--	--	0.05	--
Sulfate	--	--	--	--	--	--	250.[d]
Sulfides	--	--	0.100	--	--	--	--
TDS	--	--	--	--	--	--	500.[d]
Turbidity (NTU)[e]	--	25.	25.	--	--	LT 5.[f]	--
Zinc, Diss	5.000	--	0.500	--	--	--	--
Zinc, Total	--	--	--	10.00	25.00	--	5.[d]

[a]ADHS, Rules and Regulations Title 9, Chapter 21, 1982. The above table does not list allowable limits for temperature alteration, coliform bacteria, organic compounds and radiochemicals. The partial body contact (PBC) protected use is not shown since there are no limits for the constituents listed, except pH.

[b]Code of Federal Regulation 40 CFR 141 and 143, 1980. ADHS, Rules and Regulations Title 9, Chapter 8, 1982. The above table does not list the MCL's for coliform bacteria, organic compounds and radiochemicals. Also not listed are SMCL's for color, corrosity, foaming agents and odor.

[c]Fluoride MCL ranges from 1.4 mg/l to 2.4 mg/l, depending on annual average of maximum daily local air temperatures which is assumed proportional to water intake. Average maximum daily air temperatures for Phoenix (85.1°F) and Tucson (81.5°F) have a MCL of 1.4 mg/l. USNOAA 1980.

[d]Federal SMCL's, ADHS has not promulgated numeric SMCL's. 1982.

[e]Nephelometric turbidity units (NTU) are considered comparable to previously reported Formazin (FTU) and Jackson (JTU) turbidity units. Turbidity allowable limits apply to warm water lakes. Allowable limits for streams and cold water fisheries are not listed.

[f]The MCL is 1 NTU. However, 5 or less NTU's may be allowed if it does not cause interference with disinfection, maintenance or microbiological determinations.

Abbreviations: -- = No numeric standard established, GT = greater than, LT = les than, Diss = Dissolved Fraction, Total = Total Recoverable.

(a) Plan 8

In the future-without, CAP water would be imported to central Arizona, but would not be stored in a reservoir. Distribution would occur through conveyance systems connected to the CAP aqueduct. Colorado River water is believed to be high in dissolved organics, so that normal disinfection by CAP recipients at domestic water treatment plants could produce trihlomethane (THM).

There would be no reservoir mixing of CAP and local waters prior to delivery. Water quality constituents of surface waters (SRP and MCMWCD#1) would not be affected by mixing with CAP water in a reservoir.Concentrations of constituents in these waters are presented in the water quality section of Chapter III.

(b) Plan 1

Water quality constituent impacts of this plan would be caused by the direct substitution of CAP water for SRP water during the winter months and the introduction of SRP water into the CAP aqueduct during the summer months. It is estimated that only about 70,000 af of water or 8 percent of the average annual SRP surface water supply would be affected by this exchange. The impacts to average CAP and SRP water beyond the exchange point and during the exchange period are shown on Table IV-20[1] During normal operation of the SRP system the Verde River supplies most of the SRP surface

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1Tables IV-20 through IV-25 use weighted averages to calculate the with-project constituent levels. A weighted average does not take into account the effects of the reservoir itself or the chemical interactions between various constituents.

TABLE IV-20

WATER QUALITY IMPACTS
PLAN 1
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Water[b]			SRP Water[c]			CAP Water[d]			SRP Water[e]		
		Minimum	Average	Maximum	Minimum[f]	Average[g]	Maximum[f]	New Ave.	Change[h]	% Change[h]	New Ave.	Change[h]	% Change[h]
T	Alkalinity as $CaCO_3$	98.0	128.	150.	0	154.	350.	131.	+ 3.0	+ 2	128.	- 26.0	- 17
D	Arsenic	0.00400	0.00400	0.00400	0.00200	0.00761	0.0180	0.00443	+ 0.00043	+ 11	0.00400	- 0.00361	- 47
T	Arsenic	0	0.00284	0.00500	0.00387	0.00682	0.0210	0.00332	+ 0.00048	+ 17	0.00284	- 0.00398	- 59
D	Barium[i]	0	0	0	0	0.0676	0.200	—	—	—	0	—	—
T	Barium[h]	0	0.135	0.500	0	0.100	0.200	0.131	- 0.004	- 3	0.135	+ 0.035	+ 35
	Bicarbonate	120.	156.	177.	0.148	192.	427.	160.	+ 4.00	+ 3	156.	- 36.0	- 19
T	Boron	0.0500	0.196	0.360	0.140	0.187	0.230	0.195	- 0.001	- <1	0.196	+ 0.009	+ 5
D	Cadmium	0	0.000286	0.00100	0	0.00530	0.0140	0.000888	+ 0.000602	+ 210	0.000286	- 0.00501	- 95
T	Cadmium	0	0.00462	0.0130	0	0.00648	0.0100	0.00484	+ 0.00022	+ 5	0.00462	- 0.00186	- 29
D	Calcium	73.0	85.0	100.	19.0	47.0	420.	80.4	- 4.60	- 5	85.0	+ 38.0	+ 81
	Carbonate	0	0.0288	4.00	0	0.879	35.0	0.131	+ 0.102	+ 354	0.0288	- 0.85	- 97
D	Chloride	—	—	—	2.00	141.	610.	—	—	—	—	—	—
T	Chloride	75.0	94.5	140.	—	—	—	—	—	—	94.5	—	—
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	—	—	—	0.00100	—	—
T	Chromium	0	0.00357	0.0200	0	0.00268	0.0100	0.00346	- 0.00011	- 3	0.00357	+ 0.00089	+ 33
D	Copper[i]	0	0	0	0	0.00261	0.00700	—	—	—	0	—	—
T	Copper	0	0.00793	0.0290	0	0.00877	0.0200	0.00803	+ 0.00037	+ 5	0.00793	- 0.00084	- 10
T	Cyanide	0	0.000862	0.0200	—	—	—	—	—	—	0.000862	—	—
D	Oxygen	5.10	8.53	11.7	1.60	8.76	17.8	8.56	+ 0.03	+ <1	8.53	- 0.23	- 3
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	16.1	470.	6.14	+ 1.36	+ 28	4.78	- 11.3	- 70
D	Fluoride (84.7°F)	0.200	0.378	0.500	0	0.363	1.10	0.376	- 0.002	- <1	0.378	+ 0.015	+ 4
T	Hardness (as $CaCO_3$)	290.	339.	380.	79.0	194.	413.	322.	-17.0	- 5	339.	+145.	+ 75
	Hardness (noncarbonate)	170.	211.	243.	0	36.3	182.	190.	-21.0	- 10	211.	+175.	+482
T	Iron	0.0300	0.159	0.550	0	0.189	3.50	0.163	+ 0.004	+ 3	0.159	- 0.03	- 16
D	Lead	0	0.00144	0.00400	0	0.00507	0.0600	0.00188	+ 0.00044	+ 31	0.00144	- 0.00363	- 72
T	Lead	0	0.0408	0.100	0	0.0731	0.100	0.0447	+ 0.0039	+ 10	0.0408	- 0.0323	- 44
D	Magnesium	26.0	30.8	40.0	5.50	18.9	55.0	29.4	- 1.40	- 5	30.8	+ 11.9	+ 63
T	Manganese	0	0.0208	0.0400	0	0.0743	0.380	0.0272	+ 0.0064	+ 31	0.0208	- 0.0535	- 72
T	Mercury	0	0.0000431	0.000600	0	0.000138	0.00260	0.0000545	+ 0.0000114	+ 26	0.0000431	- 0.0000949	- 69
T	Nitrate (as N)	0.170	0.170	0.170	0	0.0720	0.160	0.158	- 0.012	- 7	0.170	+ 0.098	+136
	pH (pH units)	7.10	7.95	8.80	4.50	7.86	9.10	7.94	- 0.01	- <1	7.95	+ 0.09	+ 1
T	Phosphorus (as P)	0	0.0258	0.100	0	0.216	8.30	0.0486	+ 0.0228	+ 88	0.0258	- 0.19	- 88
D	Potassium	4.50	5.21	6.80	1.30	4.78	42.0	5.16	- 0.05	- <1	5.21	+ 0.43	+ 9
D	Selenium	0.00300	0.00300	0.00300	0	0.000430	0.00300	0.00269	- 0.000308	- 10	0.00300	+ 0.00257	+598
T	Selenium	0	0.00279	0.00500	0	0.000410	0.00200	0.00250	- 0.00029	- 10	0.00279	+ 0.00238	+580
	Specific Cond. (µ℧/cm)	950.	1120.	1720.	0.700	853.	2340.	1090.	-30.0	- 3	1120.	+267.	+ 31
D	Silver[i]	0	0	0	0	0	0.	—	—	—	0	—	—
T	Silver	0	0.00350	0.0100	0	0.000975	0.0100	0.00320	- 0.0003	- 9	0.00350	+ 0.00253	+259
D	Sodium	90.0	107.	120.	4.20	105.	382.	107.	0	0	107.	+ 2.0	+ 2
	Sodium Adsorption Ratio (no units)[j]	2.20	2.53	3.00	0.200	3.27	677.	2.60	+ 0.07	+ 3	2.53	- 0.65	- 20
D	Sulfate	240.	309.	380.	11.0	52.0	360.	278.	-31.0	- 10	309.	+257.	+494
T	Dissolved solids (180°C)	602.	722.	848.	109.	497.	1300.	695.	-27.0	- 4	722.	+225.	+ 45
	Turbidity (JTU)	1.00	2.58	10.0	1.00	37.5	2800.	6.77	+ 4.19	+ 162	2.58	- 35.	- 93
D	Zinc	0	0.00889	0.0200	0	0.0121	0.120	0.00928	+ 0.00039	+ 4	0.00889	- 0.00321	- 27
T	Zinc	0	0.0239	0.310	0.0100	0.0342	0.200	0.0251	+ 0.0012	+ 5	0.0239	- 0.0103	- 30
	Phenolics	0	0.00127	0.00700	—	—	—	—	—	—	0.00127	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; — = Data Not Available

a Levels shown rounded to three significant figures. Some zero values may represent "below detection levels".
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d In CAP aqueduct after impacts of water exchange with SRP.
e At Granite Reef Diversion Dam. During exchange period, SRP water would be the same as CAP water.
f Minimum and maximum values are for the Salt or Verde Rivers and could be experienced only if one river was flowing.
g Weighted average based on STORET data and USGS flow records resulting in a 43 percent Verde River and 57 percent Salt River mix at the confluence of the two rivers.
h Changes are relative to future without average values.
i Constituents with zero future without average values could not be used to calculate future with values.
j All average SAR values were computed from average values for Na, Ca, and Mg.

operation of the SRP system the Verde River supplies most of the SRP surface water during the proposed exchange period. A comparison of CAP and Verde River water is shown on Table IV-21 with the information in the last three columns showing how the SRP water (from the Verde River) could be changed during the exchange period.

The impacts of Plan 1 on water quality constituents are considered to be Insignificant.

(c) Plan 2

There would be no regulatory storage associated with this plan. The resulting water quality impacts would be associated only with changes in detained flood waters and in flood flows. In general this plan would provide for longer flood flows at smaller flow rates. There would be no impacts to water quality constituents associated with this plan.

(d) Plan 3

Water quality constituent impacts during the operation of this plan would primarily be caused by the mixing of CAP water with local surface water at the Confluence site. The impacts to both the average CAP and SRP surface water supplies are shown in Table IV-22. A special impact assessment showing impacts to SRP water during the period when operations would deliver only Verde River water is shown in Table IV-23.

The impacts of Plan 3 on water quality constituents are considered to be Significant Adverse.

TABLE IV-21

WATER QUALITY IMPACTS
PLAN 1
(Special Case)
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions		
		CAP Water[b]			Verde River Water[c]			SRP Water[d]		
		Minimum	Average	Maximum	Minimum	Average	Maximum	New Ave.	Change[e]	% Change[e]
T	Alkalinity as $CaCO_3$	98.0	128.	150.	0	185.	350.	128.	- 57.0	- 31
D	Arsenic	0.00400	0.00400	0.00400	0.00500	0.0121	0.0180	0.00400	- 0.0081	- 67
T	Arsenic	0	0.00284	0.00500	0.00700	0.0133	0.0210	0.00284	- 0.0105	- 79
D	Barium[f]	0	0	0	0	0.0550	0.100	0	—	—
T	Barium	0	0.135	0.500	0	0.100	0.200	0.135	+ 0.035	+ 35
	Bicarbonate	120.	156.	177.	0.148	235.	427.	156.	- 79.0	- 34
T	Boron	0.0500	0.196	0.360	0.190	0.190	0.190	0.196	+ 0.006	+ 3
D	Cadmium	0	0.000286	0.00100	0	0.00156	0.0140	0.000286	- 0.00127	- 81
T	Cadmium	0	0.00462	0.0130	0	0.00619	0.0100	0.00462	- 0.00157	- 25
D	Calcium	73.0	85.0	100.	19.0	42.5	75.0	85.0	+ 42.5	+ 100
	Carbonate	0	0.0288	4.00	0	1.57	15.0	0.0288	- 1.54	- 98
D	Chloride	—	—	—	2.00	18.8	130.	—	—	—
T	Chloride	75.0	94.5	140.	—	—	—	94.5	—	—
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	0.00100	—	—
T	Chromium	0	0.00357	0.0200	0	0.00375	0.0100	0.00357	- 0.00018	- 5
D	Copper[f]	0	0	0	0	0.00275	0.00700	0	—	—
T	Copper	0	0.00793	0.0290	0.00300	0.00888	0.0200	0.00793	- 0.00095	- 11
T	Cyanide	0	0.000862	0.0200	—	—	—	0.000862	—	—
D	Oxygen	5.10	8.53	11.7	8.60	11.6	17.8	8.53	- 3.07	- 26
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	8.35	99.0	4.78	- 3.57	- 43
D	Fluoride (84.7°F)	0.200	0.378	0.500	0	0.340	0.800	0.378	+ 0.038	+ 11
T	Hardness (as $CaCO_3$)	290.	339.	380.	79.0	212.	413.	339.	+127.	+ 60
	Hardness (noncarbonate)	170.	211.	243.	0	18.9	182.	211.	+192.	+1016
T	Iron	0.0300	0.159	0.550	0	0.192	3.50	0.159	- 0.033	- 17
D	Lead	0	0.00144	0.00400	0	0.00300	0.0120	0.00144	- 0.00156	- 52
T	Lead	0	0.0408	0.100	0.00400	0.0714	0.100	0.0408	- 0.0306	- 43
D	Magnesium	26.0	30.8	40.0	6.40	25.7	55.0	30.8	+ 5.10	+ 20
T	Manganese	0	0.0208	0.0400	0	0.0900	0.380	0.0208	- 0.0692	- 77
T	Mercury[f]	0	0.0000431	0.000600	0	0.000263	0.00260	0.0000431	- 0.00022	- 84
T	Nitrate (as N)	0.170	0.170	0.170	0.0200	0.0967	0.140	0.170	+ 0.0733	+ 76
	pH (pH units)	7.10	7.95	8.80	6.80	8.01	8.80	7.95	- 0.06	- <1
T	Phosphorus (as P)	0	0.0258	0.100	0	0.206	0.400	0.0258	- 0.18	- 87
D	Potassium	4.50	5.21	6.80	1.30	3.39	7.40	5.21	+ 1.82	+ 54
D	Selenium	0.00300	0.00300	0.00300	0	0.000750	0.00300	0.00300	+ 0.00225	+ 300
T	Selenium	0	0.00279	0.00500	0	0.000600	0.00100	0.00279	+ 0.00219	+ 365
	Specific Cond. (µ℧/cm)	950.	1120.	1720.	0.700	472.	929.	1120.	+648.	+ 137
D	Silver[f]	0	0	0	0	0	0	0	—	—
T	Silver[f]	0	0.00350	0.0100	0	0	0	0.00350	—	—
D	Sodium	90.0	107.	120.	4.20	30.5	290.	107.	+ 76.5	+ 251
	Sodium Adsorption Ratio (no units)[g]	2.20	2.53	3.00	0.200	1.05	677.	2.53	+ 1.48	+ 141
D	Sulfate	240.	309.	380.	11.0	52.9	107.	309.	+256.	+ 484
T	Dissolved solids (180°C)	602.	722.	848.	109.	314.	550.	722.	+408.	+ 130
	Turbidity (JTU)	1.00	2.58	10.0	1.00	83.3	2800.	2.58	- 80.7	- 97
D	Zinc	0	0.00889	0.0200	0	0.00700	0.0300	0.00889	+ 0.00189	+ 27
T	Zinc	0	0.0239	0.310	0.0100	0.0356	0.200	0.0239	- 0.0117	- 33
	Phenolics	0	0.00127	0.00700	—	—	—	0.00127	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; — = Data Not Available

a Levels shown rounded to three significant figures. Some zero values may represent "below detection levels".
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d At Granite Reef Diversion Dam. During the exchange period, SRP water would be the same as CAP water.
e Changes are relative to future without average values.
f Constituents with zero future without average values could not be used to calculate future with values.
g All average SAR values were computed from average values for Na, Ca, and Mg.

TABLE IV-22

WATER QUALITY IMPACTS
PLAN 3
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Water[b]			SRP Water[c]			CAP Water[d]			SRP Water[e]		
		Minimum	Average	Maximum	Minimum[f]	Average[g]	Maximum[f]	New Ave.	Change[h]	% Change[h]	New Ave.	Change[h]	% Change[h]
T	Alkalinity as $CaCO_3$	98.0	128.	150.	0	154.	350.	133.	+ 5.00	+ 4	147.	- 7.0	- 5
D	Arsenic	0.00400	0.00400	0.00400	0.00200	0.00761	0.0180	0.00471	+ 0.00071	+ 18	0.00664	- 0.00097	- 13
T	Arsenic	0	0.00284	0.00500	0.00387	0.00682	0.0210	0.00362	+ 0.00078	+ 27	0.00575	- 0.00107	- 16
D	Barium[i]	0	0	0	0	0.0676	0.200	—	—	—	—	—	—
T	Barium	0	0.135	0.500	0	0.100	0.200	0.128	- 0.007	- 5	0.109	+ 0.009	+ 9
	Bicarbonate	120.	156.	177.	0.148	192.	427.	163.	+ 7.0	+ 4	182.	- 10.0	- 5
T	Boron	0.0500	0.196	0.360	0.140	0.187	0.230	0.194	- 0.002	- 1	0.189	+ 0.002	+ 1
D	Cadmium	0	0.000286	0.00100	0	0.00530	0.0140	0.00127	+ 0.000984	+344	0.00396	- 0.00134	- 25
T	Cadmium	0	0.00462	0.0130	0	0.00648	0.0100	0.00498	+ 0.00036	+ 8	0.00598	- 0.0005	- 8
D	Calcium	73.0	85.0	100.	19.0	47.0	420.	77.6	- 7.40	- 9	57.2	+ 10.2	+ 22
	Carbonate	0	0.0288	4.00	0	0.879	35.0	0.195	+ 0.166	+576	0.651	- 0.228	- 26
D	Chloride	—	—	—	2.00	141.	610.	—	—	—	—	—	—
T	Chloride	75.0	94.5	140.	—	—	—	—	—	—	—	—	—
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	—	—	—	—	—	—
T	Chromium	0	0.00357	0.0200	0	0.00268	0.0100	0.00340	- 0.00017	- 5	0.00292	+ 0.00024	+ 9
D	Copper[i]	0	0	0	0	0.00261	0.00700	—	—	—	—	—	—
T	Copper	0	0.00793	0.0290	0	0.00877	0.0200	0.00809	+ 0.00097	+ 12	0.00854	- 0.00023	- 3
T	Cyanide	0	0.000862	0.0200	—	—	—	—	—	—	—	—	—
D	Oxygen	5.10	8.53	11.7	1.60	8.76	17.8	8.58	+ 0.05	+ <1	8.70	- 0.06	- <1
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	16.1	470.	7.00	+ 2.22	+ 46	13.1	- 3.0	- 19
D	Fluoride (84.7°F)	0.200	0.378	0.500	0	0.363	1.10	0.375	- 0.003	- <1	0.367	+ 0.004	+ 1
T	Hardness (as $CaCO_3$)	290.	339.	380.	79.0	194.	413.	311.	-28.0	- 8	233.	+ 39.0	+ 20
	Hardness (noncarbonate)	170.	211.	243.	0	36.3	182.	177.	-34.0	- 16	83.1	+ 46.8	+129
T	Iron	0.0300	0.159	0.550	0	0.189	3.50	0.165	+ 0.006	+ 4	0.181	- 0.008	- 4
D	Lead	0	0.00144	0.00400	0	0.00507	0.0600	0.00215	+ 0.00071	+ 49	0.00410	- 0.00097	- 19
T	Lead	0	0.0408	0.100	0	0.0731	0.100	0.0471	+ 0.0063	+ 15	0.0644	- 0.0087	-119
D	Magnesium	26.0	30.8	40.0	5.50	18.9	55.0	28.5	- 2.30	- 7	22.1	+ 3.20	+ 17
T	Manganese	0	0.0208	0.0400	0	0.0743	0.380	0.0313	+ 0.0105	+ 50	0.0600	- 0.0143	- 19
T	Mercury	0	0.0000431	0.000600	0	0.000138	0.00260	0.0000617	+ 0.0000186	+ 43	0.000113	- 0.000025	-181
T	Nitrate (as N)	0.170	0.170	0.170	0	0.0720	0.160	0.151	- 0.019	- 11	0.0983	+ 0.0263	+ 37
	pH (pH units)	7.10	7.95	8.80	4.50	7.86	9.10	7.93	- 0.02	- <1	7.88	+ 0.02	+ <1
T	Phosphorus (as P)	0	0.0258	0.100	0	0.216	8.300	0.0631	+ 0.0373	+145	0.165	- 0.051	- 24
D	Potassium	4.50	5.21	6.80	1.30	4.78	42.0	5.13	- 0.08	- 2	4.90	+ 0.12	+ 3
D	Selenium	0.00300	0.00300	0.00300	0	0.000430	0.00300	0.00250	- 0.0005	- 17	0.00112	+ 0.00069	+160
T	Selenium	0	0.00279	0.00500	0	0.000410	0.00200	0.00232	- 0.00047	- 17	0.00105	+ 0.00064	+156
	Specific Cond. (µ℧/cm)	950.	1120.	1720.	0.700	853.	2340.	1070.	-50.0	- 4	925.	+ 72.0	+ 8
D	Silver[i]	0	0	0	0	0	0.	—	—	—	—	—	—
T	Silver	0	0.00350	0.0100	0	0.000975	0.0100	0.00301	- 0.00049	- 14	0.00165	+ 0.000675	+ 69
D	Sodium	90.0	107.	120.	4.20	105.	382.	107.	0	0	106.	+ 1.0	+ <1
	Sodium Adsorption Ratio (no units)[j]	2.20	2.53	3.00	0.200	3.18	677.	3.25	+ 0.72	+ 28	3.02	- 0.16	- 5
D	Sulfate	240.	309.	380.	11.0	52.0	360.	259.	-50.0	- 16	121.	+ 69.0	+133
T	Dissolved Solids (180°C)	602.	722.	848.	109.	497.	1300.	678.	-44.1	- 6	557.	+ 60.0	+ 12
	Turbidity (JTU)	1.00	2.58	10.0	1.00	37.5	2800.	9.42	+ 6.84	+265	28.18	- 9.40	- 25
D	Zinc	0	0.00889	0.0200	0	0.0121	0.120	0.00952	+ 0.00063	+ 7	0.0112	- 0.0009	- 7
T	Zinc	0	0.0239	0.310	0.0100	0.0342	0.200	0.0259	+ 0.002	+ 8	0.0314	- 0.0028	- 8
	Phenolics	0	0.00127	0.00700	—	—	—	—	—	—	—	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; — = Data Not Available

a Levels shown rounded to three significant figures. Some zero values may represent "below detection levels".
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d In CAP aqueduct after regulatory storage mixing. CAP deliveries before Granite Reef would not be affected by impacts at the Confluence Reservoir.
e At Granite Reef Diversion Dam.
f Minimum and maximum values are for the Salt or Verde Rivers and could be experienced only if one river was flowing.
g Weighted average based on STORET data and USGS flow records resulting in a 43 percent Verde River and 57 percent Salt River mix at the confluence of the two rivers.
h Changes are relative to future without average values.
i Constituents with zero future without average values could not be used to calculate future with values.

TABLE IV-23

WATER QUALITY IMPACTS
PLAN 3
(Special Case)
(mg/l, unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions		
		CAP Water[b]			Verde River Water[c]			SRP Water[d]		
		Minimum	Average	Maximum	Minimum	Average	Maximum	New Ave.	Change[e]	% Change[e]
T	Alkalinity as $CaCO_3$	98.0	128.	150.	0	185.	350.	160.	- 25.0	- 14
D	Arsenic	0.00400	0.00400	0.00400	0.00500	0.0121	0.0180	0.00855	- 0.00355	- 29
T	Arsenic	0	0.00284	0.00500	0.00700	0.0133	0.0210	0.00872	- 0.00458	- 34
D	Barium[f]	0	0	0	0	0.0550	0.100	—	—	—
T	Barium	0	0.135	0.500	0	0.100	0.200	0.115	+ 0.015	+ 15
	Bicarbonate	120.	156.	177.	0.148	235.	427.	200.	- 35.0	- 15
T	Boron	0.0500	0.196	0.360	0.190	0.190	0.190	0.193	+ 0.003	+ 2
D	Cadmium	0	0.000286	0.00100	0	0.00156	0.0140	0.00100	- 0.00056	- 36
T	Cadmium	0	0.00462	0.0130	0	0.00619	0.0100	0.00550	- 0.00069	- 11
D	Calcium	73.0	85.0	100.	19.0	42.5	75.0	61.1	+ 18.6	+ 44
	Carbonate	0	0.0288	4.00	0	1.57	15.0	0.895	- 0.675	- 43
D	Chloride	—	—	—	2.00	18.8	130.	—	—	—
T	Chloride	75.0	94.5	140.	—	—	—	—	—	—
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	—	—	—
T	Chromium	0	0.00357	0.0200	0	0.00375	0.0100	0.00367	- 0.00008	- 2
D	Copper[f]	0	0	0	0	0.00275	0.00700	—	—	—
T	Copper	0	0.00793	0.0290	0.00300	0.00888	0.0200	0.00846	- 0.00042	- 5
T	Cyanide	0	0.000862	0.0200	—	—	—	—	—	—
D	Oxygen	5.10	8.53	11.7	8.60	11.6	17.8	10.3	- 1.3	- 11
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	1.00	8.35	99.0	6.79	- 1.56	- 19
D	Fluoride (84.7°F)	0.200	0.378	0.500	0	0.340	0.800	0.357	+ 0.017	+ 5
T	Hardness (as $CaCO_3$)	290.	339.	380.	79.0	212.	413.	268.	+ 56	+ 26
	Hardness (noncarbonate)	170.	211.	243.	0	18.9	182.	103.	+ 84.1	+445
T	Iron	0.0300	0.159	0.550	0	0.192	3.50	0.178	- 0.014	- 7
D	Lead	0	0.00144	0.00400	0	0.00300	0.0120	0.00232	- 0.00068	- 23
T	Lead	0	0.0408	0.100	0.00400	0.0714	0.100	0.0580	- 0.0134	- 19
D	Magnesium	26.0	30.8	40.0	6.40	25.7	55.0	27.9	+ 2.20	+ 9
T	Manganese	0	0.0208	0.0400	0	0.0900	0.380	0.0597	- 0.303	- 34
T	Mercury	0	0.0000431	0.000600	0	0.000263	0.00260	0.000167	- 0.000096	- 37
T	Nitrate (as N)	0.170	0.170	0.170	0.0200	0.0967	0.140	0.129	+ 0.323	+ 33
	pH (pH units)	7.10	7.95	8.80	6.80	8.01	8.80	7.98	- 0.03	- <1
T	Phosphorus (as P)	0	0.0258	0.100	0	0.206	0.400	0.127	- 0.079	- 38
D	Potassium	4.50	5.21	6.80	1.30	3.39	7.40	4.19	+ 0.8	+ 24
D	Selenium	0.00300	0.00300	0.00300	0	0.000750	0.00300	0.00174	+ 0.00099	+132
T	Selenium	0	0.00279	0.00500	0	0.000600	0.00100	0.00156	+ 0.00096	+160
	Specific Cond. (µ℧/cm)	950.	1120.	1720.	0.700	472.	929.	756.	+284.	+ 60
D	Silver[f]	0	0	0	0	0	0	—	—	—
T	Silver[f]	0	0.00350	0.0100	0	0	0	—	—	—
D	Sodium	90.0	107.	120.	4.20	30.5	290.	64.0	+ 33.5	+110
	Sodium Adsorption Ratio (no units)[g]	2.20	2.53	3.00	0.200	1.05	677.	1.70	+ 0.65	+ 62
D	Sulfate	240.	309.	380.	11.0	52.9	107.	165.	+112.	+212
T	Dissolved solids (180°C)	602.	722.	848.	109.	314.	550.	493.	+179.	+ 57
	Turbidity (JTU)	1.00	2.58	10.0	1.00	83.3	2800.	47.9	- 35.4	- 42
D	Zinc	0	0.00889	0.0200	0	0.00700	0.0300	0.00783	+ 0.00083	+ 12
T	Zinc	0	0.0239	0.310	0.0100	0.0356	0.200	0.0305	- 0.0051	- 14
	Phenolics	0	0.00127	0.00700	—	—	—	—	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; — = Data Not Available

a Levels shown rounded to three significant figures. Some zero values may represent "below detection levels".
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d At Granite Reef Diversion Dam.
e Changes are relative to future without average values.
f Constituents with zero future without average values could not be used to calculate future with values.
g All average SAR values were computed from average values for Na, Ca, and Mg.

(e) Plans 6 and 7

Water quality constituent impacts of these plans would be primarily caused by the regulatory storage mixing of CAP water with MCMWCD#1 water at the New Waddell site and by the addition of SRP water to the CAP aqueduct near Granite Reef Diversion Dam. Plans 6 and 7 would have the same impacts to water quality constituents since both plans utilize the same operation at the Waddell and Granite Reef sites. SRP water quality would not be affected by either plan. The impacts of regulatory storage to both the average CAP and MCMWCD#1 surface water supplies are shown on Table IV-24. The additional impacts to average CAP water which result from adding SRP water near the Granite Reef site are shown on Table IV-25.

The impacts of Plan 6 and 7 on water quality constituents are considered insignificant.

(2) Mitigation for Water Quality Constituent Impacts

Mitigation for impacts to water quality constituents will vary from plan to plan. For Plan 1, mitigation would consist of an institutional arrangement between CAP and SRP so that users of SRP water would have adequate notice of the exchange period and could plan accordingly.

For all plans which involve a regulatory storage reservoir it is recommended that all deliveries from the reservoir for domestic users be adequately aerated prior to or during discharge. Aeration of the water after release from the reservoir will help to insure that the dissolved heavy metals precipitate out of the water before the water is delivered to the users. Each reservoir which includes regulatory storage mixing of CAP

TABLE IV-24

WATER QUALITY IMPACTS
PLAN 6 - IMPACTS FROM REGULATORY STORAGE AT WADDELL
(mg/l unless otherwise noted)

	Water Quality Constituent	Future Without Conditions[a]						Future With Conditions					
		CAP Water[b]			MCMWCD#1 Water[c]			CAP Water[d]			MCMWCD#1 Water[e]		
		Minimum	Average	Maximum	Minimum	Average	Maximum	New Ave.	Change[f]	% Change[f]	New Ave.	Change[f]	% Change[f]
T	Alkalinity as $CaCO_3$	98.0	128.	150.	140.	175.	190.	129.	+ 1.0	+ <1	130.	- 45.0	- 26
D	Arsenic[g]	0.00400	0.00400	0.00400	0.00900	0.0100	0.0110	0.00414	+ 0.00014	+ 4	0.00420	- 0.0058	- 58
T	Arsenic	0	0.00284	0.00500	0.00900	0.0133	0.0160	0.00309	+ 0.00025	+ 9	0.00320	- 0.0101	- 76
D	Barium[gh]	0	0	0	0.0650	0.0730	0.0810	—	—	—	—	—	—
T	Barium[h]	0	0.135	0.500	<0.100	<0.100	0.100	0.134	- 0.001	- <1	0.134	+ 0.034	+ 34
	Bicarbonate	120.	156.	177.	—	—	—	—	—	—	—	—	—
T	Boron	0.0500	0.196	0.360	0.0900	0.165	0.230	0.195	- 0.001	- <1	0.195	+ 0.03	+ 18
D	Cadmium[gh]	0	0.000286	0.00100	<0.00300	<0.00300	<0.00300	0.000351	+ 0.000065	+ 23	0.000378	- 0.00262	- 87
T	Cadmium[h]	0	0.00462	0.0130	<0.00100	<0.00150	0.00200	0.00455	- 0.00007	- 2	0.00451	+ 0.00301	+201
D	Calcium	73.0	85.0	100.	39.0	50.8	58.0	84.2	- 0.8	- <1	83.8	+ 33.0	+ 65
	Carbonate	0	0.0288	4.00	—	—	—	—	—	—	—	—	—
D	Chloride	—	—	—	32.0	36.0	40.0	—	—	—	—	—	—
T	Chloride	75.0	94.5	140.	—	—	—	—	—	—	—	—	—
	Chromium (Hexa)	0.00100	0.00100	0.00100	—	—	—	—	—	—	—	—	—
T	Chromium	0	0.00357	0.0200	0.00300	0.00725	0.0190	0.00366	+ 0.00009	+ 3	0.00370	- 0.00355	- 49
D	Copper[gh]	0	0	0	0.00700	0.00750	0.00800	—	—	—	—	—	—
T	Copper	0	0.00793	0.0290	0.00700	0.0138	0.0290	0.00807	+ 0.00014	+ 2	0.00813	- 0.00567	- 41
T	Cyanide[h]	0	0.000862	0.0200	<0.0100	<0.0100	<0.0100	0.00108	+ 0.000218	+ 25	0.00117	- 0.00883	- 88
D	Oxygen	5.10	8.53	11.7	8.60	8.88	9.10	8.54	+ 0.01	+ <1	8.54	- 0.34	- 4
	Fecal Coliforms (cols/100 ml)	0.990	4.78	41.9	4.00	36.3	120.	5.54	+ 0.76	+ 16	5.85	- 30.4	- 88
D	Fluoride (84.7°F)	0.200	0.378	0.500	0.300	0.325	0.400	0.377	- 0.001	- <1	0.376	+ 0.051	+ 16
T	Hardness (as $CaCO_3$)	290.	339.	380.	160.	215.	240.	336.	- 3.0	- <1	335.	+120.	+ 56
	Hardness (noncarbonate)	170.	211.	243.	23.0	41.3	54.0	207.	- 4.0	- 2	205.	+164.	+397
T	Iron	0.0300	0.159	0.550	0.0600	2.04	6.40	0.204	+ 0.045	+ 28	0.223	- 1.82	- 89
D	Lead[g]	0	0.00144	0.00400	0.00200	0.00200	0.00200	0.00145	+ 0.00001	+ <1	0.00146	- 0.00054	- 27
T	Lead	0	0.0408	0.100	0.00100	0.00425	0.00800	0.0399	- 0.0009	- 2	0.0396	+ 0.0354	+832
D	Magnesium	26.0	30.8	40.0	16.0	21.8	25.0	30.6	- 0.2	- <1	30.5	+ 8.7	+ 40
T	Manganese	0	0.0208	0.0400	0.0100	0.0850	0.270	0.0223	+ 0.0015	+ 7	0.0230	- 0.062	- 73
T	Mercury[gh]	0	0.0000431	0.000600	<0.000100	<0.000100	<0.000100	0.0000445	+ 0.0000014	+ 3	0.0000450	- 0.000055	- 55
T	Nitrate (as N)	0.170	0.170	0.170	3.20	3.85	4.50	0.258	+ 0.088	+ 52	0.295	- 3.56	- 92
	pH (pH units)	7.10	7.95	8.80	8.30	8.43	8.60	7.96	+ 0.01	+ <1	7.97	- 0.46	- 5
T	Phosphorus (as P)	0	0.0258	0.100	0.0900	0.150	0.180	0.0288	+ 0.003	+ 12	0.0300	- 0.12	- 80
D	Potassium	4.50	5.21	6.80	1.60	1.98	2.30	5.13	- 0.08	- 2	5.10	+ 3.12	+158
D	Selenium[gh]	0.00300	0.00300	0.00300	<0.00100	<0.00100	<0.00100	0.00295	- 0.00005	- 2	0.00293	+ 0.00193	+193
T	Selenium[h]	0	0.00279	0.00500	<0.00100	<0.00100	0.00100	0.00275	- 0.00004	- 2	0.00273	+ 0.00173	+173
	Specific Cond. (µS/cm)	950.	1120.	1720.	420.	582.	676.	1110.	-10.0	- <1	1100.	+518.	+ 89
D	Silver[gh]	0	0	0	<0.00100	<0.00100	<0.00100	—	—	—	—	—	—
T	Silver[h]	0	0.00350	0.0100	<0.00100	<0.00100	<0.00100	0.00344	- 0.00006	- 2	0.00342	+ 0.00242	+242
D	Sodium	90.0	107.	120.	25.0	37.8	45.0	105.	- 2.0	- 2	105.	+ 67.2	+178
	Sodium Adsorption Ratio (no units)[i]	2.20	2.53	3.00	0.900	1.12	1.40	2.49	- 0.04	- 2	2.50	+ 1.38	+123
D	Sulfate	240.	309.	380.	53.0	85.0	100.	304.	- 5.0	- 2	301.	+216.	+254
T	Dissolved Solids (180°C)	602.	722.	848.	257.	358.	401.	713.	- 9.0	- 1	710.	+352.	+ 98
	Turbidity (JTU)[j]	1.00	2.58	10.0	0.600	31.6	110.	—	—	—	—	—	—
D	Zinc[gh]	0	0.00889	0.0200	<0.0120	<0.0120	<0.0120	0.00896	+ 0.00007	+ <1	0.00900	- 0.003	- 25
T	Zinc	0	0.0239	0.310	0.0200	0.0325	0.0600	0.0241	+ 0.0002	+ <1	0.0242	- 0.0083	- 26
	Phenolics	0	0.00127	0.00700	—	—	—	—	—	—	—	—	—

Note: D = Dissolved Fraction; T = Total Recoverable; — = Data Not Available.

a Levels shown rounded to three significant figures. Some zero values may represent "below detection levels".
b Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record October 1968 - June 1981.
c U.S. Geological Survey from U.S. Bureau of Reclamation, 1982; period of record January-April 1982.
d In CAP aqueduct after regulatory storage mixing at Waddell site. CAP deliveries before the Waddell site would not be affected by impacts at the Waddell site.
e At Lower Lake Pleasant.
f Changes are relative to future without average values.
g MCMWCD#1 samples for these constituents taken from below Lake Pleasant.
h These constituents show "zero" or "less than" average values. The future with conditions assumed the less than values to be representative. As a result, the change and % change may show exaggerated or wrong direction changes. Constituents with zero future without average values could not be used to calculate future with values.
i All average SAR values were computed from average values for Na, Ca, and Mg.
j MCMWCD#1 turbidity is in NTU.

TABLE IV-25

WATER QUALITY IMPACTS
PLAN 6
IMPACTS FROM ADDITION OF SRP WATER
(mg/l unless otherwise noted)

	Water Quality Constituent	CAP Aqueduct Water[ab]			Future Without Conditions[a] SRP Water[ac]			Future With Conditions CAP Water[d]			Future With Conditions SRP Water		
		Minimum	Average	Maximum	Minimum[e]	Average[f]	Maximum[e]	New Ave.	Change[g]	% Change[g]	New Ave.	Change	% Change
T	Alkalinity as $CaCO_3$	98.0	129.	190.	0	154.	350.	131.	+ 3.00	+ 2			
D	Arsenic	0.004	0.00414	0.0110	0.00200	0.00761	0.0180	0.00441	+ 0.00041	+ 10			
T	Arsenic	0	0.00309	0.0160	0.00387	0.00682	0.0210	0.00338	+ 0.00054	+ 19			
D	Barium	0	—	0.0810	0	0.0676	0.200	—	—	—			
T	Barium[h]	0	0.134	0.500	0	0.100	0.200	0.131	- 0.004	- 3			
	Bicarbonate	—	—	—	0.148	192.	427.	—	—	—			
T	Boron	0.0500	0.195	0.360	0.140	0.187	0.230	0.194	- 0.002	- 1			
D	Cadmium[h]	0	0.000351	<0.00300	0	0.00530	0.0140	0.000737	+ 0.000451	+ 158			
T	Cadmium[h]	0	0.00455	0.0130	0	0.00648	0.0100	0.00470	+ 0.00008	+ 2			
D	Calcium	39.0	84.2	100.	19.0	47.0	420.	81.3	- 3.7	- 4			
	Carbonate	0	—	—	0	0.879	35.0	—	—	—			
D	Chloride	—	—	—	2.00	141.	610.	—	—	—			
T	Chloride	—	—	—	—	—	—	—	—	—			
	Chromium (Hexa)	—	—	—	—	—	—	—	—	—			
T	Chromium	0	0.00366	0.0200	0	0.00268	0.0100	0.00358	+ 0.00001	+ <1			
D	Copper	0	—	0.00800	0	0.00261	0.00700	—	—	—			
T	Copper	0	0.00807	0.0290	0	0.00877	0.0200	0.00812	+ 0.00019	+ 2			
T	Cyanide	0	0.00108	0.0200	—	—	—	—	—	—			
D	Oxygen	5.10	8.54	11.7	1.60	8.76	17.8	8.56	+ 0.03	+ <1			
	Fecal Coliforms (cols/100 ml)	0.990	5.54	120.	1.00	16.1	470.	6.36	+ 1.58	+ 33			
D	Fluoride (84.7°F)	0.200	0.377	0.500	0	0.363	1.10	0.376	- 0.002	- <1			
T	Hardness (as $CaCO_3$)	160.	336.	380.	79.0	194.	413.	325.	-14.0	- 4			
	Hardness (noncarbonate)	23.0	207.	243.	0	36.3	182.	194.	-17.0	- 8			
T	Iron	0.0300	0.204	6.40	0	0.189	3.50	0.203	+ 0.044	+ 28			
D	Lead	0	0.00145	0.00200	0	0.00507	0.0600	0.00173	+ 0.00029	+ 20			
T	Lead	0	0.0399	0.100	0	0.0731	0.100	0.0425	+ 0.0017	+ 4			
D	Magnesium	16.0	30.6	40.0	5.50	18.9	55.0	29.7	- 1.10	- 4			
T	Manganese	0	0.0223	0.0400	0	0.0743	0.380	0.0264	+ 0.0056	+ 27			
T	Mercury[h]	0	0.0000445	<0.0001	0	0.000138	0.00260	0.0000518	+ 0.0000087	+ 20			
T	Nitrate (as N)	0.170	0.258	4.50	0	0.0720	0.160	0.243	+ 0.073	+ 43			
	pH (pH units)	7.10	7.96	8.80	4.50	7.86	9.10	7.95	0	0			
T	Phosphorus (as P)	0	0.0288	0.180	0	0.216	8.30	0.0434	+ 0.0176	+ 68			
D	Potassium	1.60	5.13	6.80	1.30	4.78	42.0	5.10	- 0.11	- 2			
D	Selenium[h]	<0.00100	0.00295	0.00300	0	0.000430	0.00300	0.00275	- 0.00025	- 8			
T	Selenium[h]	0	0.00275	0.00500	0	0.000410	0.00200	0.00257	- 0.00022	- 8			
	Specific Cond. (µ℧/cm)	420.	1110.	1720.	0.700	853.	2340.	1090.	-30.0	- 3			
D	Silver[h]	0	—	<0.00100	0	0	0	—	—	—			
T	Silver[h]	0	0.00344	0.0100	0	0.000975	0.0100	0.00325	- 0.00025	- 7			
D	Sodium	25.0	105.	120.	4.20	105.	382.	105.	- 2.0	- 2			
	Sodium Adsorption Ratio (no units)[i]	0.900	2.49	3.00	0.200	3.27	677.	2.53	0	0			
D	Sulfate	53.0	304.	380.	11.0	52.0	360.	284.	-25.0	- 8			
T	Dissolved solids (180°C)	257.	710.	848.	109.	497.	1300.	693.	-29.0	- 4			
	Turbidity (JTU)	—	—	—	1.00	37.5	2800.	—	—	—			
D	Zinc[h]	0	0.00896	0.0200	0	0.0121	0.120	0.00920	+ 0.00031	+ 3			
T	Zinc	0	0.0241	0.310	0.0100	0.0342	0.200	0.0249	+ 0.001	+ 4			
	Phenolics	0	—	—	—	—	—	—	—	—			

There would be no reservoir mixing of CAP and SRP water with this plan. However, water from the Cliff and Roosevelt sites would be naturally mixed at the confluence of the Verde and Salt Rivers and then pumped up into the CAP aqueduct. There would be no significant impacts to SRP water quality.

Note: D = Dissolved Fraction; T = Total Recoverable; — = Data Not Available

a Levels shown rounded to three significant figures. Some zero values may represent "below detection levels".
b In CAP aqueduct after regulatory mixing at Waddell site.
c Arizona Department of Health Services from U.S. EPA STORET, 1981; period of record December 1950 - September 1979.
d In CAP aqueduct after regulatory storage mixing at Waddell site and addition of SRP water at Granite Reef. CAP deliveries before Granite Reef would not be affected by impacts of adding SRP water to CAP water at Granite Reef.
e Minimum and maximum values are for the Salt or Verde Rivers and could be experienced if only one river was flowing.
f Weighted average based on STORET data and USGS flow records resulting in a 43 percent Verde River and 57 percent Salt River mix at the confluence of the two rivers.
g Changes are cumulative including impacts from MCMWCD#1 and SRP water and are relative to CAP future without average values given in previous table.
h These constituents show "zero" or "less than" average values, or were derived from "less than" average values. The "less than" average values were assumed to be representative. As a result, the change and percent change may show exaggerated or wrong direction changes. Constituents with "zero" future without average values could not be used to calculate future with values.
i All average SAR values were computed from average values for Na, Ca, and Mg.

and local surface waters should also include a reservoir water quality sampling network capable of monitoring CAP inflows and CAP outflows. This will provide data for downstream water users to utilize during planning for water treatment or irrigation operations. Monitoring both the inflow and outflow will help to establish how the reservoir affects water quality and may provide information on how to operate the reservoir to minimize water quality impacts.

The Bureau of Reclamation in conjunction with the U.S. Geological Survey has initiated a water quality monitoring system to establish baseline data for the Waddell site. Monthly sampling of the Aqua Fria River inflow and releases from Lake Pleasant releases was started in January of 1982. It is recommended that for the agency proposed action (Plan 6), more detailed studies be conducted to assess the combined effects of reservoir all water quality impacts. Also, it may be necessary to establish a monthly sampling program to monitor the SRP water quality near the point where SRP water would be diverted into the CAP aqueduct. Plans 6 and 7 would affect only MCMWCD#1 agricultural water at the New Waddell Reservoir. The after-mix water released from New Waddell reservoir would not exceed any criteria for agricultural water use and no requirement for mitigation has been identified. Plans 1 and 3, which would directly affect SRP water delivered to existing water treatment plants could require additional water treatment.

(3) Residual Impacts

It is possible that Plans 1 and 3 may impact the constituent makeup of non-CAP municipal and industrial waters such that the

advance notice of the exchange period for Plan 1 or the aeration proposed for Plan 3 is inadequate to prevent the need for additional water treatment. Any need for additional water treatment would be hard to fulfill and could also become a residual impact. No residual water quality constituent impacts have been identified for Plans 2, 6, 7, or 8.

c. Eutrophication Potential

Eutrophication is a term that describes changes consisting of nutrient enrichment and subsequent algal growth in lakes. This assessment is concerned with eutrophication as it affects water quality. Regulatory storage mixing could produce changes in nutrient concentrations and ratios, leading to potential problems of artificial (man caused) eutrophication in the storage reservoirs or subsequently in the canal systems.

Eutrophication potentials were computed for the Confluence and New Waddell regulatory storage reservoirs where mixing of CAP and local surface waters would occur. The computations used the Canfield and Bachman equations described in the USBR Technical Memorandum titled Guidelines for Studies of Potential Eutrophication, 1981. Risk of eutrophication under normal operating conditions is based on phosphorus concentration which is assumed uniform over the studied area. Reservoir surface area and depth contributed to, but are not directly involved in, calculation of risk. Eutrophication conditions for the Cliff, Roosevelt, and Stewart Mountain sites were assumed not to change from the conditions presently at Horseshoe Reservoir, and Roosevelt and Saguaro Lakes.

(1) Direct and Indirect Impacts

Direct impacts would be experienced if the reservoir was affected by artificial eutrophication. Indirect impacts could be experienced by subsequent water users if the quality of the water released from the reservoir is affected by the reservoir eutrophication.

(a) Plan 8

With Plan 8, eutrophication problems in the existing reservoir would not differ significatnly from existing conditions. There would be no affect on eutrophication potential with this plan.

(b) Plans 1 and 2

With Plans 1 and 2, eutrophication problems in the existing reservoirs would not differ significantly from existing conditions. There would be no effect on eutrophication potential with these plans.

(c) Plan 3

Conditions expected to occur in the Confluence Reservoir indicate that there is high potential for eutrophic conditions to occur during part of each year. The reservoir would be drawn down significantly in the very hot months of July and August. The greatest amount of direct sunlight for photosynthesis is also available. During the summer months, flows from the Verde River are usually small or nonexistent. With little or no inflow from the Verde River, the Verde arm of the reservoir could tend toward a stagnant condition.

Given these physical parameters and the presence of abundant nutrients (phosphorous and nitrogen), it is likely that eutrophic conditions would occur.

One downstream impact of eutrophication at the Confluence concerns THM, which is a compound produced in water with significant concentrations of organic material when the water undergoes normal disinfectant with chlorine. THM is considered a health hazard if concentrations in drinking water are high enough. New standards proposed by the Arizona Department of Health Services call for a maximum contaminant level of 0.1 mg/l for THM. Organic material in Colorado River water is present in significant quantities making it likely that THM would be produced when CAP water is treated with chlorine. This would occur in the future without and with the project, and is therefore not an impact by itself. However, mixing of SRP and CAP water in the Confluence Reservoir and distribution to M&I water users would place higher levels of organics in all treatment plants that currently take SRP water. Some of these plants may not take CAP water in the future-without the project. Eutrophic conditions at the Confluence Reservoir could intensify the problems associated with THM production by increasing the levels of organic materials in the water subsequently delivered to domestic plants for disinfection.

The effect of Plan 3 on eutrophication potential is considered Significant Adverse.

(d) Plans 6 and 7

Plans 6 and 7 are similar in reservoir operation and would have similar impacts on the eutrophication potential at the New Waddell site. Conditions expected to occur in New Waddell Reservoir indicate that there is low to moderate potential for eutrophic conditions to occur during a typical year. The reservoir would be lowest during the months of September to November, but even at its low point, the reservoir would be 120 feet deep. During the summer months, flows from the Agua Fria River are usually small or nonexistent. With little or no inflow from the river, the reservoir could tend toward a stagnant condition. Given these physical parameters and the presence of abundant nutrients (phosphorous and nitrogen), eutrophic conditions could occur. However, lack of phosphorus in the existing Waddell Reservoir (Lake Pleasant) would tend to limit algal growth.

The effects of Plans 6 and 7 on eutrophication potential are considered Insignificant.

(2) Mitigation

The high eutrophication potential predicted for the Confluence Reservoir and the moderate to low potential predicted for the New Waddell Reservoir are based on analytical models. Further studies should be conducted for the Confluence and New Waddell sites to better define the potential problem and determine if any mitigation is necessary. Mitigation, if required, could consist of notifying CAP and local surface water users of any increases in THM production potential caused by the regulatory storage reservoirs. Aeration of M&I water released from the reservoir could also be

required for mitigation. This would cause precipitation of heavy metals which are carried by the water under eutrophic conditions.

(3) Residual Impacts

The eutrophication problems associated with the Confluence (high potential) and New Waddell (low to moderate potential) Reservoirs may be hard to mitigate and may therefore become residual impacts.

d. Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

If Roosevelt Dam were to be modified instead of replaced, water quality impacts would be the same. The same types of construction impacts would be possible, but present plans provide for working in dry conditions away from the reservoir water surface. This might require some drawdown of the reservior for the modified dam but the water quality should not be affected. If SRP loses water as a result of the drawdown, the water would be replaced with CAP water delivered to users in the SRP service area who are already receiving CAP water.

Modified Stewart Mountain Dam would be the same as the new dam as far as water quality is concerned. There would be no drawdown of the reservoir and the potential for short term construction impacts would be the same for both alternatives.

3. Recreation

a. Types of Impacts to Recreation

CAWCS recreation impacts are caused by construction of dams and creation of new or enlarged reservoirs. The reservoirs would be developed for recreation, and for other CAWCS planning objectives. Conceptual recreation plans for the reservoirs call for the develoment of facilities such as camping areas, picnicking sites, beaches, boat launches, docks, and parking areas. The recreation plans are described in detail in Recreation Planning Report - Stage III Summary (USBR, 1982). The plans have been developed for all reservoirs in the action plans except for Cliff and Roosevelt Dams in Plan 2, which is a SOD-only plan.

While reservoirs would provide additional flat-water resources and facilities, they would also cause the loss of stream-oriented resources and facilities. In particular, stretches of the Salt and Verde River that are used for tubing, fishing, and stream-side picnicking and camping would be flooded by reservoirs in some plans, and would be lost for the life of the project. Stream-oriented facilities would be replaced-in-kind, to the extent possible.

Recreation impacts are measured in terms of stream and reservoir resources and facilities lost or gained, maximum annual recreation days lost or gained, and regional recreation needs met or intensified. The resource losses and gains are measured by stream miles and surface acres lost or gained. For stream-oriented recreation, the impact analysis was based on the typical-year high reservoir level for each reservoir; and for

reservoir-oriented recreation. The impact analysis was based on the average reservoir level during the recreation season of a typical year. The facility losses and gains are measured by the number of facilities lost or gained in the affected site areas.

b. Stream-oriented Recreation

(1) Direct and Indirect Impacts

(a) Plan 8

No changes in stream-oriented recreation resources are expected in the future without CAWCS action, but some additional facilities are likely to be built. In the Cliff, Roosevelt, and New Waddell site areas, no new facilities are planned, and the number of maximum annual recreation days for stream-oriented activities is projected to remain the same as in the existing condition. In the Confluence site area, Alternative D of the Lower Salt River Recreation Area plan would be implemented, leading to more intensive use of the Salt River from Stewart Mountain Dam to the confluence with the Verde River. There would be approximately 2,250,000 stream-oriented maximum annual recreation days in the Confluence site area in the year 2000, most of them associated with tubing.

The number of estimated maximum annual recreation days for stream-oriented activities would be 2,281,000 in the aggregated site areas and 8,236,000 in the five-county region in the year 2000.

(b) Plan 1

With implementation of Plan 1, a total of 3 miles of the Verde River in the Cliff site area would be lost. Stream fishing occurs along the entire length of stream miles lost. As a result of Plan 1, regional needs for stream fishing would be intensified because demand would remain the same as in the future-without, but there would be fewer resources for fishing. Approximately 1,450 estimated annual recreation days for stream fishing would be lost.

Recreation development proposed for Cliff and Roosevelt in Plan 1 include one stream-oriented recreation site in each site area. At Cliff, proposed facilities include picnic tables and developed campsites. At Roosevelt, plans call for development of a parking area for access to the Salt River. The implementation of the recreation plan for Plan 1 would result in a net gain of 10,475 estimated annual recreation days for stream-oriented recreation. The overall effect of the plan, taking into account losses and gains, has been evaluated as Insignificant.

(c) Plan 2

With implementation of Plan 2, a net gain of 1 mile of stream would occur on the Verde River in the Cliff site area. The gain represents reclaimed river in the lake bed of Horseshoe Reservoir. Losses occur along the reach of the river from Horseshoe Dam to proposed Cliff Dam, but 1 more mile of river would be gained in the lake bed than would be lost in the reach between the two dams. Because of the gain, there would be 696

additional estimated annual recreation days for stream-oriented activities in the year 2000.

During the years when Roosevelt Lake is full, the lake would be drawn down in September, October, and November. This would result in increased flows of about 700 cfs on the Salt River downstream of Stewart Mountain Dam. The recreation impacts of the increased flow in the river cannot be quantitatively assessed, but little change is expected to occur in recreation activities because of the increased flow.

The effect of Plan 2 on stream-oriented recreation has been evaluated as Insignificant.

(d) Plan 3

With implementation of Plan 3, a total of 16 miles of stream would be lost; 17 stream miles would be lost because of Confluence Reservoir and 1 stream mile would be gained because of recovery of a segment of the Verde River in the lake bed of Horseshoe Reservoir. Fishing occurs along the total length of stream miles lost, and tubing takes place on 16.8 miles. From a recreation perspective, the loss of stream miles associated with Plan 3 would constitute a major impact on tubing, an activity that is highly valued in central Arizona.

In a typical year, the entire stretch of river used for tubing would be inundated completely by the Confluence Reservoir at the beginning of the recreation season. As drawdown occurs over the spring and summer each year, more of the river channel would be exposed, but it would

not be suitable for tubing. Resources for tubing as it is experienced today and in the future without the project would not exist on the Salt River.

The loss of 16.8 miles of river suitable for tubing represents a loss of half the tubing miles on the Salt and Verde Rivers in the study area. Remaining tubing areas with Plan 3 are the segment of the Salt River from Confluence Dam to Granite Reef Dam (3.3 miles) and the segment of the Verde River below Bartlett Dam to the Confluence Reservoir (14.2 miles). Other stream-oriented activities such as fishing would be similarly impacted by the loss of stream resources in the Confluence site area.

Implementation of the conceptual recreation plan for Plan 3 would result in the development of one stream-oriented recreation site in the Confluence site area, one in the Cliff site area, and one in the Roosevelt site area. The sites would be developed for picnicking, camping, and river access.

Implementation of Plan 3 would result in the net loss of approximately 1,500,177 stream-oriented maximum annual recreation days. The effect of this loss is evaluated as an Adverse Flag.

(e) Plan 6

With implementation of Plan 6, a total of 1 mile of stream would be gained on the Verde River where the stream segment in the lake bed of Horseshoe Reservoir would be reclaimed. There are no stream-oriented recreation resources in the New Waddell area.

Recreational development proposed in the Cliff and Roosevelt conceptual recreation plans include one stream-oriented recreation site in each site area. In the Cliff site area, proposed facilities include picnicking and camping areas; in the Roosevelt site area, plans call for the development of a parking area for access to the Salt River.

As a result of Plan 6, regional needs for stream fishing would be partially met and an additional 700 maximum annual recreation days would be developed. A total of approximately 12,620 stream-oriented maximum annual recreation days would be added. Although the direction of this impact is beneficial, the overall effect has been evaluated as Insignificant.

(f) Plan 7

Impacts to stream-oriented recreation are the same in Plan 7 as in Plan 6, except that with implementation of Plan 7 a net loss of 2 stream miles would occur. Conceptual recreation plans for the site areas in Plan 7 are the same as in Plan 6. A total of approximately 11,010 stream-oriented maximum annual recreation days would be gained with implementation of the plan. The effect of this gain has been evaluated as Insignificant.

(2) Mitigation

The loss of stream resources cannot be mitigated effectively. The loss of tubing resources on the Salt and Verde Rivers caused by Plan 3 cannot be avoided if the Confluence Dam is built, nor can the resources be replaced elsewhere. The option of off-site mitigation was

explored in the CAWCS, but it was concluded that the creation of tubing elsewhere was not feasible.

Partial mitigation for tubing losses might be possible by making the Verde River upstream from Confluence Reservoir to Bartlett Dam more suitable for tubing. This would involve maintaining flows of 500 cfs along this stretch of the river during the summer and providing better access to the river. It is probably not feasible for SRP to operate the system in such a way as to make these flows available during the summer. However, if adequate flows could be maintained, then some reduction in impact could be expected.

(3) Residual Impacts

Because stream losses cannot be mitigated, the mitigated impact and effect are the same as the unmitigated impact and effect. Unmitigated/mitigated effects evaluations for the plans are as follows: Plans 1, 2, 6, and 7 - Insignificant; Plan 3 - Adverse Flag.

c. Reservoir-oriented Recreation

(1) Direct and Indirect Impacts

(a) Plan 8

No changes in reservoir resources are expected in the future without CAWCS action, but considerable change will occur in reservoir-oriented facilities in each of the site areas by the year 2000.

The U.S. Forest Service plans to develop a reservoir-oriented campsite on the western shoreline of Hoseshoe Reservoir in the Cliff site area. The only access road to the reservoir would not be improved; thus, the type of boaters that visit the lake would not be expected to change from the existing condition. Almost 60,000 reservoir-oriented maximum annual recreation days would exist in the Cliff site area in the year 2000.

Forest Service developments in the Roosevelt site area in the year 2000 include a campground with 100 campsites and boat launching facilities. Maximum annual recreation days for reservoir-oriented activities would increase to a total of almost 410,000 by the year 2000.

In the Confluence site area, there would be no development of reservoir-oriented recreation resources or facilities in the future without CAWCS action.

In the New Waddell site area, additional picnic areas, campgrounds, and boat launches are proposed by the Maricopa County Parks and Recreation Department for the Upper and Lower Lakes. A cable ski system where skiers hold onto a rope and are pulled through the water is also planned for construction on the Lower Lake. The Parks and Recreation Department expects that 200 to 300 people per day can use the cable ski system. Maximum annual recreation days for reservoir-oriented activities would total approximately 250,000 in the year 2000.

The number of maximum annual recreation days for reservoir-oriented recreation would be approximately 822,000 in the aggregated site areas and 6,479,000 in the five-county region in the year 2000.

(b) Plan 1

Plan 1 would result in the net gain of 683 surface acres of water at Cliff Reservoir for recreation. With the construction of Cliff Dam, vehicular access to Cliff Reservoir would be improved over that to Horseshoe Reservoir. Because of better access, the composition of boating activities at Cliff would be likely to change from primarily fishing and non-powerboating to a mix of activities similar to those at Bartlett Lake, where waterskiing and powerboating dominate.

Conceptual recreation plans proposed for the reservoirs reservoirs at Cliff and Roosevelt call for the development of three reservoir-oriented recreation sites at Cliff and nine at Roosevelt. With this development and the changes in boating at Cliff, regional boat fishing, powerboating, and non-powerboating needs would be intensified; waterskiing needs would be partially met. A total of approximately 670,520 maximum annual recreation days for reservoir-oriented activities would be developed with Plan 1. This gain has been evaluated as Significant Beneficial.

(c) Plan 2

With Plan 2, reservoir resources would decrease by approximately 850 surface acres. All of this decrease would be in the Cliff site area, where Cliff Reservoir would essentially replace Horseshoe Reservoir. With construction of Cliff Dam, vehicular access to the site area

would be improved over the access to Horseshoe Reservoir. As described in Plan 1, because of improvements in access to the reservoir, the composition of boating activities at Cliff is likely to be different from the activities at Horseshoe Reservoir. Waterskiing and powerboating are expected to be the primary boating activities at Cliff Reservoir, while fishing and non-powerboating are the main activities at Horseshoe Reservoir.

With Plan 2, regional boat fishing, powerboating, and non-powerboating needs would be intensified; waterskiing needs would be partially met. A total of approximately 48,650 reservoir-oriented maximum annual recreation days would be lost with Plan 2, partially because of the loss of surface acres of water. In addition, Plan 2 does not provide for new recreation development at Cliff and Roosevelt because it is a SOD-only plan. The overall effect of the plan on reservoir-oriented recreation has been evaluated as Insignificant.

(d) Plan 3

Plan 3 would result in the net gain of approximately 5,240 surface acres of water for recreation, representing an increase of approximately 30 percent over future-without conditions for reservoir-oriented resources in the study area. An increase of 5,320 surface acres would occur in Confluence Reservoir and a decrease of 77 surface acres would occur with Cliff Reservoir. The size of Confluence Reservoir would fluctuate from approximately 8,000 acres to 3,000 acres in a typical year. The impact of this fluctuation would be greatest on the Verde River arm of the reservoir where the flat topography would make the drawdown more apparent.

With the implementation of the recreation plan for Plan 3, seven reservoir-oriented sites would be developed at Confluence Reservoir, nine would be developed at Roosevelt Lake, and three would be developed at Cliff Reservoir. Facilities for picnicking, swimming, boat launching, and camping are included in the development plans. At the Confluence Reservoir, no recreation sites are planned for the Verde arm, which extends into the Fort McDowell Indian Reservation, because of the unattractiveness of the shoreline that would result from reservoir fluctuation.

Implementation of Plan 3 would have an impact on the mix of boating activities in the Cliff site area, as described in Plan 1. With Plan 3 approximately 3,537,380 additional maximum annual recreation days for reservoir-oriented activities would be developed. Regional recreation needs for all reservoir-oriented activities except boat fishing would be partially met by implementation of Plan 3. The effect of the gains associated with Plan 3 has been evaluated as Significant Beneficial.

(e) Plan 6

Implementation of Plan 6 would result in the net gain of approximately 4,200 surface acres of water for recreation. At New Waddell, a net increase of approximately 4,300 surface acres would occur. This takes into account a gain of 4,266 surface acres on the Upper Lake and a loss of 33 surface acres on the Lower Lake. In the Cliff site area, a decrease of approximately 80 surface acres would occur and improved access to the new reservoir would change the mix of boating activities as described in Plan 1.

Recreation plans call for the development of four reservoir-oriented sites at New Waddell, three at Cliff, and nine at Roosevelt. Facilities for camping, picnicking, and boat launching are included in the plans. With Plan 6, a total of an estimated 986,860 reservoir-oriented maximum annual recreation days would be gained. The effect of Plan 6 on reservoir-oriented recreation has been evaluated as Significant Beneficial.

(f) Plan 7

Implementation of Plan 7 would result in the net gain of approximately 5,100 surface acres of water for recreation. At New Waddell, a net increase of approximately 4,300 surface acres would occur, taking into account gains on the Upper Lake and losses on the Lower Lake. At Cliff, an increse of approximately 800 surface acres would occur. The same recreation plans apply to Plan 7 as to Plan 6. A net total of approximately 1,006,730 reservoir-oriented maximum annual recreation days would be gained. In addition, this plan provides for an assured water supply for the downstream Rio Salado Development District. Although the secondary development of recreation opportunities because of this supply of water has not been assessed in quntitative terms, it has been taken into consideration in the effects evaluation. The overall effect of Plan 7 has been evaluated as a Beneficial Flag.

(2) Mitigation

Because the effects of the plans are either insignificant or beneficial, no mitigation measures are required. However, with Plan 3

further analysis to provide for a more stable lake on the Verde River arm of Confluence Reservoir is recommended. The flat topography and the wide water fluctuation on this arm of the reservoir would result in the annual exposure of large expanses of unvegetated saturated soil, thereby diminishing the attractivensss of that portion of the reservoir for shoreline activities. Also, during the latter months of the recreation season (August through October), the Verde arm may experience an algal growth of sufficient magnitude that some types of boating may be restricted (see Water Quality, Section 2c). Fishing activities, on the other hand, may benefit from the early stages of algal growth, which would provide food for fish. Although algal growth could occur on the Salt River arm of the reservoir, the potential is less than on the Verde arm.

(3) Residual Impacts

The unmitigated and mitigated impact and effect are the same for the plans. Effects evaluations are as follows: Plan 1 - Significant Beneficial; Plan 2 - Insignificant; Plan 3 - Significant Beneficial; Plan 6 - Significant Beneficial; and Plan 7 - Beneficial Flag.

d. Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

Construction impacts for a modified dam at Roosevelt would be the same as the new dam option; existing recreational facilities affected by construction of either alternative would be relocated and/or replaced. Operational impacts would be the same because lake elevations, size; and storage allocations would be identical for a new structure or modified dam.

Therefore, there is no significant difference in impact at Roosevelt for recreation. No additional recreation facilities are proposed for Saguaro Lake with either a New or Modified Stewart Mountain Dam, and no change in existing recreation resources would occur under either option.

4. Cultural Resources

The cultural resources impacts and effects analysis was prepared in accordance with 36 CFR Part 800, "Advisory Council on Historic Preservation Procedures for the Protection of Historic and Cultural Properties", and with Sections 106 and 110(f) of the National Historic Preservation Act as amended, which requires that Federal agencies take into account the effects of their undertakings on properties included in or eligible for inclusion in the National Register of Historic Places.

a. Types of Impacts Cultural Resources

Impacts upon cultural resources will result from construction, inundation and reservoir operation activities. Four categories or types of site impact have been defined:

destruction - the elimination of significant values which characterize a site. Site destruction may result from a number of direct and indirect project-specific construction, operation, and maintenance actions, such as reservoir or filling activities.

alteration - the physical destruction of a portion of the data values which characterize a site.

impairment of setting - would occur when the physical or environmental setting is modified to the extent that it creates an adverse visual impact to that site, or to the extent that such modification would detract from the site's interpretive development as a public educational or recreational resource.

enhancement - a site's qualities may be enhanced through various management procedures which might include restoration, reconstruction, long-term preservation, or public-use interpretation.

The first three categories of site impact would result in adverse effects; the fourth category would result in a beneficial effect. All of the above types of impacts may occur either as a direct or indirect consequence of a project action.

The effects of the above impacts on the significant data values of a site may be expressed as the relationship between potential impacts to a site and the quality of that site. Four criteria have been recognized in evaluating a site's value or quality:

- research potential
- public interpretive/educational potential
- historical association, and
- social, religious, or ethnic significance

Construction activities produce the most severe type of impact imposed on cultural resources. They involve all earth-moving activities related to the construction of haul roads, recreation sites, transmission

lines, and dams. In the extreme, the result of such impacts is to irreversibly destroy structures and artifacts and their spatial relationships within a cultural deposit and to eliminate the potential for additional studies. No all construction activities are equally destructive. Some activities, such as the paving of a parking lot, may even serve to cap archaeological deposits and preserve them for the future. Such beneficial effects are limited and finite. Distinctions of this nature will be made when construction plans are finalized. In general, construction related activities are the source of the most severe types of impacts anticipated for cultural resources.

Flooding of a site can result in relatively light to moderately severe impacts. In general, inundation will alter some of the contents structures and the physical relationships within a site, but it will not usually result in the total destruction of a site. Processess associated with inundation which are responsible for the impacts to cultural deposits include mechanical disturbances, chemical deterioration, and biological decay (Lenihan and others 1981). The severity of impacts will vary with the frequentcy of inundation.

Secondary impacts are defined as those which result from secondary use of a facility. These are predominantly recreational activities associated with the reservoirs. The creation of recreational facilities often encourages vandalism of sites by increasing the ease with which they may be reached. Other types of recreation impacts occur when sites are used as locations for campgrounds, parking areas, or picnicking areas. Vehicular and pedestrian traffic serve to displace the material and enhance erosion by

decreasing vegetation cover. Unusual forms of artifacts are often picked up by collectors thereby biasing the overall assemblage of artifacts recoverable by the archaeologist. The impacts associated with secondary uses of a dam are thus fairly substantial. These impacts will also occur in the upper reservoir zones that are infrequently inundated. Alhough the sites are not totally destroyed, they will, unless protected or specfically managed, be considerably degraded over a 50 to 100 year period with most of the damages occuring during the early life of the project.

The procedures for assessing impacts and evaluating effects within this conceptual framework have been presented in detail in the Stage III Methodology for Environmental Quality Assessment (CAWCS, 1981).

b. Direct and Indirect Impacts

(1) Prehistoric Cultural Resources

All sites within the construction zone will be destroyed. The impacts resulting from inundation have been divided into four categories of alteration which include 1) the permanent pool (typical-year low pool), 2) the fluctuating pool (between typical-year low and typical-year high pools), 3) the less-than-annual and Standard Project Flood pool (between typical-year high and SPF pools), and 4) the Inflow Design Flood zone.

All plans are compared to each other as well as to the "future-without" condition. This comparison is based on four factors:

- the number of prehistoric archaeological sites
- the acreage of archaeological remains

- the quality of the resource base
- the severity of the impact

Table IV-26 shows the existing number and types of prehistoric archaeological sites in the CAWCS affected site areas.

Table IV-27 presents the number of sites in each plan according to plan number, type of impact, and site type. Qualitative and quantitative analyses resulted in an adverse effect rating for all plans, in the following ranking:

	Plan Number
BEST	2
	1
	6
	7
WORST	3

(a) Plan 8

In the future without the project, in the affected site areas, which include a perimeter beyond each proposed reservior beyond the maximum water surface elevation there will be approximately 3,350 prehistoric archaeological sites covering 12,027 acres (see Table IV-26).

Natural decay through forces such as erosion, animal burrowing, plant and root growth, and oxidation will affect archaeological sites. Sites currently located along the perimeter of Lake Roosevelt

TABLE IV-26

TOTAL NUMBER OF ARCHAEOLOGICAL SITES IN AFFECTED SITE AREAS[1/]

	Cliff	Roosevelt	New Waddell	Confluence	Total
Artifact Scatters	486	487	78	201	1,252
1 room	347	492	27	5	871
2-5 rooms	464	299	13	23	799
6-20 rooms	136	175	9	0	320
21-100 rooms	8	38	0	1	47
101+ rooms	3	2	0	0	5
Petroglyph Only	2	1	11	22	36
Agricultural Sites	8	1	0	11	20
Total Number of Sites	1,454	1,495	138	263	3,350
Special Features					
Trash Mounds	75	166	8	635	884
Ball Courts	1	0	0	13	14
Water-Soil Control Features	1,801	1,476	82	9	3,368
Acreage of Archaeological Remains	1,479	2,662	143	7,743	12,027

1/ Second Level Environmental Inventory, CAWCS, 1982

Table IV-27

Number of Sites In Each Plan/By Plan Number, Impact Type and Site Type

	CONSTRUCTION		PERMANENT POOL		FLUCTUATING POOL		LESS THAN ANNUAL AND SPF		IDF		SECONDARY IMPACT ZONE		TOTALS	
	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES
SCATTERS	1	39	1	4	1	8	1	102	1	83	1	737	1	973
	2	22	2	2	2	6	2	--	2	167	2	776	2	973
	3	57	3	8	3	31	3	104	3	100	3	874	3	1174
	6	50	6	4	6	29	6	105	6	88	6	775	6	1051
	7	50	7	8	7	25	7	105	7	88	7	775	7	1051
1 ROOM	1	40	1	3	1	8	1	95	1	92	1	601	1	839
	2	19	2	0	2	2	2	--	2	163	2	655	2	839
	3	41	3	1	3	5	3	101	3	92	3	604	3	844
	6	47	6	0	6	7	6	102	6	94	6	616	6	866
	7	47	7	2	7	5	7	102	7	94	7	616	7	866
2-5 ROOMS	1	32	1	0	1	4	1	59	1	58	1	610	1	763
	2	18	2	0	2	5	2	--	2	94	2	646	2	763
	3	35	3	3	3	6	3	57	3	60	3	625	3	786
	6	35	6	3	6	7	6	57	6	59	6	615	6	776
	7	35	7	4	7	6	7	57	7	59	7	615	7	776
6-20 ROOMS	1	14	1	1	1	1	1	26	1	23	1	246	1	311
	2	8	2	0	2	2	2	--	2	35	2	266	2	311
	3	14	3	1	3	0	3	27	3	23	3	246	3	311
	6	19	6	1	6	0	6	27	6	23	6	246	6	320
	7	19	7	1	7	4	7	27	7	23	7	246	7	320

Table IV-27 (continued)

	CONSTRUCTION		PERMANENT POOL		FLUCTUATING POOL		LESS THAN ANNUAL AND SPF		IDF		SECONDARY IMPACT ZONE		TOTALS	
	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES
21-100 ROOMS	1	1	1	0	1	0	1	6	1	8	1	31	1	46
	2	1	2	0	2	0	2	--	2	10	2	35	2	46
	3	2	3	0	3	0	3	6	3	8	3	31	3	47
	6	1	6	0	6	0	6	6	6	8	6	31	6	46
	7	1	7	0	7	0	7	6	7	8	7	31	7	46
101+ ROOMS	1	2	1	0	1	0	1	3	1	0	1	0	1	5
	2	0	2	0	2	0	2	--	2	5	2	0	2	5
	3	2	3	0	3	0	3	3	3	0	3	0	3	5
	6	2	6	0	6	0	6	3	6	0	6	0	6	5
	7	2	7	0	7	0	7	3	7	0	7	0	7	5
PETROGLYPH ONLY	1	1	1	0	1	0	1	2	1	0	1	0	1	3
	2	1	2	0	2	0	2	--	2	2	2	0	2	3
	3	2	3	0	3	10	3	2	3	2	3	9	3	25
	6	1	6	0	6	0	6	2	6	1	6	10	6	14
	7	1	7	0	7	0	7	2	7	1	7	10	7	14
AGRICULTURAL SITES	1	1	1	0	1	0	1	3	1	5	1	0	1	9
	2	1	2	0	2	0	2	--	2	6	2	2	2	9
	3	1	3	1	3	2	3	3	3	6	3	7	3	20
	6	1	6	0	6	0	6	3	6	5	6	0	6	9
	7	1	7	0	7	0	7	3	7	5	7	0	7	9

Table IV- 27 (continued)

	CONSTRUCTION		PERMANENT POOL		FLUCTUATING POOL		LESS THAN ANNUAL AND SPF		IDF		SECONDARY IMPACT ZONE		TOTALS	
	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES	PLAN	SITES
TOTAL	1	130	1	8	1	21	1	296	1	269	1	2225	1	2949
	2	70	2	2	2	15	2	--	2	482	2	2380	2	2949
	3	154	3	14	3	54	3	303	3	291	3	2396	3	3212
	6	156	6	8	6	47	6	305	6	278	6	2293	6	3087
	7	156	7	15	7	40	7	305	7	278	7	2293	7	3087
TRASH MOUNDS	1	19	1	1	1	2	1	41	1	30	1	148	1	241
	2	14	2	1	2	2	2	--	2	61	2	163	2	241
	3	70	3	2	3	115	3	41	3	121	3	527	3	876
	6	24	6	1	6	4	6	41	6	31	6	148	6	249
	7	24	7	2	7	3	7	41	7	31	7	148	7	249
BALL COURTS	1	0	1	0	1	0	1	0	1	1	1	0	1	1
	2	0	2	0	2	0	2	--	2	0	2	1	2	1
	3	2	3	0	3	1	3	0	3	2	3	9	3	14
	6	0	6	0	6	0	6	0	6	1	6	0	6	1
	7	0	7	0	7	0	7	0	7	1	7	0	7	1
WATER-SOIL CONTROL FEATURES	1	162	1	0	1	7	1	776	1	458	1	1874	1	3277
	2	41	2	0	2	5	2	--	2	1155	2	2076	2	3277
	3	162	3	0	3	5	3	778	3	459	3	1882	3	3286
	6	175	6	0	6	22	6	778	6	464	6	1920	6	3359
	7	172	7	5	7	17	7	778	7	464	7	1920	7	3359
ACREAGE OF ARCHAEOLOGICAL REMAINS	1	493	1	3	1	73	1	382	1	404	1	2786	1	4141
	2	169	2	2	2	67	2	--	2	857	2	3056	2	4141
	3	573	3	8	3	607	3	403	3	612	3	9681	3	11884
	6	528	6	3	6	99	6	404	6	412	6	2838	6	4284
	7	528	7	45	7	57	7	404	7	412	7	2838	7	4284

and Lake Pleasant will be affected by inundation and subsequent drying as a result of fluctuations in the water level. Cultural factors which will affect prehistoric resources include activities such as land development, vandalism, pothunting, or vehicular disturbances as a result of increased use of the area, predominantly for recreational purposes. Most of the deterioration which is anticipated to occur will result from pothunting and fluctuations in the water level. In some areas, recent State legislation should help to counteract the negative effects of some of these conditions.

(b) Plans 1 and 2

Plans 1 and 2 are similar in the total number of sites impacted, but Plan 2 is preferable to Plan 1. Plan 1 impacts 60 additional sites through construction, 12 additional sites in the permanent and fluctuating pools, and 296 additional sites in the less-than-annual and SPF pool. Under Plan 2, these sites would be impacted in the IDF and secondary impact zone where the impacts are less severe.

Each of these site areas also contain numerous large and special sites with features such as ball courts, trash mounds, and platform mounds not common to the majority of locations in the region. In each of the site areas there is evidence for inter-regional interaction between the groups which occupied the areas prehistorically. This type of information is critical to an understanding of the prehistory of central Arizona. As such, to impact even one of these areas would cause the irreplaceable loss of information on intra- and inter-regional trade, interaction, and organization.

The effect of Plans 1 and 2 on prehistoric resources is considered an Adverse Flag.

(c) Plan 3

Plan 3 is considered to have the most severe impacts and effects on prehistoric resources because it would destroy the greatest number of sites with the highest acreage of archaeological remains. It combines Cliff, Roosevelt, and Confluence which all contain high quality, unique resources. In addition to the resources at Cliff and Roosevelt described in Plans 1 and 2, the high quality resources at the Confluence site would be negatively affected.

Research in the Confluence area indicates several differences between sites on the Salt River arm and sites on the Verde arm. Together, the Cliff, Roosevelt, and Confluence site areas represent a large social network which interacted on a regular basis. Because of this, Plan 3 would have an irreversible effect on a major data base which can provide valuable information on local and regional patterns of trade, interaction, social organization, and political organization in the central Arizona area.

Because of the severity of impacts of Plan 3 to prehistoric resources, this effect is considered an Adverse Flag.

(d) Plans 6 and 7

Plans 6 and 7 are very similar, with Plan 6 slightly preferable to Plan 7. The total number of sites impacted in both plans is

the same, as is the number of sites in the construction zone, IDF zone, and secondary impact zone. However, the severity of impacts to sites differs between plans. The difference between the two plans is that in Plan 7 the permanent pool and fluctuating pools at New Waddell would be higher and, therefore, impact more sites which would be located within these pools. In Plan 6, these sites would be located in the less-than-annual pool where the impacts are not as severe as in the permanent and fluctuating pools. As Roosevelt and Cliff are included in this plan and contain high quality resources, the impacts are substantial.

This plan is preferable to Plan 3 because the impacts at New Waddell are much less severe than at the Confluence site. While the number of sites is relatively close, the acreage of archaeological remains is much higher at Confluence.

The effect of Plans 6 and 7 to prehistoric resources is considered an Adverse Flag.

(2) Historic Cultural Resources

Impacts and effects of each plan are presented below and are summarized in Table IV-28 for comparative purposes.

(a) Plan 8

None of the 192 inventoried historic sites within the CAWCS study area will be affected under this alternative. In general, the condition of significant historic sites within the study region will deteriorate at an increasing rate in the future. While the physical remains

Table IV-28

HISTORIC SITE IMPACT/EFFECT BY PLAN

	Plan 8	Plan 1	Plan 2	Plan 3	Plans 6-7
Number of Sites	192	103	103	177	118
Number of Significant sites	0	89	89	163	(100)
Total Number of Sites Impacted (Range) a/		29-64	29-64	73-90	39-74
- Destroyed (Range)		27-59	27-59	72-85	34-66
- Altered (Range)		2-4	2-4	1-4	3-5
- Impaired (Range)		1	1	1	2-3
Effects Factor (Range) b/		-173 to -370	-173 to -370	-434 to -798	-225 to -422

a/ Range indicates the smallest number of sites affected to the largest number of sites affected, and reflects different reservoir pool levels.

b/ Comparative effect factor ratings are based on the severity of impact to the site and the value or importance of the site. The lower the rating the more severe are the impacts.

of these sites may deteriorate, the sites will probably continue to be present in the future. Many of these sites will increase in significance due to their increased age and uniqueness. In addition, existing sites which were not considered during this study due to their relatively recent age will achieve significance in the future as they become older and more representative of the past.

The five plans discussed below include Roosevelt and Stewart Mountain Dams. The effects on historic sites remain essentially the same whether new dams or modified dams are constructed. The difference between a new and a modified Roosevelt is that with a new dam, the existing dam will be destroyed; modification requires raising the existing dam, a change that will severely alter its physical structure. Both actions will thus destroy those qualities making it a National Historic Landmark.

A new Stewart Mountain Dam will result in the destruction of the existing dam which is potentially eligible to the National Register of Historic Places. A modified Stewart Mountain Dam will moderately alter the existing dam; the addition of a new spillway may not affect the potential of the dam to be placed on the National Register.

(b) Plans 1 and 2

A total of 103 inventoried historic sites are present at the three affected site areas within both of these plans. Of this total, 89 sites possess scientific or historical values which would suggest that they are potentially eligible for nomination to the National Register of Historic Places. Between 29 (typical-year reservoir) and 64 (maximum reservoir) sites would be impacted as a result of Plan 1; 27 and 59, respectively, would be destroyed; and 2 and 4 sites, respectively, would be altered. One site would be imparied. The effect of these impacts is expressed as an Adverse Flag with a comparative effect factor rating of between minus 173 and minus 370.

(c) Plan 3

A total of 177 inventoried historic sites are present at the four affected site areas within this plan. Of this total, 163 are potentially eligible for nomination to the National Register of Historic Places. Between 73 and 90 sites, respectively, would be impacted as a result of this plan; 72 and 85 of these respective totals would be destroyed; 1 and 4 sites would be altered, and one site would be impaired. Included is Fort McDowell, a particularly important site which would either be altered or partially destroyed. The effect of these impacts is expressed as an Adverse Flag with a comparative effect factor rating of between minus 434 and minus 798. Two National Register properties would be adversely affected, Roosevelt Dam and the Verde River Sheep Bridge.

(d) Plans 6 and 7

A total of 118 inventoried historic sites are present at the four affected site areas included in these plans. Of this total, 100 sites are potentially eligible for nomination to the National Register of Historic Places. Between 39 and 74 sites, respectively, would be impacted as a result of Plan 6; 39 and 66 of these respective totals would be destroyed. Between 3 and 5 would be altered; and 5 sites would be impaired. The effect of these impacts is expressed as an Adverse Flag with a comparative effect factor rating of between minus 225 and minus 422. Two National Register prop- erties, the Verde River Sheep Bridge and Roosevelt Dam, would be adversely affected.

c. Mitigation

Mitigation of impacts to cultural resources is aimed at preserving the significant values of sites within the site areas. If a sites is important for its association with an important person or event or embodies distinctive characteristics, mitigation is possible only by altering the proposed action to lessen the impacts. If a site is significant because of its potential to yield important information about the past, that data can be recovered, at least in part, and documented prior to the occurrence of an impact, thus lessening the impact. However, since cultural resources are nonrenewable, the generally preferred strategy for all types of sites is to avoid and protect them in place. In several cases, site avoidance may be feasible if it would not involve a major modification of planned construction or operation actions. For example, haul roads, transmission lines, and borrow areas may be relocated to avoid particular sites. Site protection could be implemented through the development of a long-term management plan for sites in secondary impact zones or upper reservoir levels where inundation would be infrequent. This action would be expecially applicable at Cliff and Roosevelt, where a wide diversity of site types exist, and adjacent lands are under federal control.

In the majority of cases, however, mitigation would consist of data recovery. Data recovery would involve archaeological investigation such as surface mapping, mapping of buried features by use of remote sensing techniques, surface artifact collection, test and full scale excavation, historical documentary research, and documentation through the compilation of narrative histories, site descriptions, scaled drawings, and photographs.

It is likely that a mitigation plan would deal with a sample of a range of site types with more intensive study performed at sites to be destroyed or seriously altered (in the construction zone, permanent pool, and annual fluctuating pool). Mitigation through data recovery must be considered partial. There are some sites, such as Roosevelt Dam and Fort McDowell, which would be affected by CAWCS actions whose impacts clearly cannot be fully mitigated through data recovery. In these cases efforts would, however, be made to maximize data recovery or documentation.

The National Historic Preservation Act requires the Bureau of Reclamation to develop a mitigation plan in consultation with the State Historic Preservation Officer (SHPO) and the Advisory Council on historic Preservation (Council). To fulfill this obligation a Reclamation is negotiating a Programmatic Memorandum of Agreement (PMOA) between the Arizona and New Mexico SHPOs and the Council for all of the Central Arizona Project. Under the provisions of the PMOA is preparing a historic preservation plan which will provide a overall mitigative data recovery strategy.

d. Residual Impacts

The data recovery approach to impact mitigation assumes that it is not necessary or possible to recover all information from each site; therefore, unrecovered information would remain at some sites and would be lost or destroyed as a result of project implementation. The net effect for any of the plans would result in a determination of adverse effect, in accordance with the Council's "Procedures for Protection of Historic and Cultural Properties" (36 CFR800). Therefore even though the impact analysis presented above displays considerable variations among the plans, all are

ranked as an Adverse Flag. This is because the number, quality, uniqueness, and complexity of the cultural resources impacted by any plan means that mitigation would be partial. In view of overriding public benefits to be realized through project implementation, the cultural resource data or value losses may be deemed an acceptable loss. Because the Secretary of the Interior is both the administrator of historic Landmarks and other National Register of Historic Places properties, as well as being responsible for selecting a CAWCS plan, the tradeoffs rest with a single individual.

e. Impacts with Modified Roosevelt and Modified Stewart Mountain in Plans

There is no difference in impacts to prehistoric cultural resources between New and Modified Stewart Mountain Dam since the water level will remain the same and borrow material will be obtained from outside of the site area. The difference in impacts between New and Modified Roosevelt is negligible; there are no known sites recorded in the vicinity of the new dam site. The difference in maximum water level is also minimal, although in some rare instances sites located on the 2,136 foot contour could be inundated for a longer period of time.

The effects on historic sites remain essentially the same whether new dams or modified dams are constructed. The difference between New and Modified Roosevelt is that with a new dam, the existing dam will be destroyed; modification requires raising the existing dam, a change that will severly alter its physcial structure. Both actions will thus destroy those qualities making it a National Historic Landmark. New Stewart Mountain Dam will result in the destruction of the existing dam which is potentially

eligible to the National Register of Historic Places. Modified Stewart Mountain Dam will moderately alter the existing dam; the addition of a new spillway may not affect the potential of the dam to be placed on the National Register.

5. Social Resources

a. Types of Impacts to People

The social impacts analysis focuses on (1) impacts of relocation to individuals, families, and communities and (2) impacts of flood reduction on transportation, health, and safety.

Relocation would occur at the following sites and would involve the communities or entities indicated:

- Confluence site - Fort McDowell Indian Community (Plan 3)
- Roosevelt site - Rockhouse Farm, Roosevelt Lake Estates, North Bay Estates, and Roosevelt Gardens East (all action plans)
- Cliff site - KA Ranch (all action plans)

Flood reduction impacts would occur in the 200-year floodplain of the Salt and Gila Rivers through the Phoenix metropolitan area. Affected communities include the cities of Mesa, Tempe, and Phoenix; the town of Buckeye and surrounding areas; the Salt River and Gila River Indian Communities; and the area known as Holly Acres.

b. Impacts with Modified Roosevelt and Modified Stewart Mountain Dams In Plans.

Relocation and flood reduction impacts would be the same for New or Modified Roosevelt or Stewart Moutain because lake elevations, size, storage allocations, and flood control operations would be identical for a new structure or modified dam. Therefore, there is no significant difference in impact between either option.

c. Relocation

The consequences of relocation vary, both on the individual and community level. Depending on the nature of the relocation and on the characteristics of affected individuals and communities, the consequences of relocation could range from temporary stress to permanent lifestyle disruption. The impact of relocation depends on two general conditions: (1) how much change is generated by the relocation, and (2) how that change is interpreted and tolerated by the people who are relocated.

Stress and its manifestations are the primary impacts of relocation to individuals, families, and communities.

Relocations would occur at the Fort McDowell Indian Community (Plan 3) and the Roosevelt Lake communities (Plans 1, 2, 3, 6, and 7). While impacts at both areas are adverse, relocation of the Fort McDowell Community assumes an extraordinary adverse dimension because of characteristics of the community. By comparison, Roosevelt Lake impacts are less severe; however, they are still rated as Significant Adverse prior to mitigation.

(1) Direct and Indirect Impacts - Fort McDowell Indian Community

Table IV-29 summarizes the impacts and effects of relocation for the Fort McDowell community, which are discussed below.

(a) Plan 8 and Plans 1, 2, 6, and 7

The existing conditions at Fort McDowell reflect changes in the community that are a result of long-proposed relocation. The future-without condition will be significantly altered. For example, health problems resulting from proposed relocation will be reduced and illness rates will return to normal.

The potential for economic self-sufficiency, community autonomy, and viability will be higher in the future-without condition than the present condition. The tribe's economy will no longer be stymied by the prospects of impending relocation, and the stature of community leaders and tribal government will be enhanced because they succeeded in preventing the community's relocation.

Identical conditions are predicted to occur with Plans 1, 2, 6, and 7. It is probable that conditions would be even better with these plans than with Plan 8 because any future potential for a Confluence Dam would be eliminated by implementation of these plans.

(b) Plan 3

The Confluence Dam and Reservoir would inundate a large portion of Fort McDowell Indian Community lands. Approximately

Table IV-29

FORT McDOWELL INDIAN COMMUNITY
SOCIAL IMPACTS AND EFFECTS OF RELOCATION

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 3	Plans 1, 2, 6, and 7
Social Factors			
	No Relocations (374 people in affected community)	290 Relocations (77% of affected population)	No Relocations
Individual			
1. Changes in mortality and morbidity rates	1. Normal mortality and morbidity rates given age distribution of population	1. Substantial increase in mortality and morbidity rates	1. There are no impacts because no individuals are relocated
2. Changes in personal autonomy: (the degree to which individuals believe they have freedom and power to control their lives)	2. High levels of personal autonomy	2. Extreme decline in levels of personal autonomy	
3. Satisfaction with way of life	3. High satisfaction with way of life	3. Extreme decrease in satisfaction with way of life	
4. The potential for financial self-sufficiency	4. High potential for increased financial self-sufficiency	4. Substantial decrease in potential for sustained financial self-sufficiency	
Interpersonal			
1. The nature and extensiveness of family ties and informal support networks	1. High levels of extended family ties; highly integrated support systems within the family and tribe	1. Substantial decrease in extended family ties and family support networks	1. No Impact
2. Incidence of family problems such as divorce, child abuse and neglect, and alcohol and drug abuse	2. Normal incidence of family problems such as divorce, child abuse and neglect, and drug abuse; moderate incidence of alcohol abuse	2. Substantial increase in incidence of family problems	
Community			
1. Community Cohesiveness: (the extent to which a community is unified with individuals mutually depending on each other for support)	1. High community cohesion; high levels of informal support networks	1. Extreme decrease in community cohesion. Substantial decline in number and efficacy of informal networks	1. No impact
2. Community Viability:	2. High community viability (significant increase from present condition); strong community leadership; high potential for tribal autonomy	2. Extreme decrease in community viability; substantial decline in autonomy (ability to control the direction of the community) and in efficacy of tribal leadership; elimination of trend toward self-determination	

Table IV-29 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 3	Plans 1, 2, 6, and 7
Social Factors	No Relocations (374 people in affected community)	290 Relocations (77% of affected population)	No Relocations
Community (Con't)			
3. Economic self-sufficiency: the degree to which a community is/is not reliant on outside agencies for economic support; unemployment rate	3. High potential for increased tribal economic self-sufficiency; moderate level of unemployment	3. Substantial decrease in potential for tribal economic self-sufficiency (increased dependency on governmental services); substantial increase in unemployment	
4. Potential for sustaining the Yavapai culture;	4. High potential for sustaining Yavapai culture	4. Extreme decrease in potential to sustain Yavapai culture	
Mitigation Recommendation			
	1. NA	1. Relocate the entire community together; do not relocate on an individual basis	1. NA
		2. Provide the tribe with additional land equal to or greater in size than that acquired and of the highest quality available which is contigous to the reservation boundaries	
		3. Monetary compensation should cover all expenditures and new expenses incurred by the residents as a result of relocation and should be distributed according to the tribe's wishes	
		4. Provide special services to meet needs that are unique to this area	
		5. Initiate a plan that ensures the participation of the entire community in all decisions and plans revelant to the relocation	
		6. Provide an accurate, reliable system for disseminatng information to residents so that they are constantly informed about the relocation proceedings; provide a means by which residents can participate in the relocation planning	

Table IV-29 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 3	Plans 1, 2, 6, and 7
Social Factors	No Relocations (374 people in affected community)	290 Relocations (77% of affected population)	No Relocations
Residual Impacts			
1. Residual Impacts are those that cannot be eliminated by mitigation procedures	1. NA	1. Mitigation could not eliminate any of the impacts of relocation among Fort McDowell residents. At best it could only slightly reduce a few of the impacts.	1. None
Unmitigated/Mitigated Effects	1. NA	AF/AF	No Effect

13,000 acres of the total 25,000 acres owned by the tribe would be acquired by the Bureau of Reclamation for the dam and reservoir. Some 290 members of the 374-member community would be relocated.

The consequence of this project action would be a marked increase in stress at both the individual and community level. The stress that would result from relocation of the Yavapai would be made manifest in three general ways: physiologically, psychologically, and sociocultural. Each of the following predicted impacts is a specific manifestation of one of these three forms of stress.

(i) Substantial Increase in Mortality and Illness Rates: Following relocation, the Yavapai would experience increased physical and mental health problems that would result in a substantial increase in the community's mortality rates. Residents have experienced escalated stress levels resulting from threats of relocation, and medical utilization rates have significantly increased as the stress has escalated.

(ii) Extreme Decline in Levels of Autonomy: Relocation would result in an extreme decline in both personal and tribal autonomy. For many residents, their opposition to relocation has become the most critical issue in their lives. If, despite years of activity in which virtually every resident participated, they failed to prevent the construction of a Confluence Dam, residents inevitably would feel a tremendous sense of defeat. This defeat would be construed as evidence that they are powerless to protect their own interests and effect change.

(iii) Substantial Decrease in Potential for Sustained Economic Self-Sufficiency: Past experience with resettlement programs indicates that forced relocation for an Indian community does not improve the financial status of the residents. Almost invariably, monetary compensation, even including sums that appear quite generous, does not result in sustained financial security for relocatees and their descendants.

(iv) Decrease in Family Support Systems, Increase in Family Problems: The severe stress, demoralization, and sense of defeat experienced by the community would take its toll on family members causing disturbed family life, depression, anxiety, and a breakdown of family support systems. The hardships and pressures brought to bear on the family would result in disorganization within the family structure. The incidence of family problems such as alcohol and drug abuse, family violence, and child neglect would increase.

(v) Extreme Decrease in Informal Support Networks and in Community Cohesiveness: Relocation disrupts social support networks. Normal behavior patterns are disrupted and people become isolated from each other as they attempt to cope with the shock of resettlement.

The disruption of support networks would substantially reduce the cohesiveness of the community. This cohesiveness is, in part, a consequence of residents' shared strong attachments to their land and their belief in their ability to control their lives and sustain the community. Relocation would disrupt their attachment to the land and cause residents to lose confidence in themselves and in their leaders. This would further reduce the cohesiveness of the community.

(vi) Extreme Decline in Satisfaction With Life: Residents of Fort McDowell are currently very satisfied with their lives except for stress caused by threat of relocation. The tribe is making significant progress toward their goal of self-determination. This would cease if residents were forced to relocate. Residents virtually all agree that the vast changes induced by their relocation would be highly undesirable and would alter those things which are presently most satisfying to them.

(vii) Extreme Decrease in Community Viability: Community viability is defined as the ability of a community to sustain itself. It is projected that compulsory relocation would result in an extreme decrease in the viability of the Fort McDowell community, for the following reasons.

Relocation would have deleterious consequences for the economy at Fort McDowell. Unemployment would increase and economic development activities would be abandoned because, following relocation, the Fort McDowell community would not have a reliable economic base.

One of the most commonly reported outcomes of compulsory relocation is the demise of the leadership or local government of the affected population. Besides losing confidence in their leadership, the residents would lose confidence in their system of government, for they would perceive it as inadequate to protect them and meet their most basic needs.

For Fort McDowell residents, the community is their tribe; it constitutes an integral part of their cultural identity.

Relocation would disrupt their strong identification with their community because of the interrelatedness of their culture, community and land.

(viii) Extreme Decrease in Potential to Sustain Yavapai Culture: The prehistory and history of the Yavapai demonstrates that culturally and historically they are a people distinct from other groups in the Southwest.

Relocation would likely result in the destruction of the culture and society of the Yavapai. Even if the community would be relocated as a whole, it could take decades for new ties to form. In a cultural sense, fundamental patterns of social interaction, which are public displays of cultural behavior, can no longer be carried out after relocation. Certainly Yavapai people will survive as will some aspects of the culture; however, fundamental subsystems would be irreparably damaged, especially those that relate to the tribe as a cultural and legal entity, the community in its relationship to the land, and the people in their social relationships.

(c) Mitigation and Residual Impacts

The conceptual mitigation plan for Fort McDowell residents is outlined in Table IV-29. The impacts at Fort McDowell would be severe, irreversible, long lasting, and would affect every member of the tribe. While some mitigation may be possible, it would not significantly reduce the effects of relocation impacts.

One impact that could be partially mitigated is the breakdown of extended family and social networks. Enough land could be

provided for the entire community to duplicate existing spatial housing patterns. Such an arrangement would have less of an impact than dispersing family and neighborhood networks, providing that residents were in good mental and physical health. Clearly, money would not mitigate any of the social impacts described here; money would, however, be paid to the tribe in compensation for land required by the project. Many members of the tribe have expressed concern for the consequences of an influx of large sums of money to people not experienced or trained to invest it.

Since mitigation does little to reduce the impacts of relocation on Fort McDowell residents, residual impacts remain virtually the same as unmitigated impacts. The mitigated effect remains the same, Adverse Flag.

(2) Direct and Indirect Impacts - Roosevelt Lake Communities

The impacts and effects of relocation for Roosevelt Lake area residents are summarized in Table IV-30.

(a) Plan 8

In the future-without condition for Roosevelt Lake communities, few changes in population numbers and characteristics are expected from the existing condition. This is because little private land remains available in the area, and residents do not want increased development. The proportion of full-time residents, however, will increase as individual lots are developed and housing structures are made more permanent.

Table IV-30

ROOSEVELT LAKE AREA
AGGREGATED SOCIAL IMPACTS AND EFFECTS OF RELOCATION

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 2	Plans 1, 3, 6, and 7
Social Factors			
	No Relocations (596 people in affected communities)	247 Relocations (40% of affected population)	347 Relocations (58% of total population)
Individual			
1. Changes in mortality and morbidity rates	1. Normal mortality and morbility rates given age distribution of population	1. Slight increase in mortality and morbility rates	1. Slight increase in mortality rates and increased morbidity rates
2. Changes in personal autonomy: (the degree to which individuals believe they have freedom and power to control their lives)	2. High levels of personal autonomy	2. Substantial decrease in personal autonomy	2. Substantial decrease in personal autonomy
3. Satisfaction with way of life	3. High satisfaction with way of life	3. Substantial decrease in satisfaction with way of life	3. Substantial decrease in satisfaction with way of life
4. The potential for financial self-sufficiency	4. High potential for financial self-sufficiency	4. Moderate reduction in potential for self-sufficiency	4. Moderate reduction in potential for self-sufficiency
Interpersonal			
1. The nature and extensiveness of family ties and informal support networks	1. Low levels of informal support networks in all communities except Roosevelt Gardens; at Roosevelt. Gardens moderate developed informal support networks. Family interaction primarily within nuclear family at all locations	1. Slight decrease in informal support networks among family and friends	1. Moderate decrease in informal support networks. Slight decrease in informal interactions between familiar households
Community			
1. Community Cohesiveness: (the extent to which a community is unified with individuals mutually depending on each other for support. A cohesive community is characterized by extensive informal support networks, frequent personal interaction, and by strong personal identification of residents with the community as a whole)	1. Low to moderate community cohesion in all communities except Roosevelt Gardens: High community cohesion at Roosevelt Gardens (formal social organization emerges on temporary basis to meet needs and respond to immediate problems). Low level community organization on day to day basis. (Emphasis on individuality more than community)	1. Slight decrease in community cohesion and social organization	1. Moderate decrease in community cohesion and slight decrease in social organization
2. Community Viability: (the ability of a community to sustain itself)	2. Community development likely to remain at present low level which is adequate to sustain viability. Moderate potential for sustained community viability at area level	2. Moderate decrease in potential for sustained community viability	2. Substantial decrease in potential for sustained community viability

Table IV-30 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 2	Plans 1, 3, 6, and 7
Social Factors			
Mitigation Recommendation	1. NA	1. Relocate only those people who live within the area likely to be inundated more than once in 200 years, but not within the lower IDF area; provision of low-cost flood insurance to people residing in the IDF area	1. Relocate only those 50 people who live within the confines of the SPF take-line, with no relocation of people in the IDF area 2. Provision of low-cost flood insurance to people in the IDF area 3. Provision of Forest Service land in the Roosevelt Lake area bordering Roosevelt Lake Estates for relocations, allowing enough space so neighbors may relocate near each other if they wish - include enough additional land for the community to build a school 4. Monetary compensation for all relocation expenses incurred by residents 5. Provide special services to meet needs that are unique to this area 6. Provide an accurate and reliable system for disseminating information to residents so that they are constantly informed about relocation proceedings; provide a means by which residents can participate in the relocation planning process

Table IV-30 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plan 2	Plans 1, 3, 6, and 7
Social Factors			
Residual Impacts			
1. Residual Impacts are those that cannot be eliminated by mitigation procedures	1. NA	1. Through mitigation, it is possible to eliminate all impacts by eliminating relocation	1. 50 individuals reside below 2,173 feet in elevation at Roosevelt Lake Estates and would require relocation with mitigation. These individuals would experience minimal levels of stress and inconvenience if relocated in the community and awarded equitable compensation
Unmitigated/Mitigated Effects			
	1. NA	SA/No Effect	SA/I

(b) Plans 1, 2, 3, 6, 7

With all action plans (Plans 1, 2, 3, 6, and 7) Roosevelt Dam would change, creating a larger reservoir than currently exists behind Roosevelt Dam. Land would be acquired by the Bureau of Reclamation for the larger reservoir, and homes and businesses within the take-line would be relocated.

As a result of differences among action plans, the number of people relocated at Roosevelt Lake would vary; however, the general impacts would be the same because of the similarity in the communities that would be affected. In the following sections, these general impacts are first described, and then the differences in the affected communities of Rockhouse Farm, Roosevelt Lake Estates, North Bay Estates, and Roosevelt Gardens East are discussed.

(i) General Impacts at Roosevelt Lake: Relocation would be stressful for Roosevelt Lake residents and would require considerable adjustment from them. Many residents are older and live on fixed incomes. However, relocation would not result in pervasive, long-lasting change in the residents' lives. Since private land is no longer available in the immediate vicinity, relocation could force many to leave the area. If residents could no longer maintain the same lifestyle elsewhere, the change in their lives would be both significant and disruptive.

Stress levels would be limited, to some extent, because there is not a high degree of consensus among residents regarding their expectations about relocation. None of the residents

want to be relocated, but some feel they could adjust quite easily to relocation. Some residents believe that relocation would undermine their ability to live as they desire, while others think relocation would not change much in their lives.

If forced to move, residents would be very upset and disappointed; however, they would not construe their relocation as a personal defeat and would not be likely to internalize feelings of helplessness or failure. Because of this, their ability to cope with the stress would be increased.

Since community cohesiveness, formal organization, and community viability are generally at low or moderate levels, relocation would not significantly reduce these factors even if it results in the dissolution of the community, as with Rockhouse Farm or North Bay Estates.

The aggregate impact to Roosevelt Lake residents is displayed in Table IV-30. The unmitigated effect has been evaluated as Significant Adverse. The severity of the impact stems from residents' strong desire to remain in the area, the problems associated with moving and re-establishing a home, financial considerations, and relocating large proportions of, or in some cases, entire communities. Differences among the affected communities are described in the following sections.

(ii) Rockhouse Farm: All of the 47 residents of Rockhouse Farm would be required to relocate with all action plans. The residents (except the owners) rent their trailer lots; most rent their mobile

homes or trailers as well. The degree of change caused by relocation of this community would not be great.

(iii) Roosevelt Lake Estates: Approximately 125 people would be relocated from Roosevelt Lake Estates with Plan 2; 175 people would be relocated with Plans 1, 3, 6, and 7. A total of 359 people live in the Estates. The Estates residents own their own property. Since no private property remains available near the lake, those who are relocated would have to leave the area. This would disperse the community, disrupt interpersonal relationships, and substantially reduce individuals' feelings of satisfaction and autonomy.

(iv) North Bay Estates: All of the 60 residents of North Bay Estates would be relocated with all the action plans. About two-thirds of North Bay Estates residents live there only part-time. As a result, the community is not highly cohesive or well developed and community level impacts are minimal. However, individual level impacts would result in significant change for people who would be relocated.

(v) Roosevelt Gardens East: Fifteen people would be relocated as a result of Plan 2. Most of these are part-time residents, so impacts on all levels would not be great. Since private land near the lake is no longer available, residents would have to leave the area. With Plans 1, 3, 6, and 7, about one-third of the residents would have to relocate, and impacts would be significant.

(vi) Impacts to Roosevelt Lake Area Business: The Lakeview Marina on the east side of the lake would be relocated with all

action plans. The marina is the only boat launching ramp of its kind at Roosevelt Lake and includes a small store equipped with supplies. The Rockhouse Farm store and trailer park, also on the east side of the lake, would require relocation with all action plans. One ranch, located on the west of the lake in Roosevelt Gardens East, would be relocated with all action plans. Other lands used by ranchers for grazing cattle on both sides of the lake would be inundated with any increase in the lake's elevation, resulting in adverse impacts to area ranchers.

Area businesses would experience a decrease in sales and profits if nearby communities are relocated. Recreational facilities would experience a temporary loss in income, with long-term prospects of profitability increasing because of greater recreational use of the lake. The Punkin Center School would have a decrease in enrollment if residents are relocated out of the area.

(c) Mitigation and Residual Impacts

The conceptual mitigation plan for Roosevelt Lake relocations focuses on not relocating people from areas where the probability of reservoir inundation is very low. In all plans, mitigation would consist of not relocating people from the IDF area. Other provisions of the conceptual mitigation plan are presented in Table IV-30.

With mitigation, the severity of the impacts would be greatly reduced in Plans 1, 3, 6, and 7, resulting in an Insignificant effect. The 50 people still requiring relocation with mitigation (those who live at elevations below 2,173 feet) live near the northern boundary of

Roosevelt Lake Estates, close to the lake. About half of these are part-time residents, many of whom are planning to retire in the community. Since it is possible to compensate for financial losses, to provide land in the area so that residents can retain the same lifestyle, and to provide moving services, the impacts of relocation for these 50 people can be significantly reduced. If these individuals can be relocated to higher Forest Service land adjacent to the community and compensated for all expenses incurred as a result of their move, all impacts would be virtually eliminated.

Mitigation for Plan 2 would eliminate all impacts because there would be no relocations.

(3) Direct and Indirect Impacts & Mitigation-KA Ranch (Cliff Site)

Relocation would occur at the Cliff site under all action plans. The impacts and effects of relocation at the KA Ranch within the Cliff site area are summarized in Table IV-31. The unmitigated impacts at the KA Ranch stem mostly from financial considerations and from the residents' desire to live in the area. Mitigation, based on monetary compensation and providing equivalent alternate land, could reduce the impacts. The impacts are described as slight because of the small number of people involved (16 people) and steps the family has taken to remain together in the area. The current owners of the ranch have recently purchased another ranching operation in the area and plan to relocate together.

d. Flood Reduction

This section describes the social impacts and effects of flood reduction. Impacts and effects of alternative plans, including no action,

Table IV-31

CLIFF SITE (KA RANCH)
SOCIAL IMPACTS AND EFFECTS OF RELOCATION

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plans 1, 2, 3, 6, and 7
Social Factors		
	No Relocations (16 people reside in community)	16 Relocations (100% of total population)
Individual		
1. Changes in mortality and morbidity rates	1. Normal mortality and morbidity rates	1. No change in mortality and morbidity rates
2. Changes in personal autonomy: (the degree to which individuals believe they have freedom and power to control their lives)	2. High levels of personal autonomy	2. Slight decrease in personal autonomy
3. Satisfaction with way of life	3. High satisfaction with way of life	3. Slight decrease in satisfaction with way of life
4. The potential for financial self-sufficiency	4. High potential for financial self-sufficiency	4. Moderate reduction in potential for self-sufficiency
Interpersonal		
1. The nature and extensiveness of family ties and informal support networks	1. High levels of informal support networks among familial households	1. No impact
Mitigation Recommendations		
	1. NA	1. Monetary compensation should cover all expenditures and new expenses incurred by the residents as a result of relocation
		2. Attempt to replace patented land owned by residents with equivalent acreage in region with potential for adjacent grazing lease land and sufficient water rights to grow feed for cattle operation
		3. Provide an accurate, reliable system for disseminating information to relocatees so that they are constantly informed about the relocation proceedings

Table IV-31 (Continued)

Impacts and Effects	Plan 8 CAWCS No Action Future Without Project	Plans 1, 2, 3, 6, and 7
Social Factors		
Residual Impacts		
1. Residual Impacts are those that cannot be eliminated by mitigation procedures.	1. NA	1. Mitigation procedures would lessen the stress and financial problems associated with relocation, although residents would experience minor stress and inconvenience while relocations take place.
Unmitigated/Mitigated Effects		
	1. NA	I/I

are described in Tables IV-32 and IV-33. Alternative plans are associated with three flood flow levels. Plan 8 (no action) does not provide flood control of the 200-year flood (275,000 cfs) to 157,000 cfs at Sky Harbor Airport. Plans 1, 3, 6, and 7 control the 200-year event to between 70,000 and 92,000 cfs at the airport.

(1) Types of Flooding Reduction Impacts

Each of the alternative flood control plans are analyzed according to two levels of measurement: individual and area. The individual level of analysis describes the direct effects of flooding while the area level describes the indirect effects.

The direct impacts of flood control are the reduction or elimination of conditions experienced by individuals due to property inundation during and following a flood. These conditions include changes in physical and mental health, financial capacity, and life satisfaction. Indirect impacts are the reduction or elimination of threats to area-wide public safety and welfare during and following a flood. These threats are contingent upon the degree of breakdown experienced by a particular area's physical infrastructure and public safety organizations. Area level impacts are assessed according to organizational characteristics peculiar to the CAWCS study area. These include disruptions in automobile, air, and rail transportation; public utilities; telecommunication; public safety response organizations; business operations; tourism; and communities inundated as they related to public safety and welfare. One added impact of flood control is the additional land available for development as a result of reduced flood flows.

The degree of individual and area wide description in a flooding disaster varies; it depends largely upon the suddeness, duration and intensity of a particular flood event. Historic flooding events are used to characterize the type of impacts caused by flood in central Arizona.

(2) Direct and Indirect Impacts of Plan 8

Future social conditions without flood control are assumed to be social conditions in the event of a 200-year flood by the year 2000. In the CAWCS study area, the 200-year flood is defined as a flow of 275,000 cfs as measured at Sky Harbor International Airport. Projection of the year 2000 population for the Salt-Gila flood inundation area is 46,560. This number is slightly less than 2 percent of the projected Maricopa County population of 2,400,000 for the year 2000.

FUTURE-WITHOUT 200-YEAR INUNDATION AREA POPULATION

Community	Population
Holly Acres Area	1,500
City of Mesa	16,000
City of Tempe	2,600
City of Phoenix	22,000
Salt River Pima-Maricopa Indian Community	360
Gila River Indian Community (Lehi)	300
Buckeye Area	3,800
Total projected 200-year inundation area population (year 2000)	46,560

(3) Direct and Indirect Impacts of Plans 1, 3, 6, 7 and Plan 2

Impacts and effects of action plans are described in Tables IV-32 and IV-33.

TABLE IV-32

SOCIAL IMPACTS OF PLANS 1, 3, 6 and 7
CONTROL OF 200-YEAR FLOOD TO FLOW OF 70,000 TO 92,000 cfs

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of Between (70,000 and 92,000 cfs) (Plan(s) 1,3,6,7)	Impact
Individual Level Factors			
(1) Physical and Mental Health	Potential for inundations of 46,560 individuals in year 2000. High probability for large number of flood-related deaths. Widespread potential for physical injury, illness, and severe stress for inundated flood victims. High levels of disorganized (panic) activity.	Potential for inundations of less than 100 individuals in year 2000. No flood-related deaths anticipated. Potential for physical injury and illness for <100 individuals. Low levels of disorganized (panic) activity.	Elimination of potential for inundations of >46,460 individuals. Elimination of high probability of large number of flood-related deaths. Potential for physical injury and illness and severe stress eliminated for >46,460 individuals. Substantial reduction of potential for disorganized (panic) activity.
(2) Net Disaster Losses	Projected $87,292,000 in residential property damages in year 2000; majority of 46,560 individuals directly affected in low-to-moderate income brackets. Majority	Projected $602,000 in residential property damage in year 2000. Majority of <100 individuals affected low-to-moderate income sequential flooding disaster	Reduction of $86,690,000 in residential property damage by year 2000; majority of directly affected individuals in low-to-moderate income

TABLE IV-32 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of Between (70,000 and 92,000 cfs) (Plan(s) 1,3,6,7)	Impact
Individual Level Factors (Continued)			
	of flood victims required to obtain loans or use personal savings to make repairs to property.	victims. Majority of <100 individuals inundated required to obtain loans or use personal savings to make repairs to property.	brackets. Extreme reduction of potential for loans and depletion of personal savings for property repairs by majority of >46,460 individuals.
(3) Lifestyle Disruption	Temporary lifestyle disruption for 46,560 individuals inundated by floodwaters. Long and debilitating clean-up for many months; lost work and school time. Permanent changes in lifestyle for majority of 525 sequential disaster victims in Holly Acres subdivision.	Temporary lifestyle disruption for <100 individuals inundated; permanent lifestyle disruption for majority of <100 sequential disaster victims in Holly Acres.	Extreme reduction of lifestyle disruption. Elimination of disruptions for >46,460 individuals. Elimination of lost work and school time for >46,460 individuals.

TABLE IV-32 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of Between (70,000 and 92,000 cfs) (Plan(s) 1,3,6,7)	Impact
Area Level Factors			
(1) Transportation Disruptions			
- Automobile	Damages to roads and bridges projected to be $15,800,000 by year 2000. 0-1[a] river crossings operable. Transportation delay costs projected to be $39,694,000 by year 2000. High levels of stress experienced by area motorists due to traffic delays and hazardous driving conditions. Many unable to cross floodplain area.	15 bridge crossings remain operable. Closure of dip crossings. Damages to roads and bridges totalling <$5,000,000. No significant delays in transportation by the year 2000.	14-15 bridge crossings maintained. Substantial reduction of costs of damages to bridges and roads (>$10,800,000). Elimination of significant transportation disruptions.
- Air and Rail	Damages to airport facilities and railroad tracks and yard projected to be $7,021,000 by year 2000. Major delays in air service for 2 days beyond peak flow. Repairs would require 3 months to complete. >$500,000 in damages to airport channel clearing project.	No damage to air and rail transportation facilities. Minor damage may occur to airport channel clearing project.	Elimination of $7,021,000 in damage costs and reduction of damages to airport channel clearing project by year 2000.

TABLE IV-32 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of Between (70,000 and 92,000 cfs) (Plan(s) 1,3,6,7)	Impact
Area Level Factors (Continued)			
(2) Public Utilities	Damages totalling $6,400,000 to electrical transmission towers and power lines: repairs would take 2 months to complete. No blackout expected. >$275,000 in damages to sewage and wastewater treatment plants. Damages to active landfills nonquantifyable at present time.	Damages to electrical transmission towers and power lines would range well below $1 million. Insignificant damages to sewage and wastewater treatment plants. Damages to active landfills nonquantifiable at present time.	Substantial reduction of damages to electrical transmission towers and power lines (>$5,400,000). Substantial reduction of damages to sewage and wastewater treatment plants and active landfills.
(3) Communication	Temporary delays in telephone service. Major delays in delivery schedules of newspapers, mail, and other subscription services.	Possibility of delays in telephoned service for some. No delays in delivery schedules of newspapers, mail and other subscription services.	Elimination of disruption of delivery service of published material (i.e., mail, newspapers, etc.). Substantial reduction in disruption of phone service.
(4) Business Community	Damages totalling $68,713,000; combined both short and long term revenue losses costs could be in excess of $150 million according to Natelson Company (1980).	Damages totalling $6,194,000; Majority of damages occurring to sand and gravel operations.	Reduction of $62,519,000 in damages. Elimination of lost revenues due to transportation disruptions.

TABLE IV-32 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of Between (70,000 and 92,000 cfs) (Plan(s) 1,3,6,7)	Impact
Area Level Factors (Continued)			
(5) Tourism	Short- and long-term losses due to forced cancellations of trips and adverse publicity.	No significant disruption in tourist trade.	Substantial reduction of short- and long-term losses due to cancellations of trips and adverse publicity.
(6) Public Safety	Civil defense warning system fully activated. Emergency aid required from outside of metropolitan area. Emergency costs of $1,109,000. Lack of emergency personnel to carry out all door-to-door warnings.	Although no accurate estimate exists for emergency costs in a flood of this level, it is estimated that costs would range below $60,000.	Reduction of <$1,049,000 in emergency costs. Elimination of needed aid from outside of the Phoenix metropolitan area.
(7) Communities Inundated	Mesa, Tempe, Phoenix, SRPMIC, GRIC, Buckeye, Holly Acres. Breakdowns in established informal support networks and community cohesion for 7 communities.	Less than 100 individuals residing in the subdivision of Holly Acres could be inundated by floods below 100,000 cfs. Major breakdowns in informal support networks and community cohesion would not be anticipated.	Elimination of residential property damage and breakdowns in informal support networks and community cohesion for >46,460 individuals of 7 communities (Mesa, Tempe, Phoenix, SRPMIC, GRIC, Buckeye, Holly Acres).

TABLE IV-32 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of Between (70,000 and 92,000 cfs) (Plan(s) 1,3,6,7)	Impact
Area Level Factors (Continued)			
(8) Additional Land Use	No additional land available.	Approximately 3,563 additional acres available for higher urban uses. Valued at $107,311,000 by year 2000.	Additional 3,563 acres available for higher urban uses. Valued at $107,311,000 by year 2000.

[a]-Dependent on Mill Avenue Bridge

TABLE IV-33

SOCIAL IMPACTS OF PLAN 2
CONTROL OF 200-YEAR FLOOD TO FLOW OF 157,000 CFS

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Individual Level Factors			
(1) Physical and Mental Health	Potential for inundation of 46,560 individuals in year 2000. High probability for large numbers of flood-related deaths. Widespread potential for physical injuries and illness and severe stress for inundated flood victims. High levels of disorganized (panic) activity.	Potential for inundation of approximately 525 individuals by the year 2000. Low probability for large numbers of flood-related deaths. Potential for physical injury and illness and severe stress for 525 individuals. Low levels of disorganized (panic) activity.	Elimination of potential for inundation for approximately 46,035 individuals in year 2000. Moderate decrease in probability for large number of flood-related deaths. Potential for physical injury and illness and severe stress for 46,035 individuals eliminated. Substantial reduction of potential for disorganized (panic) activity.
(2) Net Disaster Losses	Projected $87,292,000 in residential property damage in year 2000; majority of 46,000 people directly affected in low-to-moderate income brackets. Majority	Projected $5,684,000 in residential property damage in year 2000. Majority of 525 individuals affected low-to-moderate income sequential flooding disaster	Reductions of projected $81,608,000 in residential property damage by year 2000; majority of directly affect individuals in low-to-moderate

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Individual Level Factors (Continued)			
	of inundated flood victims required to obtain loans or use personal savings to make repairs to property.	victims. Majority of 525 inundated individuals required to obtain loans or use personal savings to make repairs to property.	income brackets. Elimination of potential for loans and depletion of personal saving for property repairs for 46,035 individuals.
(3) Lifestyle Disruption	Temporary lifestyle disruption for 46,560 individuals inundated by floodwaters. Long and debilitating clean-up for many month. Lost work and school time. Permanent changes in lifestyle for majority of 525 sequential disaster victims in Holly Acres.	Temporary lifestyle disruptions for 525 individuals inundated; permanent lifestyle disruption for many of 525 sequential disaster victims in Holly Acres. Lost work and school time for inundated individuals.	Substantial reduction of lifestyle disruption. Elimination of disruption for 46,035 individuals. Elimination of lost work and school time for 46,035 individuals.

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Area Level Factors			
(1) Transportation Disruptions			
- Automobile	Damages to roads and bridges projected to be $15,800,000 by year 2000. 0-1[a] river crossings operable. Transportation delay costs projected to be $39,694,000 by year 2000. High levels of stress experienced by area motorists due to traffic delays and hazardous driving conditions. Many unable to cross floodplain area.	15 river crossings operable. Damages to roads and bridge crossings totalling >$5,000,000.[b] Closure of all dip crossings. Transportation delay costs considered to be insignificant with new bridge crossings in place. Low levels of stress experienced by area motorists due to minor transportation delays (i.e. added driving distances to cross floodplain).	Substantial reduction of damages to bridges and roads as a result of flooding (<$10,800,000). Substantial reduction of transportation delay costs. Elimination of stress associated with long waits to cross floodplain area.
- Air and Rail	Damages to airport facilities and railroad tracks and yard projected to be $7,021,000 by year 2000. Major delays in air service for 2 days beyond peak flow. Repairs would require 3 months to complete. >$500,000 damage to airport channel clearing project.	No damage to air and rail transportation facilities in year 2000. No delays in service. Approximately $500,000 in damage to airport channel clearing project.	Elimination of $7,021,000 in damages to airport facilities and railroad tracks and yards by year 2000. Elimination of service disruptions.

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Area Level Factors (Continued)			
(2) Public Utilities	Damages totalling $6,400,000 to electrical transmission towers and power lines; repairs would take 2 months to complete. No blackout expected. $275,000 in damages to sewage and wastewater treatment plants. Damages to active landfills nonquantifyable at present time.	Damages totalling approximately $1,500,000 to electrical transmission towers and power lines. Approximately $80,000 in damages to sewage and wastewater treatment plants[b] (majority at Buckeye Plant). Damages to active landfills nonquantifyable at present time.	Substantial reduction of damages to electrical transmission towers and power lines ($4,900,000). Reduction of $195,000 in damages to sewage and wastewater treatment plants. Substantial reduction of damages to active landfills.
(3) Communication	Temporary delays in telephone service. Major delays in delivery schedules of newspaper, mail and other subscription services.	No delays in delivery schedules of newspapers, mail and other subscription services. Temporary delays in telephone service in some areas. Unable to quantify damage costs at present time.	Elimination of delays in scheduled deliveries of subscription services (i.e., newspapers, mail, etc.), due to reduction of transportation disruptions. Substantial reduction in number of telephone service disruptions.

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Area Level Factors (Continued)			
(4) Business Community	Damages totalling $68,713,000; combined with both short and long term revenue losses costs could be in excess of $150 million according to Natelson Company (1980).	Damages totalling $6,977,000. Majority of damages to sand and gravel operations.	Reduction of $61,736,000 in damages to business community. Substantial reduction of damages to sand and gravel operations.
(5) Tourism	Short- and long-term losses due to forced cancellations of trips and adverse publicity.	No significant disruption in tourist trade.	Substantial reduction of short- and long-term losses due to cancellations of trips and adverse publicity.
(6) Public Safety	Civil defense warning system fully activated. Emergency aid required from outside of metropolitan area. Emergency costs of $1,109,000. Lack of emergency personnel to carry out all door-to-door warnings.	Civil defense warning system fully activated. Emergency costs in excess of $505,000.[b] No aid required from outside of metropolitan area.	Reduction of approximately $604,000 in costs of emergency aid. Elimination of needed aid from outside of the Phoenix metropolitan area.

TABLE IV-33 (Continued)

Condition	200-Year Flood (275,000 cfs) (Plan 8)	Flood Level of 157,000 cfs (Plan 2)	Impact
Area Level Factors (Continued)			
(7) Communities Inundated	Mesa, Tempe, Phoenix, SRPMIC, GRIC, Buckeye, Holly Acres. Breakdowns in established informal support networks and community cohesion for 7 communities.	Phoenix[c], Holly Acres. Breakdowns in established informal support networks and community cohesion for 2 communities (approximately) 525 individuals.	Elimination of residential property damage in 5 communities (Mesa, Tempe, Phoenix, SRPMIC, GRIC, Buckeye); Elimination of damage for approximately 46,035 individuals. Damages continue to occur in Phoenix[c] and Holly Acres.
(8) Additional Land Use	No additional land available for development.	2,248 acres available for higher urban uses. Value for year 2000 is $66,026,000.	2,248 additional acres available for higher urban uses. Value for year 2000 is $66,026,000.

[a]-Dependent on Mill Avenue Bridge

[b]-figures based on projections used for 18-year flood (140,000 cfs)

[c]-portions of south Phoenix residential areas would be inundated by 157,000 cfs flood

6. Economics

a. Types of Economic Impacts

National economic development impacts are measured in current dollars and are called net benefits. If net benefits are negative the economic effects are adverse; if positive, the effects are beneficial. beneficial or adverse.

The accounting framework used in the CAWCS studies is shown schematically in Figure IV-2. Costs include construction contracts, design, engineering, and administration of the plans. Energy is a significant component of the operation costs of all plans except 2 and 8 because much of the increased water supply developed by the plans must be pumped into Central Arizona from the Colorado River.

Benefits include the major categories of regulatory storage, flood control and safety of dams corresponding to the major CAWCS project purposes. Recreation benefits are expressed as net loss or gain. Economic benefits are detailed in Table IV-34.

Regulatory storage benefits include water supply, hydropower, and power management benefits. Water supply benefits were calculated separately for irrigation water and municipal and industrial water. Power management benefits are distinguished from hydropower benefits. Power management refers to benefits derived from the ability to better manage CAP pumping loads provided by some of the regulatory storage structures. Hydropower benefits are benefits derived from the installation of a powerplant at a regulatory storage structure.

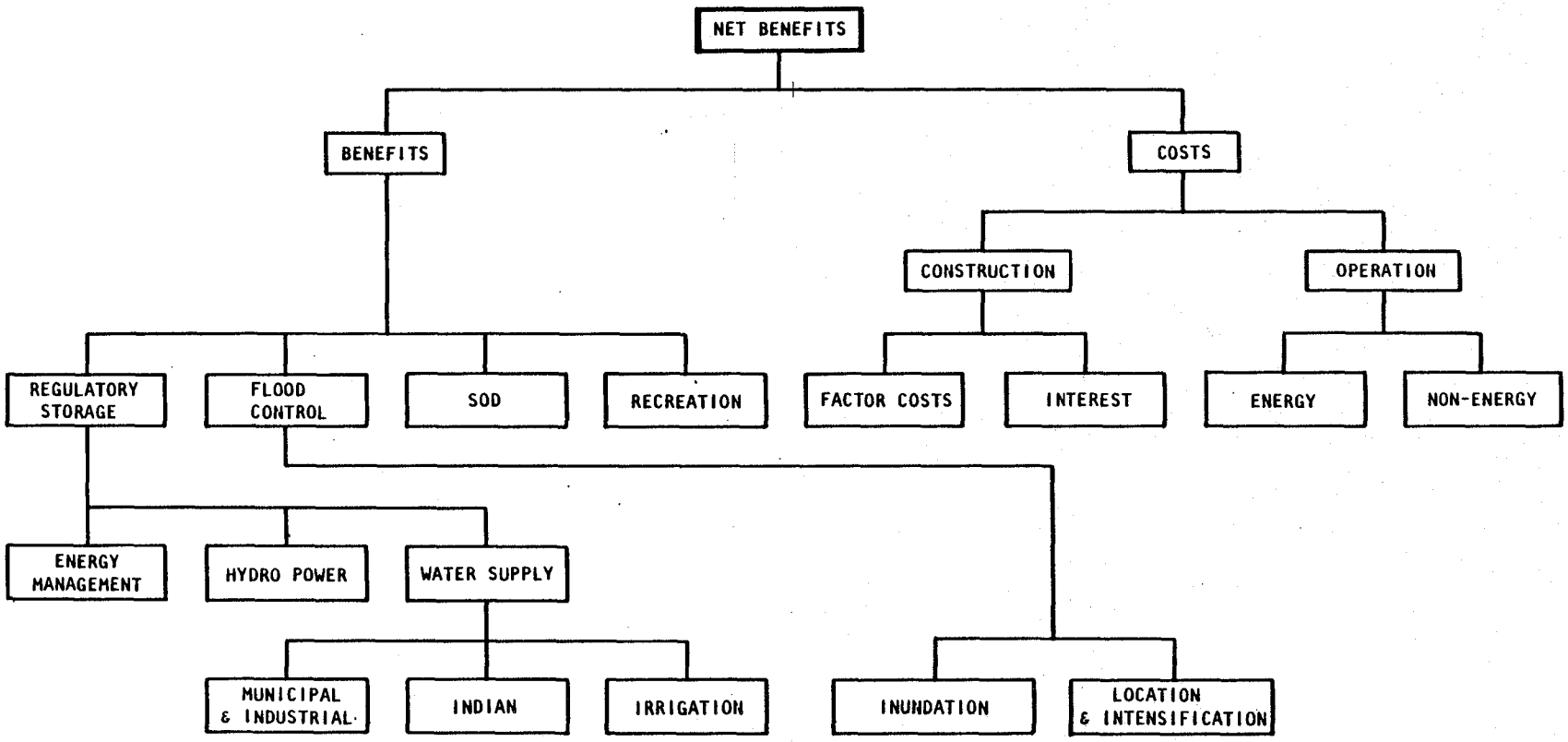

FIGURE IV-2
National Economic Impacts Accounting Frame Work

Table IV-34

ECONOMIC BENEFITS OF PLANS[a]

Factors/Measures	Plan 8 CAWCS No Action (Future Without Project)	Plan 1	Plan 2	Plan 3	Plan 6	Plan 7
Regulatory Storage Benefits	0					
Energy Management		0	0	18,640,000	72,640,000	72,640,000
Hydropower		760,000	0	3,910,000	8,580,000	8,580,000
Water Supply		9,410,000	1,310,000	15,130,000	12,900,000	6,770,000
Total Regulatory Storage Benefits		10,170,000	1,310,000	37,680,000	94,120,000	87,990,0000
Flood Control Benefits	0					
Inundation Reduction		13,200,000	6,700,000	13,200,000	13,200,000	13,200,000
Location and Intensification		20,540,000	6,080,000	20,540,000	20,540,000	20,540,000
Total Flood Control Benefits		33,740,000	12,780,000	33,740,000	33,740,00	33,740,000
Safety of Dams Benefits	0	39,220,000	39,220,000	39,220,000	39,220,000	39,220,000
Recreation Benefits	0	5,910,000	0	15,330,000	7,210,000	7,210,000
Total Annual Benefit	0	89,040,000	53,310,000	125,970,000	174,290,000	168,160,000

[a]Shown in January 1982 dollars.

SOURCE: Economic Supporting Document, USBR, 1982.

Flood control benefits include inundation reduction benefits, which result from prevention of physical damages to structures in the floodplain as well as savings in costs associated with floodfighting, closed businesses, transportation delays, and emergency operations. Location and intesification benefits of flood control result from improved land use in former flood prone areas.

b. Direct and Indirect Impacts

(1) Net Economic Benefits

Table II-9 in Chapter II shows the net economic benefits for each CACWS plan as well as annual benefits attributable to regulatory storage, flood control dam safety, and recreation. Net benefits are the dollar difference between annual costs and annual benefits. Details of the determination of the values are also discussed in the Economics Supporting Document and the Recreation Supporting Document, (CAWCS, 1981). All values are based on a the 1982 price level. All are annualized at 7 3/8 percent.

(2) Cost

The total construction cost of each plan and the total annual cost are shown on Table II-9.

(3) Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

Table II-9 shows differences in costs and benefits between new and modified dams.

7. Other Impacts of Plans

a. Air Quality

(1) Types of Impacts to Air Quality

The primary impact on air quality will be dust emissions or, (TSP), total suspended particulates from construction-related activities, which is a direct function of distance from the construction site(s). Other miscellaneous impacts are expected to have insignificant effects. The exception may be incineration impacts which may have significant adverse effects at times. The impacts of project actions on the ambient concentrations of air pollutants other than TSP (NMH,NO_2, O_3, SO_2) were investigated during the study. Both short and long-term impacts for all factors except TSP were found to be negligble in all of the scenarios analyzed; therefore, this section describes only TSP impacts of plans.

It should be noted that all of the impacts and effects described below are of short-to-moderate duration, lasting only as long as construction activities.

(2) Direct and Indirect Impacts

(a) Plan 8

The future-without conditions for ambient TSP at the affected site areas are shown in Table IV-35. The information presented for the period 1981 to 2000 is an estimate of the overall trend from the beginning of the period to the end.

Within the general Phoenix metropolitan area the Federal primary and State annual geometric mean TSP standard of 75 micrograms per cubic meter (ug/m^3) is often exceeded. With controls, the annual geometric mean is expected to decrease from 1981 through 1985 and then increase gradually through 2000. It is assumed that planned control measures will result in the regional attainment and maintenance of standards after 2000. TSP concentrations in the region outside the metropolitan area will likely remain near or below the Federal primary and State annual geometric mean standard during the entire period of 1981 through 2000.

Table IV-35

FUTURE-WITHOUT CONDITION
TOTAL SUSPENDED PARTICULATES[a]

Site Area	1981-2000 (est. ann. geometric mean concentrations in ug/m^3)
Stewart Mountain	50 - 75
Cliff	35 - 60
New Roosevelt	35 - 60
Confluence	50 - 75
New Waddell	40 - 65
Downstream	
Country Club to 35th Ave.	100 - 140
91st Ave. to Gillespie Dam	60 - 75

[a]Federal and State annual geometric mean standard is 75 microgram per cubic meter (ug/m^3).

(b) Plans 1 and 2

With regard to the Cliff site, any points of public access within 1/2 mile of construction sites may have increases in ambient TSP concentrations of approximately 55 ug/m^3. Beyond 1/2 mile the impact should be less than 55 ug/m^3.

Within approximately 1/4 mile of the construction areas at the New Roosevelt site, public access areas may have increases in ambient TSP concentrations of about 50 ug/m^3 due to construction activity. At distances greater than 1-1/2 miles the increases should be less than 35 ug/m^3.

Within about 1/2 mile of the Stewart Mountain construction sites, areas of public access may have increases in ambient TSP concentrations of about 25 ug/m^3 or more due to construction activity. At distances greater than one mile the increases should be less than 15 ug/m^3.

(c) Plan 3

Impacts related to TSP would be the same as for Plans 1 and 2 with the addition of impacts from the Confluence site. At the Confluence site, public access areas within approximately 1-1/2 miles of construction areas may have increases in ambient TSP concentrations of 30 to 70 ug/m^3 due to construction activity. Beyond 1-1/2 miles the increases should be less than 30 ug/m^3.

(d) Plans 6 and 7

Impacts related to TSP would be the same as for Plans 1 and 2 with the addition of impacts from the New Waddell Site. At the New Waddell site, public access areas within approximately 1/2 mile of construction areas may have increases in ambient TSP concentrations of 25 to 70 ug/m^3 due to construction activity. Beyond 1-1/2 miles the increases should be less than 25 ug/m^3.

(3) Mitigation

The effect of air quality impacts is considered. Significant Adverse for all plans. Effects may be reduced to Insignificant if mitigation measures in the form of dust suppression are applied. Dust suppression may be accomplished through the use of any or all of the following: paving; chemical stabilization; watering; speed control; covering; vegetation; gravelling unsurfaced roads; and wind breaks.

(4) Residual Impacts

The only residual TSP impacts that are expected to result from plan implementation are those related to increased vehicular activity in excess of the existing condition. Such impacts would be secondary TSP impacts that cannot be quantified at this time.

(5) Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

Construction impacts for a modified dam at Roosevelt or Stewart Mountian would be the same as the new dam option except construction

activities for a modified dam would be shorter in duration and require less area. N long-term impacts have been identifed for either option. Therefore, there is no significant difference in impact at either location for air quality.

b. Aesthetics

(1) Types of Impacts to Visual Quality

Impacts on the visual quality of affected site areas are described as changes in land composition. For purposes of impacts and effects analysis Visual Quality Zones (VQZ) have been identified which indicate the aesthetic condition of the areas.

(2) Direct and Indirect Impacts

(a) Plan 8

Visual quality of the site areas will not change significantly from the existing condition. Quality of the site areas is expressed in terms of the number of acres of visual quality zones, with VQZ 1 being highest quality, VQZ 2 average quality, and VQZ 3 lowest quality. Acreages are shown on the Table IV-36.

Table IV-36

ACREAGE OF VISUAL QUALITY ZONES IN FUTURE WITHOUT PROJECT

	VQZ1	VQZ2	VQZ3	TOTAL
Cliff	13,170	17,428	22,192	52,790
Roosevelt	23,973	50,396	6,601	80,970
Confluence	25,443	35,466	9,491	70,400
New Waddell	16,590	24,490	0	41,080
Aggregate	79,176	127,780	38,284	245,240

(b) Plan 1

With the implementation of Plan 1, there would be a gain of 7,500 acres of VQZ 1 (highest quality), a loss of 4,100 acres of VQZ 2 (average quality), and a loss of 3,400 acres of VQZ 3 (lowest quality). Most of the beneficial changes occur at the Cliff site area. Although flowing stream would be lost at Cliff additional public access would be provided by new recreation access areas, and a major gain would occur in acres of riparian vegetation. The effect of these impacts is considered Significant Beneficial.

(c) Plan 2

With the implementation of Plan 2, there would be a gain of 4,000 acres of VQZ 1 (highest quality) and a loss of 4,000 acres of VQZ 2 (average quality). These changes indicate a shift from lower quality visual resources to higher quality visual resources. Most of the

beneficial changes occur at the Roosevelt site area as a result of increases in riparian vegetation. The effect of the impacts is considered Significant Beneficial.

(d) Plan 3

With the implementation of Plan 3 there would be a net gain of 900 acres of VQZ 1, a net loss of 3,500 acres of VQZ 2, and a net gain of 2,600 acres of VQZ 3. Most of the adverse change would occur at the Confluence site area where 7,000 acres of VQZ 1 would be lost due to the loss of flowing river and streamside vegetation. Although Roosevelt and Cliff site areas would experience beneficial changes due to increases in riparian vegetation and additional public sensitivity due to new recreation access areas, the overall effect on visual quality is considered to be Significant Adverse because of the major loss of VQZ 1 at the Confluence site area.

(e) Plans 6 and 7

With the implementation of Plan 6, there would be a net gain of 7,600 acres of VQZ 1, a loss of 4,200 acres of VQZ 2, and a loss of 3,400 acres of VQZ 3. The overall effect of these impacts is considered Significant Beneficial.

(f) Plan 7

With the implementation of Plan 7 there would be a gain of 10,600 acres of VQZ 1, a loss of 7,200 acres of VQZ 2, and a loss of 3,400 of VQZ 3. Most of the beneficial changes occur at the Roosevelt

site area due to increases in riparian vegetation. The effect of these impacts is considered Significant Beneficial.

(3) Mitigation

The overall impact of Plan 3 on visual quality includes adverse impacts on flowing stream, loss of riparian vegetation, and drawdown, especially at the Confluence area. These impacts, to a large degree, cannot be mitigated. Tree planting is not effective when a constant water level cannot be maintained. No mitigation is required for Plans 1, 2, 6, and 7.

(4) Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans

Construction impacts for a modified dam at Roosevelt or Stewart Mountain would be the same as teh new dam option except construction activities for a modified dam would be shorter in duration and require less area. Operational impacts would be the same at Roosevelt or Stewart Mountain because lake elevations, size, and changes in visual quality zones would be identical for a new structure or modified dam. Therefore, there is no significant difference in impact at either location for visual quality.

c. Noise

(1) Types of Impacts to Noise

Noise impacts are described as construction or short-term impacts, and operational or long-term impacts. Impacts are measured by decibel (dB) changes in the ambient day-night sound level (L_{dn}) at each of the affected site areas. The U.S. Environmental Protection Agency has

suggested an annual L_{dn} of less than 55 dB as being requisite to protect public health and welfare. Recent EPA strategy calls for a short-term goal in which the L_{dn} should not exceed 65 dB in residential and recreational areas or other outdoor areas in which quiet is the basis of use.

Impact analysis has been restricted to noise-sensitive areas where potential impacts would occur. For example, only those areas where existing sound levels are below a day-night sound level (L_{dn}) of 65 dB and which would experience an increase in the ambient L_{dn} exceeding 10 dB due to project construction or operations have been assessed.

Construction activities at each of the dam sites will generally occur in open areas and away from noise-sensitive receptors; although some cases of noise impact may occur (people or wildlife affect by noise)

(2) Direct and Indirect Impacts

(a) Plan 8

Little or no change in the Cliff site ambient sound environment is expected by the year 2000. Day-night sound levels are expected to remain below 55 dB.

At the Roosevelt site area, developed recreational facilities and new facilities will generally be anticipated to result in increases in the day-night sound level to between 55 and 65 dB. The L_{dn} would comply with the EPA's short-term goals for residential and noise-sensitive recreational areas.

At the Confluence site, continued growth in population in the communities of Fountain Hills, Fort McDowell, Rio Verde, and Goldfield Estates will cause an increase in the ambient sound levels to between 35 and 70 dB. Most noise-sensitive receptors will continue to experience L_{dn} below 65 dB; however, the number of residents experiencing sound levels between 55 and 65 dB will increase significantly.

Little or no change in the ambient sound quality environment at the New Waddell site is expected. The day-night sound levels are expected to remain below 55 dB.

(b) Plans 1 and 2

Construction activities at Cliff Dam are anticipated to result in insignificant noise impacts with the relocation of recreational facilities and residents near the existing Horseshoe Dam prior to construction. Upon completion of construction, no significant change from existing or future-without sound levels is anticipated. Day-night sound levels would remain below 55 dB.

Construction activities at Roosevelt Dam and borrow pits would occur and within less than 1/4 mile of the community of Roosevelt. The sound levels anticipated during construction at these two sites could be as high as 71 dB during peak periods of construction. Upon completion of construction, no significant change from future-without sound levels is anticipated.

Construction activities at the Stewart Mountain Dam are anticipated to result in insignificant noise impacts with the relocation of the nearest noise sensitive receptors prior to construction. Upon completion of construction, no significant change from existing or future-without sound levels is anticipated.

In summary, Plans 1 and 2 would result in localized temporary increases in noise levels at the Cliff and Roosevelt sites during construction. The effect of these impacts is considered Insignificant.

(c) Plan 3

In Plan 3 impacts at Cliff and Roosevelt are combined with impacts at the Confluence site.

Construction activities for the Confluence Dam would occur away from local receptors and would therefore result in insignificant noise impacts. Upon completion of construction no significant change from future-without conditions is anticipated.

The effect of these impacts is considered Insignificant.

(e) Plans 6 and 7

In Plan 6 construction noise impacts in the area of the New Waddell Dam would be insignificant.

Upon completion of construction, no significant change from existing sound levels is anticipated due to the minimal

development within the primary or secondary acoustical study areas. Day-night sound levels would remain below 55 dB.

The effect of these impacts is considered Insignificant.

(3) Mitigation

Because of the generally insignificant effect of noise associated with CAWCS plans, no mitigation is recommended.

(4) Residual Impacts

There are no residual impacts since no mitigation is proposed.

(5) Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans.

Construction impacts for a modified dam at Roosevelt or Stewart Mountain would be the same as the new dam option except construction activities for a modified dam would be shorter in duration and require less area. Operational impacts would be the same at Roosevelt or Stewart Mountain for a new structure or modified dam. Therefore, there is no significant difference in noise impact at either location.

d. Geology/Soils

(1) Types of Impacts to Geology/Soils

Impacts of CAWCS plans on geology and soils focus on mineral resources, primarily sand and gravel, and on prime farmland. Impacts

to mineral resources were measured in terms of surface acres enhanced by reduced flood levels or lost as a result of acquisition and inundation. Impacts to prime farmland were measured by acres lost for construction and operation of a plan.

(2) Direct and Indirect Impacts

(a) Plan 8

With Plan 8, the "future without" condition assumes that mining of sand and gravel in the Verde-Salt-Gila channel area will occur on approximately 570 surface acres on the Fort McDowell Indian Community and on portions of approximately 17,725 surface acres within the Salt-Gila River channel (primarily on the Salt River Indian Community, in the Salt River channel, and along the Gila River). In these areas, mining is expected to occur where suitable material is found, where mining is compatible with surrounding land use, and near areas where the greatest urban development is anticipated.

Mining of sand and gravel within the study area is anticipated to yield nearly 22 million short tons for the year 2000. Approximately 19 million short tons were extracted in 1980 (CAWCS, Regional Future Without the Project).

Prime farmland by the year 2000 is expected to include approximately 16,385 acres in affected areas: 15,065 acres in the downstream area, 130 acres in the Cliff site area, 1,120 acres in the Confluence site area, and 70 acres in the New Waddell site area.

Within the CAWCS study area, there are an estimated 620,000 acres of prime farmland (1980 value). By the year 2000 it is projected that there will be approximately 589,000 acres. In general, there will be an increase in prime farmland acreage on the Indian reservations and a decrease on non-Indian lands, primarily as a result of urban growth.

(b) Plans 1,2,3,6,7

Plans 1,2,3,6, and 7 have impacts on the sand and gravel deposits in the Verde-Salt-Gila Rivers area. Nearly all of the 18,295 surface acres of known and potential sand and gravel resource is currently subject to losses from major flooding. The impacts and effects of alternative plans are summarized in Table IV-37.

Adverse impacts to prime farmland result from loss of acreage during construction and/or operation of a project. Downstream impacts to prime farmland were not evaluated because of the uncertainty of land use changes as a result of increased flood control. The end result of this protection may be the conversion of agricultural lands to industrial, commercial, or recreational uses. Table IV-38 shows the impacts and effects of plans to prime farmland.

(3) Mitigation

In Plan 3, approximately 190 surface acres of known and potential sand and gravel deposits on the Fort McDowell Indian Community would be acquired for the project and inundated during operation. A mitigation policy which would allow mining operations to continue beyond the limits

Table IV-37

SUMMARY OF IMPACTS TO SAND AND GRAVEL DEPOSITS ON VERDE-SALT-GILA RIVERS

Plan	Impact/Mitigation	Effect Unmitigated/Mitigated
1	3,120 surface acres enhanced by reduced flood levels; 15,175 surface acres unaffected by project. No mitigation necessary.	Significant Beneficial/ Significant Beneficial
2	1,350 surface acres enhanced by reduced flood levels; 16,945 surface acres unaffected by project. No mitigation necessary.	Significant Beneficial/ Significant Beneficial
3	3,120 surface acres enhanced by reduced flood levels; 190 surface acres acquired for project; 14,985 surface acres unaffected by project. Mitigation plan negates loss of 190 surface acres.	Significant Beneficial/ Significant Beneficial
6,7	3,120 surface acres enhanced by reduced flood levels; 15,175 surface acres unaffected by project. No mitigation necessary.	Significant Beneficial/ Significant Beneficial

Table IV-38

SUMMARY OF IMPACTS TO PRIME FARMLAND

Plan	Impact/Mitigation	Effect Unmitigated/Mitigated
1,2	130 acres of prime farmland at Cliff site acquired for project. On site mitigation is not possible.	Significant Adverse/ Significant Adverse
3	850 acres of prime farmland acquired for project (130 acres at Cliff site, 720 acres at Confluence site). On site mitigation at Cliff site not possible. Mitigation at Confluence site could reduce loss of 720 acres to 350 acres; mitigation of total loss is not possible.	Significant Adverse/ Significant Adverse
6,7	130 acres of prime farmland at Cliff site acquired for project. On site mitigation is not possible. Prime farmland acreage within New Waddell site area boundary is not affected by the project.	Significant Adverse/ Significant Adverse

of the Confluence maximum storage pool would reduce loss of on-site resources from 33 percent to 27 percent. Increasing sand and gravel production capabilities at the Fort McDowell Indian Community may require Federal assistance for equipment, market development, and other related items.

Historically there has not been a policy for mitigation of environmental losses of prime farmland. However, on-site losses could be minimized if additional acreage of prime farmland were brought into agricultural production as a replacement for the acreage lost. With Plans 1,2,6, and 7 on-site mitigation of prime farmland losses is not possible. With Plan 3, some prime farmland acreage loss could be prevented if a policy was established allowing acreage outside of the Confluence maximum storage pool to remain under agricultural production.

(4) Residual Impacts

Unmitigatable losses of prime farmland occur at the Cliff site (130 acres) and at the Confluence site (350 acres). Loss at Cliff is a residual impact of all plans. Loss at Confluence site occurs in Plan 3.

(5) Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans.

Impacts would be the same for New or Modified Roosevelt or Stewart Mountain because lake elevations, size; storage allocations, and level of flood control would be identical for a new structure or modified dam. Therefore, there is no significant difference in impact at either location for geology/soils.

e. Land Resources

(1) Types of Impacts to Land Resources

The land resource analysis focuses on two factors: impacts on adjacent land resources (land use compatibility), and impacts of potential secondary development opportunities and induced land use changes of regional significance (land use conversions). Complex site-specific land ownership and institutional decisions and agreements will be required once the preferred plan has been selected and detailed engineering plans have been completed.

(2) Direct and Indirect Impacts

(a) Plan 8

The CAWCS no-action alternative, Plan 8, will not provide any additional increment of flood protection to areas within the Agua Fria, Verde and Salt/Gila River floodplains, and thus will limit or prohibit the implementation of proposed plans such as the Rio Salado Development District, Sky Harbor International Airport Expansion, and the Maricopa County Flood Control District channel maintenance program.

As the Phoenix metropolitan area expands outward, considerable development will likely occur on presently vacant lands and agricultural lands located outside of the 100-year floodplain. However, the land use patterns of the Gila River floodplain below the Salt/Gila confluence will most likely remain essentially as agricultural/conservation open space

areas, with development opportunities generally prohibited by possible flood flows from the Salt and Gila Rivers and their uncontrolled tributaries.

The predominantly open space desert characteristics of the Cliff area are expected to be maintained in the future given present U.S. Forest Service land management plans and policies. Additionally, lands along the Verde River corridor immediately north of the existing Sheep Bridge near Hot Springs have been determined to meet criteria for possible Congressional designation as a wild and scenic river. Through the Tonto National Forest the Verde floodplain is likely to continue to remain as an open space area primarily used for recreational, conservation, and livestock grazing purposes (U.S. Forest Service, Tonto National Forest).

Roosevelt Lake is the largest water body in the CAWCS study area. The recreational facilities at Roosevelt Lake are expected to increasingly serve regional recreational demands.

Developments which are expected to occur in the Confluence area include the continued development of the Fountain Hills, Rio Verde, and Goldfield Estates urban areas; the construction of some additional U.S. Forest Service recreational facilities and upgrading of access routes near the Blue Point Bridge on the Lower Salt River; and, the development of approximately 5,000 acres of irrigated agricultural lands and the establishment of sand and gravel mining operations at five locations on the Fort McDowell Indian Community. The Salt River Indian Community also has conceptual plans for commercial recreation developments extending from the Confluence site to south of Granite Reef Diversion Dam. The presently

unincorporated area immediately south of the Tonto National Forest between Granite Reef Diversion Dam and the Superstition Mountains is likely to be urbanized as part of the City of Mesa.

Several public- and private-sector plans have been proposed within the Lake Pleasant vicinity. Such plans include State acquisition of selected BLM lands with eventual disposition planned to private developers; City of Peoria annexation of State trust lands for future development; and, the Cities of Phoenix and Glendale are considering alternative locations for a new water treatment plant to deliver CAP municipal and industrial water. Residential and electronic/engineering industrial development are also being considered in the Lake Pleasant vicinity.

(b) Plan 1

Land use compatability assessments for the alternative action plans are based on four major assumptions:

- Land areas encompassed within the surcharge space at the reservoirs will be managed as open space with natural habitat land cover;

- All construction-related sites will be completely reclaimed as stated in the plan descriptions;

- Present Congressional, U.S. Forest Service, Indian and local governmental land management and conservation policies will remain relatively unchanged for national forests, Indian reservations and regional parks through the next century; and

- Any future developments on adjacent private lands will be planned and implemented in accordance with contemporary zoning and environmental regulations so as to minimize the formation of any potential incompatible land use patterns.

The implementation of Plan 1 would likely result in only insignificant modifications to the existing land use compatibility of parcels located adjacent to the maximum storage pools. Almost all of the parcels adjacent to the proposed reservoirs are classified as mostly compatible open space desert rangelands within the Tonto National Forest. The effect of Plan 1 on land use compatability is considered Insignificant.

No significant land use conversions are expected as a result Cliff, Roosevelt, and Stewart Mountain Dams because these areas are almost exclusively public lands located within the Tonto National Forest.

Plan 1 would limit 100-year flows in the Salt River channel to 55,000 cfs at the Sky Harbor International Airport. This 100-year level of flood protection would protect approximately 6,219 acres of land located in the present floodplain thereby creating several opportunities for land conversations and redevelopment of adjacent parcels along the Salt River corridor through the Cities of Mesa, Tempe and Phoenix.

At Sky Harbor International Airport the 1,100-foot reconstruction of the eastern part of the southern runway destroyed during the three recent floods is scheduled in 1983. Plan 1 would provide adequate permanent flood protection required for the reconstructed runway (City of Phoenix).

Also at Sky Harbor, the concept of constructing a third 9,000-foot parallel runway requiring the relocation or channelization of a segment of the Salt River has been proposed.

None of the CAWCS alternative plans would create additional land development/land conversion opportunities in floodplain areas downstream of the Salt/Gila confluence nor would they provide an adequate level of permanent flood protection to preclude the need for Maricopa County Flood Control District's to develop and maintain a cleared (from phreatophytic vegetation) and graded 1,000-foot-wide corridor within the floodway of the Salt and Gila Rivers from 91st Avenue to Gillespie Dam (Maricopa County Flood Control District, U.S. Fish & Wildlife Service).

The effects of land use conversion impacts have been assessed as Significant Beneficial for Plan 1.

(c) Plan 2

The land resources impacts of Plan 2 are the same as Plan 1, with the following exceptions for land conversions.

Plan 2 is a limited structural plan, and would provide flood control of the 100 year event to 150,000 cfs, rather than 55,000 cfs, at Sky Harbor Airport; thereby protecting approximately 2,248 acres of land located in the present floodplain. Implementation of Plan 2 would not enhance development opportunities in the vicinity of any of the proposed dam sites.

An Insignificant effects value has been assigned to identified land conversion impacts of Plan 2.

(d) Plan 3

Land resources impacts of Plan 3 are the same as Plan 1 with the addition of impacts at the Confluence site.

At the Confluence site some adjacent residential parcels would periodically overlook reservoir drawndown areas. Also, new recreational facilities could complement the planned Goldfield Estates Residential Community. Overall, the effect of land use compatability impacts of Plan 3 is considered Insignificant.

Under Plan 3, the Confluence Dam and Reservoir would necessitate the acquisition of approximately 9,460 acres of Fort McDowell and Salt River Indian reservation lands and would preclude the planned development of irrigated agricultural lands and planned sand and gravel mining operations on the Fort McDowell Indian Community.

On privately owned lands, the anticipated rate of urban development could be slightly accelerated. Also, some limited urban development could potentially occur on approximately 1,200 acres of adjacent State trust lands. In total, the effect of land use conversions in Plan 3 is considered Insignificant.

(e) Plan 6

The impacts of Plan 6 are the same as Plan 1, with the following additions.

Implementation of Plan 6 may permit or accelerate urbanization of the northern and western sectors of the greater Phoenix metropolitan area. This is because of a locational advantage offered by storage of CAP water intended for municipal and industrial purposes at the New Waddell site instead of storage at the Confluence, Cliff or Roosevelt sites.

Implementation of the proposed larger New Waddell Dam and Lake Pleasant Reservoir under Plan 6 would necessitate the acquisition of approximately 1,350 acres of privately owned lands, 400 acres of Bureau of Land Management National Resource Lands, and 2,050 acres of Arizona State Land Department trust lands.

Also, under Plan 6 no land conversion opportunities are likely within the 35-mile segment of the Agua Fria River floodplain between the existing Waddell Dam and the Agua Fria/Gila River confluence because the New Waddell Dam would provide only incidental additional downstream flood protection.

Overall, the effect of Plan 6 for land use conversions is considered Significant Beneficial.

(f) Plan 7

Plan 7 is the same as Plan 6 except that it would provide approximately 30,000 af per year of water for the Rio Salado Development District. Because of this, the effect of Plan 7 for land use conversions is considered a Beneficial Flag.

(3) Mitigation

Because of the generally insignificant and/or beneficial effects of CAWCS plans, no mitigation is recommended.

(4) Residual Impacts

There are no residual impacts since no mitigation is proposed.

(5) Impacts with Modified Roosevelt and Modified Stewart Mountain Dams in Plans.

Impacts would be the same at Roosevelt or Stewart Mountain because lake elevations, size; storage allocation, and land use and ownership would be identical for a new structure or modified dam. Therefore, that there is no significant difference in impact at either location for land resources.

C. Cumulative Impacts of Plan 6

Cumulative impacts are changes in the environment which result from the incremental impact of implementing the proposed action (Plan 6) when added to other past, present, and reasonably foreseable future actions. Cumulative impacts result from individually minor but collectively significant actions taking place over the next several decades.

1. Future Actions in the CAWCS Area

In general, future environmental conditions within the CAWCS area will be driven by man's activities. As the population base of the study area grows, additional public services will be demanded, transportation systems will require expansion and changes in the use and ownership of land resources will occur. The expanded population base will require increasing quantities of energy supplies. Consequently, population and economic growth implicity assume a full range of public service delivery system requirements. These man-induced requirements will directly influence natural surroundings and regional environmental conditions. Environmental problems typically associated with growth include poorer air quality, loss of natural habitat areas, overcrowding at developed recreational facilities, degradation of water quality, and deterioration in cultural resources (see Regional Future Without the Project, CAWCS, 1981)

Several non-CAWCS actions are likely to occur in the immediate future:

a. Population of the CAWCS area is projected to increase from 1,582,000 in 1980 to 2,571,000 in 2000, a gain of 63 percent. Density will climb from 123 persons per square mile to about 200 persons per square mile over the same period. Municipal and industrial water use requirements for the additional population will be about 168,000 acre-feet of water by 2000. According to the Arizona Department of Water Resources, water will be available to adequately support the projected future population and economic growth.

b. The Central Arizona Project (CAP) aqueduct will deliver Colorado River water to central Arizona municipal, industrial, and agricultural users, and Indian tribes by 1985. The salinity of CAP water delivered to the CAWCS area will not increase above 1972 Colorado River salinity levels due to implementation of the Colorado River Water Salinity Stabilization Program. Delivery of CAP water to agricultural users will tend to maintain prime farmland in areas where extreme overdraft of groundwater occurs.

c. Promulgation of Arizona's Groundwater Management Act (1980) will lead to a safe water yield by 2025 in all designated Active Management Areas.

d. Salt River Project will modify existing dams and/or spillways and construct new dams near existing ones on the Salt and Verde Rivers. In addition, hydroelectric facilities will be added at some of SRP's structures.

e. Treated effluent from wastewater treatment plants described in the MAG 208 Water Quality Management Program plan will be reused. The Palo Verde Nuclear Generating Station and the Buckeye Irrigation District will be

major users of treated effluent, with the Gila River and Salt River Indian Reservations also being potential users. Smaller quantities of treated effluent will be used for golf courses, parks, and nonedible crops.

f. Sand and gravel mining will continue in the floodplain of the Salt River. The demand for aggregate materials will be largely dictated by construction industry trends.

g. Endangered species recovery programs will be implemented by the U.S. Fish and Wildlife Service. Remaining flowing reaches of the Salt and Verde Rivers will likely be designated as "critical habitat", and threatened and endangered species reintroduction sites will be established by the U.S. Forest Service and Arizona Game and Fish Department. There will be an increase in special use and rehabilitation sites for cottonwood and willow along the Salt and Verde Rivers to improve bald eagle habitat and productivity.

h. In the Gila River channel, riparian vegetation will be cleared periodically by the Maricopa County Flood Control District.

i. Alternative D of the Forest Service's Lower Salt River Recreation Area Plan will be implemented. This plan provides for recreation development along 12 miles of the lower Salt River on the Tonto National Forest. It features a transport system to facilitate on-ground movement of river floaters, dispersed use areas via trails, new picnic areas and concessions, and establishment of critical wildlife habitat. Major erosion control, river bank stabilization and vegetation rehabilitation projects would also be initiated.

j. Some form of the Rio Salado concept will be implemented, depending upon the level of upstream flood control and flows in the Salt River through the Phoenix area which are provided.

k. Approximately 80 additional surface acres of water is projected to be developed for recreational purposes.

2. Cumulative Impacts

Implementation of the proposed action, along with the foregoing actions, will foster changes on the local environment. These incremental changes are discussed for each factor or discipline.

a. Biological Resources

In addition to project-induced losses of biological resources, human encroachment on wildlife and habitat will increase in the future in all site areas as a result of increased recreational use of the sites and the development of access and facilities. If the Rio Salado concept is implemented, there will likely be an increase in riparian vegeta tion and urban fisheries in the downstream area.

Wildlife protection and recovery programs will enhance the propagation and productivity of threatened and endangered species. Construction and operation of the CAP aquaduct will not have a significantly adverse impact on biological resources.

b. Water Quality

Water quality is site-specific and fluctuates on both an annual and long-term basis. Changes in water quality constituents will occur in the New Waddell Reservoir as a result of mixing CAP water with local surface waters in the regulatory storage reservoir. The quality of CAP water, either from regulatory storage or directly from the Colorado River, which is delivered to agricultural and municipal users will be different from the quality of currently used groundwater or local surface waters. CAP water could have either higher or lower quality for specific constituents than local supplies.

The State of Arizona has a law which prohibits degradation of designated surface water bodies, many of which are in the CAWCS study area. For this reason it is presumed that surface waters will maintain a quality similar to their existing quality. However, there may be isolated instances of general degradation of water quality within the study area. Over the long run water quality in the CAWCS area is expected to be slightly poorer than at present.

c. Recreation

Demands on recreational facilities in all site areas will increase. Although participation rates in regional recreation activities are assumed to remain constant, the number of recreationists is forecast to increase considerably.

New recreation facilities will be developed at Cliff, Roosevelt, and New Waddell. In addition, recreation facilities will probably be

planned in the downstream area of the Salt River if elements of the Rio Salado development concept are implemented. U.S. Forest Service's Lower Salt River Recreation Area will provide expanded recreational facilities upstream of the Confluence area.

d. Cultural Resources

In addition to impacts caused by implementation of Plan 6, prehistoric resources will continue to be altered by natural and human-induced factors. Natural deterioration results from animal burrowing, plant growth, and erosion. The majority of site destruction and alteration will occur as a result of expanded development. Vandalism of sites will increase where new roads and recreational access are provided. Management and protection of prehistoric resources will likely increase on federal lands as a result of legislation and increased patrolling of recreational visitors.

In addition to potential impacts to Roosevelt Dam and the Verde River Sheep Bridge as a result of Plan 6, historic resources will be affected by other factors in the future. Within the site areas, increased recreational development will increase vandalism of historic resources. Ranching leases in the Cliff and Roosevelt areas may impact historic resources. In the downstream area, historic resources will be affected or destroyed by development along the Salt and Gila Rivers. The loss of historic resources to urban development and vandalism will be offset somewhat by improved management practices, particularly on federal and state lands, and by legal sanctions. More historic properties will be declared eligible for inclusion in the National Register, ensuring some protection and data recovery as a result of federal actions.

e. Social Resources

Impacts of relocation are a result of project implementation. These impacts may be altered by factors such as the locations to which people are relocted and concomitant changes in lifestyle. Assuming that the mitigation recommendations outlined in this report are implemented, the lifestyle of relocated families would not change significantly. A rural lifestyle will be possible in the future since no additional development is expected on federal lands in the site areas. Increased visitor use of recreational resources and facilities may be viewed by some residents as an encroachment.

Cumulative social impacts of flood reduction for downstream areas include reduced stress and inconvenience associated with flooding. The threat of evacuations will be eliminated, and reduced property damage may improve the economic situation of families living in flood-prone areas. Upstream flood control in combination with the Maricopa County Flood Control District Gila channel clearing program will eliminate major flood-related problems for the Holly Acres and Buckeye areas. The construction of new bridges will eliminate transportation congestion across the Salt River. The economic base of downstream areas will improve as a result of increased land values in former floodplain areas.

f. Economics

Because economic impacts are calculated based on changes in the national economy, cumulative economic impacts relative to Plan 6 have already been considered in the impact analyses.

g. Air Quality

Increased use of recreation facilities and resources in the site areas will cause an increase in vehicular emissions and TSP. While these emissions are not quantifiable at this time, no federal or state standards are likely to be violated. In general, the metropolitan Phoenix area will remain a non-attainment area for TSP; CO standards are expected to be achieved.

h. Aesthetics

The visual character of the areas will not change significantly after project implementation. Reservoir drawdown will likely cause the most significant visual impact in the site areas in the future.

i. Noise

No significant change in sound levels is expected in any of the site areas. Although sound levels would increase as a result of increased recreational use of the sites, day-night sound levels would generally remain compatible with EPA's goals for residential and noise-sensitive recreational areas.

j. Geology/Soils

Indian lands in the Confluence area will be designated as prime farmland. It is possible that regulations to protect prime farmland could be adopted in the future; however, an overall loss of prime farmland is expected in the study area due to conversion of agricultural lands to urban uses.

Sand and gravel mining operations in the downstream area and on the Fort McDowell Indian Reservation will expand moderately and generally emulate construction industry trends. Sand and gravel deposits will be enhanced by reduced flood levels.

k. Land Resources

With the exception of the downstream area, land in and around the site areas will remain predominately in public ownership. Increased land use conversions for potential implementation of Rio Salado and other developments will occur within and outside of the 200-year floodplain in downstream urban areas; land use downstream from the Gila-Salt Confluence will remain agricultural and open-space. The Roosevelt site area will experience some increased recreational and residential development. There will be development around the New Waddell site such as the John F. Long solar housing development and Biscuit Flats complex. In the Confluence area some additional U.S. Forest Service recreational development will occur, residential communities such as Fountain Hills and Rio Verde will continue to expand.

D. Energy Requirements and Conservation for Plan 6

Energy required for the operation of Plan 6 is electricity, allocated to the Central Arizona Project from the Navajo Generating Station. Energy will be required to pump water through the CAP aquaduct from the Colorado River and from the aquaduct into the regulatory storage reservoir at New Waddell. Hydroelectric energy will also be produced by the operation of Plan 6, by generating facilities which will use water as it is released from the

reservoirs. The net energy consumption of Plan 6 is 145 gigawatt hours (GWH = one billion watts) per year over the life of the project.

There is no net energy conservation associated with Plan 6; however, the energy management capability provided by regulatory storage for the CAP would allow coal-fired electricity to be substituted for electricty produced by higher priced oil and natural gas. This would be achieved by using Navajo Generating Station power (coal-fired) to pump water into storage during off-peak periods, such as winter months or at night. The peak period power which is not used by the CAP would be sold to other users, who would replace oil and gas-fired electricity with Navajo power. The energy which could be shifted from peak periods to off-peak periods in Plan 6 is 369 GWH per year; this includes power produced by the hydropower facilities included in the plan.

E. Relationship Between Short-Term Uses of the Environment and Long-Term Enhancement for Plan 6

Plan 6 would increase CAP yield by 142,500 af per year, would control a 200-year flood event to 92,000 cfs at Sky Harbor Airport, and would ensure the structural safety of existing dams on the Salt and Verde Rivers. The long-term effects of Plan 6 would be more efficient management of the CAP system, an increase in the amount of Colorado River water imported to central Arizona and concomitant reduction in groundwater use, and a level of flood control for metropolitan Phoenis which would substantially reduce or eliminate major property damage and transportation disruptions.

Short-term disturbances to the environment would occur during construction of the dams in Plan 6 as discussed in section A of this chapter. Long-term impacts would also result from implementation of the plan. Land required for the structures, reservoirs, and rights-of-way would not be available for other uses during the life of the project. Other long-term impacts would include the loss or alteration of environmental resources required for construction or operation of the project, and impacts to people relocated as a result of the project.

Table IV-39 summarizes the short- and long-term impacts associated with Plan 6. Short-term impacts are assumed to occur immediately or during construction of the project, and long-term impacts would result over the life of the project (100 years) or permanently.

Table IV-39

RELATIONSHIPS AND TRADEOFFS BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM ENHANCEMENT

Resource	Short-Term	Long-Term	Tradeoffs
Riparian & Wetland Communities	Loss of high-quality cottonwood-willow, mesquite and cattail habitat, los of habitat for important Arizona wildlife.	Gain of riparian vegetation primarily mixed-scrub and salcedar-mesquite.	High quality resources traded for a gain in lower quality resources. No enhancement.
Other Terrestrial Communities	Loss of desert upland vegetation such as paloverde-mixed cacti habitat.	Same.	Loss of vegetation traded for increased water storage capacity. No enhancement.
Perennial Stream/ Riverine Communities	Disruption of perennial stream and riverine habitat due to erosion and high turbidity.	Gain of 1 mile of perennial stream. instream flow would remain 50 cfs.	Enhancement would occur if guaranteed 200 cfs instream flows are provided; remaining riverine communities would be improved.
Reservoir Aquatic Communities	Disturbance of reservoir communities during construction.	Gain of 370 acres of reservoir habitat, and guaranteed minimum pool for fisheries at New Waddell.	Short-term disruption traded for gain in habitat quantity. No enchancement of habitat quality.

Table IV-39 (continued)

Resource	Short-Term	Long-Term	Tradeoffs
Threatened & Endangered Species	Possible loss of breeding productivity in bald eagle breeding areas during construction.	Loss of bald eagle preferred habitat.	Habitat management programs would improve quality and restrict accessibility of remaining bald eagle habitat, and may improve productivity.
Special Use & Management Areas	Loss of riparian habitat rehabilitation sites in Cliff area, loss of rangeland (AUM's).	Loss of riparian habitat rehabilitation sites at Cliff, implementation of riparian and rangeland rehabilitation programs in Confluence & Roosevelt areas.	Rehabilitation sites at Cliff traded for additional management sites at Confluence and Roosevelt. Enhancement expected in site-specific areas.
Water Quality	Increased turbidity and sedimentation from construction-related activities.	Changes in the average level of water quality constituents in CAP and MCMWCD#1 water supplies, increased potential for reservoir entrophication, increased potential for THM production.	Change in quality of local water supplies is traded for increased supply, reliability of supply during peak use periods, and reduction of groundwater pumping. No enhancement.
Stream-Oriented Recreation	Existing recreation except resources and facilities would be disrupted or eliminated as a result of construction.	Increase of 43,398 maximum annual recreation days and development of additional facilities for swimming, camping, & picnicking; loss of 1 stream mile.	Short-term disturbance of recreational facilities and activities and loss of stream traded for increased stream-oriented facilities.

Table IV-39 (continued)

Resource	Short-Term	Long-Term	Tradeoffs
Reservoir-Oriented Recreation	Existing recreation facilities would be disrupted or replaced during construction.	Increase of surface acres of water during the recreation season and gain of recreation days for boating, camping, picnicking, and swimming.	Short-term disturbance of recreational facilities and loss of boat-fishing resources at Cliff traded for increased resources facilities at Roosevelt and New Waddell. Enhance-would occur.
Prehistoric Resources	Sites destroyed or altered by construction activities; documentation and data recovery of selected sites prior to construction.	Sites destroyed or altered as a result of construction, operation and increased site visitation; collected information and and artifacts preserved but sites lost for further study.	Future research potential and existence of sites traded for immediate site documentation and data collection. No enhancement.
Historic Resources	Roosevelt Dam and other sites destroyed or altered by construction acitivties; documentation and data recovery of sites prior to construction.	Sites on or eligible for inclusion on the National Register of Historic Places destroyed, altered, or impaired; loss of public educational/recreational value of sites.	Future research potential and existence of sites traded for immediate site documentation and data collection. No enchancement.

Table IV-39 (continued)

Resource	Short-Term	Long-Term	Tradeoffs
Social	People relocated from around Roosevelt Lake and from KA Ranch.	Decrease in personal autonomy, satisfaction with lifestyle, self-sufficiency, and community cohesion. Increase in mortality and illness rates for relocatees; illimination of or reduction of flood-related problems for residents downstream floodplain.	Relocation of upstream residents traded for flood control and elimination of dam safety hazard for downstream residents. Enhancement expected for downstream residents.
Economic Resources	Expenditure for construction and interest payments.	Repayment of local costs over life of the project; benefits realized yearly from regulatory storage and flood control exceed cost.	Construction and repayment costs are traded for national economic develment benefits of project.
Air Quality	Temporary increase in dust emissions (TSP) and vehicular emissions during construction of dams and recreation sites.	No state or federal ambient air quality standards would be violated in any site area.	None identified. No enchancement.
Aesthetics	Temporary disruption of visual quality during construction.	Gain of acres of Visual Quality Zone 1, representing a shift from low to high quality visual resources.	Disruption of existing visual resources traded for long-term gain of higher quality resources. Enhancement expected.

Table IV-39 (continued)

Resource	Short-Term	Long-Term	Tradeoffs
Noise	Temporary increase in noise in excess of EPA's short-term goal for residents in the Roosevelt area during construction.	Day-night sound levels in all site areas would remain in compliance with EPA's long-term goals.	None identified. No enhancement.
Sand & Gravel Resources	None identified.	Some sand and gravel deposits enhanced by reduced flooding.	None identified. Enhancement expected.
Prime Farmland	Aquisition of prime farmland at Cliff site for construction.	Protection of downstream prime farmland from flooding; possible conversion of some downstream prime farmland to urban uses.	Loss of prime farmland upstream traded for protection of downstream prime farmland. No enhancement identified.
Land	Changes in land use within affected site areas due to construction of dams and facilities; changes in land ownership due to federal acquisition of lands required for construction at New Waddell.	Land use conversions and increased development in downstream areas due to flood control, including Rio Salado and Sky Harbor Airport expansion.	None identified - no major incompatible land uses are anticipated. Enhancement of downstream lands expected.

F. Irreversible and Irretrievable Commitment of Resources

The construction and operation of Plan 6 would irreversibly and irretrievably commit physical and environmental resources to the project. An irreversible commitment of these resources is considered the permanent loss of the resource. Loss of resources is described for the typical-year and represents unmitigated impacts unless otherwise noted.

1. Bilogical Resources

Bilogical resources lost as a result of Plan 6 include 270 acres of riparian/wetland habitat, 11,340 acres of terrestrial habitat, 290 animal unit months (AUM's) for special use and management areas. These resources would be inundated by reservoirs included in the plan.

2. Water Quality

Municipal, industrial and agricultural users of regulatory storage water may be required to commit finiancial resources for treating water to meet standards or to improve its quality. The cost of regulatory storage water treatment for Plan 6, if any, is not quantifiable at this time.

3. Recreation

There are no irreversible commitments of recreational resources associated with Plan 6.

4. Cultural Resources

In Plan 6, at least 156 prehistoric sites would be destroyed by construction activities, including artifact scatters, domestic and agricultural sites, petroglyphs, trash mounds, and water-soil control features.

Construction and operation of Plan 6 would destroy at least 39 historic sites. The most signficiant site to be affected is Theodore Roosevelt Dam, which is a National Historic Landmark. The dam would be destroyed by construction of New Roosevelt Dam or altered by modification.

5. Social Setting

There are no irreversible, irretrievable commitment of human resources associated with Plan 6.

6. Economics

Non-reimbursible dollars committed to the construction of Plan 6 would not be available for other uses.

7. Aesthetics

There would be irreversible changes in the aesthetic quality of the affected site areas in Plan 6. These changes would result from the construction of the dams and appurtenant facilities and from the operation of the reservoirs.

8. Geology/Soils

Approximately 130 acres of prime farmland would be acquired for Plan 6 and subsequently inundated. Additionally, sand, gravel, and other soil fill materials will be committed for the construction of the dams and facilities. These resources would come from borrow areas near the dam sites or from commerical sources.

9. Land Resources

Land required for the construction of Plan 6, including dam sites, reservoir areas, and rights-of-way would be irreversibly committed to the project and would be unavailable for other uses.

G. Conflicts with Other Agency Programs, Plan, and Policies

Letters were sent on January 19, 1982 to members of the CAWCS Governor's Advisory Committee and Technical Agency Group, representing over 80 agencies. The letters requested notification of whether the "planning or implementation of any CAWCS alternative action (Plans 1, 2, 3, 6, or 7) presents conflicts with your agency's programs, policies, or plans".

Letters were received from 12 agencies in response, the following agencies presented possible conflicts with their policies, programs, or plans which must be considered in implementing an alternative.

1. Arizona Department of Transportation

The Department and the Federal Highway Administration are jointly participating in a plan to upgrade and realign a 14-mile segment of State Route 188, including the portion which crosses Roosevelt Dam. This road would require relocation under CAWCS alternatives. The Bureau is working with the Department of Transportation to coordinate planning of Route 188 modifications. The Department also has plans to extend State Route 74 for possible connection with New River in the vicinity of Lake Pleasant, and has several materials pits in the area. Bureau planning of New Waddell Dam construction and operation will consider these sites and avoid impacting them is possible. Compensation will be made for land and facilities required to construct New Waddell Dam and Reservoir.

2. Maricopa County Department of Planning and Development

The Advance Planning Division may have potential zoning conflicts if construction of New Waddell Dam and Reservoir creates significant growth impacts in the area. Planning for impacts caused by an influx of workers during dam construction is also a concern of the Planning Department. These factors have been considered in CAWCS planning, and the Bureau does not expect signficiant development impacts either during the construction period or as a long-term result of dam construction, mainly because of the public ownership and management of land around the proposed dams.

3. Maricopa County Parks and Recreation Department

The Parks Department operates Lake Pleasant Regional Park. The enlargement of New Waddell Dam and Reservoir presents several conflicts with the Department's policies, plans, and programs. The Bureau is working closely with the Parks Department to coordinate plans for development of the area.

4. City of Mesa

Implementation of Plan 6 may present conflicts with the proposed operation of the City of Mesa water treatment plant by either reducing the amount of water available to the city or increasing the turbidity of water delivered to the treatment plant. These conflicts are being investigated by the Bureau.

5. Rio Salado Development District

Plan 2 conflicts with Rio Salado development plans because the level of flood control provided by the plan is not considered by the District to be sufficient to allow implementation of the Rio Salado concept.

6. U.S. Fish and Wildlife Service

The Fish and Wildlife Service stated that Plan 3 is in conflict with its policies for preserving and managing habitat identified as Resource Category 1. Such habitat would be destroyed by construction of Confluence Dam and Reservoir.

H. Compliance With Other Environmental Statutes

Federal environmental statutes which have application to Plan 6 are listed in Table IV-40. Requirements of these statutes, as well as the status of Plan 6 compliance, are also described.

Table IV-40

STATUS OF COMPLIANCE WITH OTHER ENVIRONMENTAL STATUTE

Affected Resource	Statute	Requirements	Plan 6 Complaince Status
Water Quality	Federal Water Pollution Control Act of 1972 (PL 92-500)/Clean Water Act of 1977, Section 404.	Requires a Corps of Engineers permit for the discharge of dredged or fill material into navigable waterways. In certain circumstances, federal agencies are exempted from obtaining a Section 404 permit if the provisions of federal regulations (40 CFR Part 230) are fulfilled.	A Section 404 evaluation to meet requirements of Section 404(b)(1) is included as Appendix E of the report. This evaluation satisfies the requirement for Bureau compliance with Section 404.
Wild & Scenic Rivers	Wild and Scenic Rivers Act of 1968 (PL 90-542) paloverde-mixed cacti habitat.	Section 7 prohibits federal agencies from assisting or licensing water resource projects on or affecting any river designated for study as a potential component of the national wild and scenic river sytem. Section 5 requires consideration of wild and scenic rivers in planning water resource projects.	Tonto Creek from its source to Roosevelt Lake is listed on the Nationwide Rivers Inventory and is eligible for inclusion in the Wild & Scenic Rivers System. The Verde River upstream of Horseshoe Dam is considered eligible and suitable for inclusion in the system. These segments of river would be affected only under Standard Project Flood (SPF) conditions which is equivalent to a 200-year flood Due to the infrequency of such an event, Plan 6 is not likely to diminish the wild and scenic value of these rivers.

Table IV-40 (continued)

Affected Resource	Statute	Requirements	Plan 6 Complaince Status
Floodplains & Wetlands	Executive Order 11988, Avoid Impacts Associated with Occupancy Modification of Floodplains, May 24, 1977 / Executive Order 11990, Avoid Adverse Impacts to Welands, May 24, 977.	Agencies must determine whether their actions will affect floodplains and wetlands, consider alternatives, and include all practical measures to minimize impacts.	Impacts to floodplains and wetlands are addressed in the Section 404 evaluation in Appendix E.
Biological Resources	Endangered Species Act of 1973, as amended (PL 93-205).	Section 7 required consultation with the U.S. Fish & Wildlife Service to determine if federal project actions will affect threatened or endangered wildlife species, and to insure that any action authorized, funded, or carried out does not jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat which is determined to be critical.	A preliminary Biological Assessment to identify impacts to threatened and endangered species has been prepared by the Bureau and is under review. The Biological Assessment will be used as the basis of the consultation with the Fish & Wildlife Service. After the completion of the consultation (October 1982), the Fish & Wildlife Service will render a formal Bilogical Opinion as to whether Plan 6 actions will jeopardize the existence of affected species (February 1983).

Table IV-40 (continued)

Affected Resource	Statute	Requirements	Plan 6 Complaince Status
	Fish & Wildlife Coordination Act (PL 85-624).	Requires coordination with federal and state wildlife agencies (Fish & Wildlife Service and Arizona Game & Fish Department) for the purpose of mitigating and compensating for project-caused losses to wildlife resources.	A Habitat Evaluation Procedure (HEP) has been completed as the basis for identifying impacts to biological resources. Mitigation recommendations are being developed and conceptual mitigation measures are included in this EIS. A Fish & Wildlife Coordination Report will be issued at the end of the coordination process.
Prime Farmland	Council on Environmental Quality Memorandum, Analysis of Impacts on Prime and Unique Farmlands, August 30, 1976.	Required that federal agencies analyze the effects of their actions on prime and unique farmland, document these effects in an EIS where appropriate, and develop alternatives and/or mitigation measures.	Plan 6 impacts and effects to prime farmland, and mitigation measures, are described in this EIS.

Table IV-40 (continued)

Affected Resource	Statute	Requirements	Plan 6 Complaince Status
Cultural Resources	National Historic Preservation Act of 1966; Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 13, 1971 and implementing regulations under the Archaeological and Historic Preservation Act of 1974 (PL 92-291).	Federal agencies are responsible for the identification, protection, managment, and nomination to the National Register of Historic Places of signficiant cultural resources which are located on federal lands and/or which would be affected by federal actions. Consultation with the Advisory Council on Historic Preservations and the State Historic Preservation Officer (SHPO) is required when a federal action may affect cultural resources on or eligible for inclusion on the National Register (Section 106 of the National Historic Preservation Act).	Determination of Elegibility Forms have been completed for cultural resources affected by Plan 6 which are being nominated to the National Register. A preliminary case report is being prepared outlining impacts to cultural resources and mitigation measures. The case report will be used as the basis for the consultation process and the development of a mitigation plan.
Recreational Resources	Federal Water Project Recreation Act, 16 USC 4601.	Provides for outdoor recreational and fish and wildlife enhancement for federal water projects, in coordination with existing and planned recreational developments.	Conceptual Recreation Plans have been developed for the Plan 6 affect site areas. Descriptions of recreational sites proposed in conjunction with the plan and analyses of the effects of use of such sites on existing and planned recreational developments are outlined in this EIS.

Table IV-40 (continued)

Affected Resource	Statute	Requirements	Plan 6 Complaince Status
Water Resources	President Carter Water Policy Memorandum, July 12, 1978.	Establishes criteria for the planning and evaluation of federal water resource projects, including emphasis on water conservation and appropriate non-structural measures, avoidance of intergovernmental conflicts, use of up-to-date information in analysis and impacts statements, and funding of mitigation measures.	These criteria have been followed in the Bureau's planning and evaluation process for the CAWCS. Funding for mitigation measures in included in Plan 6 cost estimates.

V. LIST OF PREPARERS

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Name	Firm	Qualifications	Participation
James E. Ayres	Archaeological Research Services, Inc.	M.A. Anthropology, 17 years experience, formerly Arizona State Historic Preservation Officer and Arizona State Museum staff.	Associate Principal Investigator, Historic Cultural Resources.
Richard G. Bauman	U.S. Bureau of Reclamation	B.S. Wildlife Biology, 5 years experience in natural resource resource protection, Wildlife Biologist.	HEP team member, Biology Technical Reviewer.
Thomas G. Burbey	U.S. Bureau of Reclamation	B.S. Civil Engineering, 21 years experience in water resource planning and project operations.	Technical reviewer for water quality and water resources.
Glenn R. Cass	Dames & Moore	B.S. Architectural Engineering, 8 years experience, Project Engineer, P.E.	Principal Investigator, Acoustics.
Randy Chandler	U.S. Bureau of Reclamation	B.S. Civil Engineering, 4 years experience, Hydraulic Engineer.	Computer programmer for water supply analysis.
Barbara A. Conrad	Dames & Moore	B.S. Zoology, M.S. Botany, 7 years experience, Certified Ecologist, Ecological Society of America (ESA).	Associatere Principal Investigator, Biological Resources.
Joe Dixon	U.S. Army Corps of Engineers	B.S. Geological Engineering, M.S. Sanitary Engineering, 12 years experience in planning and water resources development.	Corps of Engineers Study Manager.
Debra A. Duerr	Dames & Moore	B.A. Urban Affairs, 7 years experience in environmental planning, assessment, and regulation.	EIS Coordinator.
Bruce D. Ellis	U.S. Bureau of Reclamation	B.A. Anthropology, 5 years experience, Environmental Specialist.	EIS Reviewer.
Carol Erwin	U.S. Bureau of Reclamation	B.S. Engineering, 9 years experience, Planner.	Team Leader for non-structural flood control analysis.
Wendy Espeland	Consultant	B.A., M.A. Sociology, Ph.D. candidate Sociology, 4 years experience in social assessment.	Principal Investigator, Social Resources.
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V. LIST OF PREPARERS (continued)

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V. LIST OF PREPARERS (continued)

Name	Firm	Qualifications	Participation
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Martha A. Rozelle	Dames & Moore	Ph.D. Community Management and Education, 12 year experience in public participation.	Public Involvement Coordinator.
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Lyle Stone	Archaeological Research Services, Inc. (Principal)	Ph.D. Anthropology, 17 years experience in Historical Archaeology.	Principal Investigator, Historic Cultural Resources.
Natalie S. Waugh	Dames & Moore	B.A. Liberal Arts, M.S. English, 12 years experience in environmental regulatory compliance and multidisciplinary envionmental planning.	Project Manager.
James R. Wagner	U.S. Bureau of Reclamation	B.S. Civil Engineering, 3 years experience in public health engineering.	Technical Reviewer, air water quality.
Guy Wilson	Consultant	M.A. Sociology, 2 years experience in social assessment.	Associate Principal Investigator, Social Recources.
Will Worthington	U.S. Bureau of Reclamation	M.S. Civil Engineering, 20 years experience, P.E., Chief of Dams Planning Branch.	Policy Reviewer.

GLOSSARY

Abutment - That part of existing topography into which the end of a dam is constructed.

Acre-foot - The quantity of water required to cover one acre of land to a depth of one foot; equivalent to 43,560 cubic feet or 325,851 gallons (U.S.).

Air Quality Standards (National Ambient Air Quality Standards):

Primary - The maximum pollutant levels allowable and necessary to protect the public health with an adequate margin of safety.

Secondary - The maximum pollutant levels allowable and necessary to protect the public welfare from any known or anticipated adverse effect.

Alluvium - General term for clay, silt, sand, gravel, or unconsolidated detrital material deposited by a stream or other body of running water.

Ambient - Encompassing or surrounding.

Animal Unit Month (AUM) - The amount of forage necessary for the sustenance of one cow or its equivalent for a period of one month.

Artifact - A simple object (such as a tool or ornament) showing human workmanship or modification.

Biotic community - An aggregation of plant and animal populations whose distribution is controlled primarily by physical factors in the environment and which exhibits interrelationships among member species.

Bosque - A densely wooded area along a stream or river.

cfs - Cubic feet per second. A unit of measure of the rate of liquid flow past a given point equal to one cubic foot in one second.

Check dams - Usually small dams located on tributaries to slow flowing water and allow for greater infiltration, temporary storage or to control erosion.

Concrete gravity dam - A water retaining structure which derives its strength to hold back the water because of the enormous weight of the dam itself.

Confluence - The point where two streams converge and unite.

Conservation pool - In a reservoir, that part of the storage volume dedicated to storing water for future use.

Conservation storage - See Conservation pool.

Dam crest - The top of the dam.

Decibel (dB) - A unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain level.

Earthfill dam - A dam constructed of engineered soils. A typcial earthfill dam would have several types of soil with different properties placed in "zones" within the embankment.

Easements - an interest in land owned by another that entitles its holder to a specific limited use.

Earth fissures - cracks in the alluvium of basins which have land subsidence due to large water level declines.

Effect - an interpretation of the significance of the impact.

Energy management - The operation of a system (in this case CAP) to maximize energy use when energy is relatively inexpensive (during the winter or at night) and to have excess energy available when demand (and price) is high.

Endangered species - Any species determined by the U.S. Department of the Interior to be in danger of extinction throughout all or a significant portion of its range.

Enhancement - to improve or make better than the existing condition.

Eutrophication - The process by which waters become enriched with an influx of nutrients required for the growth of aquatic plants such as algae that are important for fish and animal life.

Flood Event - 100-year flood event - calculated by the U.S. Army Corps of Engineers to be a flow of 215,000 cfs for the City of Phoenix.

- 200-year flood event - calculated by the U.S. Army Corps of Engineers to be a flow of 275,000 cfs for the City of Phoenix.

Flood outlet - Large low level outlets designed to release flood waters at high flowrates.

Floodproofing - An adjustment to a building or its contents which is designed to stop the inflow of water or to reduce the effects of water entry.

Floodplain - The surface of relatively level land adjacent to a river channel which is covered by water when the river is covered by water when the river overflows its banks at times of high water;

- 200-year floodplain - the floodplain which is under water during a 200-year flood event.

Fluctuating pool - water level between the typical year low and the typical year high pool elevations (as defined by Prehistoric Cultural Resources for the purpose of this project).

Geomorphic - Pertaining to the surface features of the Earth.

Groundwater - Water which saturates all spaces at some depth below the surface of the ground. The top surface of the groundwater is the water table.

Groundwater recharge - Replenishing of groundwater.

Hydropower - Power generated from the movement of water.

Head (hydraulic) - The pressure of a fluid on a given area.

Infiltration - The movement of water or solution into soil or rock.

Inflow Design Flood (IDF) - A flood event used by design engineers to size facilities for a new dam. This is usually a very large flood, greater than the SPF or MPF.

Impact - Measured change due to a project action.

- Residual impact - Impact which occurs after mitigation.

Inactive pool - That part of the reservoir storage pool which is below the outlet works.

Less-than-annual pool - Water level between typical year high and Standard Project Flood (SPF); term defined by Prehistoric Cultural Resources for the purpose of this project.

Levees - An embankment built to prevent overflow.

Lithic - Made of stone.

Low-level outlets - A water conveyance system designed to release water from behind a dam by gravity flow from near the bottom of the reservoir.

Maximum annual recreation days - Based on the carrying capacity of the resources and facilities as well as the length of the recreation season and the amount of recreation use that occurs on weekends; represents the capacity of the site without overcrowding.

Maximum Probable Flood (MPF) - determined by hydrologic analyses. That flood which would result from the most severe combination of critical meterological and hydrological conditions that are reasonably possible in the region. (Also known as PMF)

Maximum Storage Pool (MSP) - This represents the largest pool the reservoir would have when all space dedicated for the storage of conservation water is full.

Microclimate - Localized climate influenced by land form, elevation and other local environmental variables.

Minimum pool - This is the smallest pool a reservoir would have to meet specific requirements. For instance, a certain minimum pool may be required to support a fish population.

Mitigation - An action to reduce or eliminate an adverse impact.

Overdraft - Withdrawal of groundwater in excess of replenishment.

Orogeny - The process of the formation of mountains.

Outlet works - A water conveyance facility designed to release water from behind a dam by gravity flow without having the water flow over the top of the dam.

Perennial stream - A stream that flows at all times.

Permanent pool - Water level up to the typical year low pool (defined by Prehistoric Cultural Resources for the purpose of this project).

Petroglyph - A carving or inscription on a rock.

Physiography - The study of the evolution of landforms.

Prime farmland - Classification of U.S. Soil Conservation Service for lands with the soil quality, growing season, and moisture supply necessary to produce sustained high agricultural fields by modern farming methods.

Raptor - A bird of prey, e.g. eagle, hawk, etc.

Regulatory storage pool - That part of a reservoir allocated for the temporary storage of water so that flows in the rest of the delivery system can be better regulated.

Reversible canal - A level open channel capable of passing flow in either direction.

Replacement pool - That part of a reservoir allocated to provide storage similar to the storage which was perviously available.

Riparian - Associated with the banks of rivers or other stable water bodies.

Riprap - Brokern stones or boulders placed compactly or irregularly on dams, levees, dikes, or similar embankments for protection of earth surfaces against the action of waves or currents.

Right-of-way - The right of passage over another's land.

Riffle - A natural shallows in a stream or river bed over which the water flows swiftly and the water surface is broken in waves by obstructions wholly or partly submerged.

Safety of Dams (SOD) - 1978 Reclamation Safety of Dams Act (P.L. 95-578).

Salt loading - Increase in the volume of salts (Na^{++}, K^{+})

Sediment pool - That part of a reservoir which is allocated for the storage of debris and sediment carried by inflowing waters. Sediment may

actually be deposited at almost any point in the reservoir and this reduces the amount of storage volume available for water storage.

Service outlet - Outlet works designed to deliver water to designated users.

Spillway - A conveyance facility which allows for water to pass over or around an obstruction such as a dam.

- gated - A spillway which can be closed or opened at will.
- ungated - A spillway which is open all the time.

Spillway surcharge space - The volume above the spillway crest occupied by floodwaters as reservior inflow exceeds outflow. This condition causes the water surface to rise temporarily.

Standard Project Flood (SPF) - The flood that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the region.

Subsidence - A lowering of ground elevation as a result of excessive ground-water pumping, dewatering of sediments, ground movements due to earthquakes, etc.

Surcharge pool - See Spillway surcharge space.

Terrace (agriculture) - An artificial ridge or embankment of earth built for the purpose of conserving moisture, controlling runoff, or reducing erosion.

Threatened species - Any species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Turbidity - The state, condition, or quality of reduced clarity of a fluid due to the presence of suspended material in the fluid.

Water exchange - An institutional arrangement utilizing physical facilities where one user's water is stored while his water needs are met by deliveries from a second user and then the second user has water "credits" against this first user. During a later period the second user may request that his credited water be released from the first user's storage facilities and delivered as required.

Water supply outlets - See Service outlet.

Water yield - The volume of water which is available as a result of operations of a water system.

Visitor-days - A measure of impact; one visitor day equals twelve hours of use of a site.

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Roosevelt Dam and Reservoir

Construction

Impacts and effects - see specific environmental, social, or economic factor

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Stewart Mountain Dam

Construction

Impacts and effects - see specific environmental, social, or economic factor

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Impacts and effects - see specific environmental, social, or economic factor

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Cliff Dam and Reservoir

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Impacts and effects - see specific environmental, social, or economic factor

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Roosevelt Dam and Reservoir

Construction

Construction

Impacts and effects - see specific environmental, social, or economic factor

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Impacts and effects - see specific environmental, social, or economic factor

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Cliff Dam and Reservoir

Construction

Impacts and effects - see specific environmental, social, or economic factor

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Impacts and effects - see specific environmental, social, or economic factor

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Impacts and effects - see specific environmental, social, or economic factor

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Impacts and effects - see specific environmental, social, or economic factor

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Impacts and effects - see specific environmental, social, or economic factor

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CONSULTATION AND COORDINATION

Two groups were key in the CAWCS public involvement program: the Governor Advisory Committee (GAC) and the Technical Agency Group (TAG). Governor Bruce Babbitt appointed 28 members to the GAC which provided general study guidance and acted as a review board for study progress. The GAC met 19 times between June 1979 and October 1981. At the final meeting on October 2, 1981, Governor Babbitt asked the committee to present him with a unanimous recommendation on a preferred plan. He stressed the importance of Arizona's support for one plan. After deliberations and discussions, the GAC voted twenty to one to recommend Plan 6 to the Governor, contingent on Congressional authorization and funding for safety of dams, regulatory storage, and flood control. The committee also recommended that advanced engineering and design begin for Plan 6 and that the statutory language in the CAP authorizing legislation giving the Secretary of the Interior power to condemn Indian lands be removed after Plan 6 is implemented. Members of the GAC are listed in Table B-1.

The TAG was established as an advisory committee for technical aspects of the study. Approximately 50 groups and governmental agencies participated in the TAG. The group served a coordinating function, provided technical information to the CAWCS team, and reviewed study data. TAG held 24 meetings between January 1979 and September 1981. Although the TAG did not take a position on a preferred plan, they helped build credibility for technical aspects of the study. The role of TAG was one of peer review and technical guidance. Important relationships and viewpoints were developed

Table B-1

GOVERNOR'S ADVISORY COMMITTEE MEMBERS

Mr. Tom Chauncey, Sr.

Hon. Herbert R. Drinkwater

Ms. Joann Enos

Mr. Tom Fannin

Mr. Art Hamilton

Hon. Margaret Hance

Mr. Thomas Jones

Ms. Sue Lofgren

Hon. Dessie M. Lorenz

Mr. Manuel G. Marin

Mr. Chet McNabb

Mr. John R. Norton III

Hon. Ed Pastor

Ms. Eva Patten

Mr. Hank Raymond

Mr. William. R. Schulz

Mr. Norris Soma

Hon. Don Strauch

Dr. Lee Thompson, Chairman

Mr. Keith Turley

Mr. Mason Walsh

Dr. Robert Witzeman

Mr. Howard Wuertz

Mr. Don Tostenrund

Hon. Harry Mitchell

by the principal investigators and their agency counterparts which proved critical to the TAG's interim acceptance of technical reports and EIS documentation. Early discussion and airing of technical matters within the TAG undoubtedly contributed significantly to the widespread acceptability of the proposed action. Members of the TAG are listed in Table B-2.

Public involvement was an integral part of the CAWCS planning process and decision making. Throughout the study, people suggested various alternatives or technical aspects which they felt should be examined. For the most part, nearly every substantive public concern had been by the end of CAWCS. Information pertaining to the final candidate plans was released in the September 1981 Factbook. All of the publics who had been involved in the study had an opportunity to evaluate the plans for themselves. They were permitted to express their preferences at public meetings, through letters and response forms, and/or through the TAG and GAC. Results of this public evaluation were used by the CAWCS staff at the Stage III trade-off. Public acceptability was one of the four major factors used by staff in their evaluation of plans.

Public involvement had both direct and indirect influences on the final decision-making process. Indirectly, the choice of a proposed action was based in part on CAWCS staff recommendations, which included as a major factor the public acceptability of plans. Bureau of Reclamation officials and Interior Secretary James Watt had direct contact with many of the publics involved in the study through letters and personal visits and were aware of public views regarding the plans. While it is not possible to determine the exact weight given to public opinion in the choice of the proposed action, it did play an important role.

Table B-2

TECHNICAL AGENCY GROUP MEMBER AGENCIES

National Park Service

Salt River Pima Indian Council

City of Phoenix

Arizona Department of Water Resources

Soil Conservation Service

Arizona Department of Health Services

Arizona Outdoor Recreation Coordinating Commission

Town of El Mirage

Rio Salado Development District

Arizona Game & Fish Department

Central Arizona Water Conservation District

Maricopa County Health Department

Arizona Department of Transportation

City of Scottsdale

Wildlife Society

Fort McDowell Mohave-Apache Tribal Council

U.S. Forest Service

U.S. Fish & Wildlife Service

Arizona Division of Emergency Services

Heritage Conservation and Recreation Service

Arizona Public Service Company

Town of Buckeye

Inter-Tribal Council of Arizona

Bureau of Indian Affairs

Environmental Protection Agency

Gila River Indian Community

Maricopa County Highway Department

City of Mesa

Governor's Office

Arizona Land Department

U.S. Geological Survey

City of Glendale

Town of Tolleson

Salt River Project

Maricopa County Planning Department

Maricopa County Audubon Society

Western Area Powr Administration

Federal Highway Administration

City of Peoria

City of Avondale

Arizona State Parks Board

Bureau of Land Management

Maricopa County Municipal Water Conservation District #1

Maricopa Association of Governments

Maricopa County Parks Department

Flood Control District of Maricopa County

City of Tempe

In evaluating the CAWCS public involvement program key participants and the general public were asked whether they felt their views and public comments had been considered in the decision. Approximately 84 percent of those who responded said yes. This seems to indicate satisfaction with the choice of a plan and with the effectiveness of the public involvement program in integrating public views into the decision-making process.

APPENDIX C

ENVIRONMENTAL COMMITMENTS

To Be Provided for Final EIS

APPENDIX D

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APPENDIX E

SECTION 404 EVALUATION

Introduction: The following evaluation has been prepared in compliance with section 404(b)(1) of the Federal Water Pollution Control Act Amendments (Public Law 92-500) and Environmental Protection Agency Guidelines for Specification of Disposal Sites for Dredged or Fill Material (Federal Register, 24 December 1980); the evaluation is included in the final environmental impact statement for the proposed project in accordance with Section 404(r) of the Clean Water Act of 1977 (Public Law 95-217), which amends Public Law 92-500.

I. GENERAL

A. Purpose

The purpose of the proposed plan is to provide flood control for the Salt and Gila Rivers through the Phoenix metropolitan area and to provide a regulatory storage reservoir for the storage of Central Arizona Project (CAP) water.

B. Description of Proposed Plan

The proposed plan would include modifications at four sites. A new dam would be constructed on the Agua Fria River about 1/4 mile downstream from the existing Waddell Dam to replace the existing storage and to also provide for storage of CAP water. A new Cliff Dam would be constructed on the Verde River about 6 miles downstream of the existing Horseshoe Dam to replace the existing storage, provide flood control on the Verde River, and relieve dam safety problems at the existing dam. A new Roosevelt Dam would be constructed on the Salt River about 1,000 feet downstream from the existing dam to replace the existing storage, provide flood control for the Salt

River, and relieve dam safety problems at the existing dam. A new Stewart Mountain Dam would be constructed on the Salt River against the base of the existing dam to replace the existing storage and relieve dam safety problems at the existing dam. It may be possible to modify the existing Roosevelt and Stewart Mountain Dams instead of replacing them. These decisions have not yet been finalized.

C. Authority

This project would be implemented under the authority of Section 301(a)(3) of the Colorado River Basin Project Act (PL 90-537).

D. Compliance with Guidelines

1. Determinations

An ecological evaluation has been made following the evaluation guidance in Guidelines for Specification of Disposal Sites for Dredged or Fill Material, 24 December 1980 (Part 230.11). Appropriate measures have been identified and incorporated in the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge. Consideration has been given to the need for the proposed activity, the availability of alternate sites and methods of disposal that are less damaging to the environment, and such water quality standards as are appropriate and applicable by law. It was determined that the activity associated with the fill must have direct access or proximity to, or be located in, the water resources in order to fulfill its basic purpose.

2. Findings

On the basis of the guidelines, the proposed disposal sites for the discharge of dredged and fill material are specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the affected aquatic ecosystem.

II. SITE-SPECIFIC ACTIVITIES

A. Waddell Site

1. General Description of Proposed Activity

A new earthen dam 306 feet in height will be constructed across the Agua Fria River to provide for replacement and enlargement of the reservoir at the existing dam. The dam will include water supply outlets and a detached emergency spillway through the right abutment.

2. Description of the Proposed Discharge of Dredged or Fill Materials

The fill material will consist of impervious and pervious soils required to construct a zoned earthfill dam along with graded rock riprap to protect the dam faces. The material would be obtained from within the borrow areas as shown on the map. Approximately _____ cubic yards of material will be used to construct the dam.

All unsuitable material (debris, unusable soils, etc.) encountered during the foundation excavation and subsequent construction will be disposed of away from the wetland habitat or within the proposed reservoir area

between the old and new dams where it would be covered with suitable natural materials.

Stockpiling of materials for construction would be within the designated borrow areas but away from the river channel.

Other materials needed to construct the embankment and related facilities would include concrete aggregates, cement, and other construction materials as needed. All commercially available materials used to construct the various elements of the project will be pollution-free.

3. Project-Related Considerations

The upstream existing dam would capture and detain in the conservation pool all but major flood flows from the upper watershed. The existing lower lake would be drained during construction so that all construction would be accomplished under dry conditions. Conventional equipment and methods will be employed in constructing the project. Releases from the existing dam would be timed with the new dam construction so they could be diverted around the active construction site and not pick up pollution caused by the construction activities. The Agua Fria River channel below the lower lake is dry except for some seepage past the existing dam and during times of emergency spillway releases. Construction will take four years to complete.

4. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem

A detailed discussion of the environmental setting, project-related impacts, and proposed mitigation measures is contained in the final

environmental impact statement for the combined project. This and following subsections will briefly outline anticipated impacts and proposed mitigation measures.

Water used during the construction and rainfall on the site may be degraded in quality by the construction activities. Increases in suspended materials and turbidity are probable for the runoff from the construction site. There may also be occasions where overland flow may pick up oil, grease, or small quantities of chemicals used during construction. Runoff from construction-related sites will be diverted into detention basins to prevent degradation of flows in the river channel downstream from the site. All sanitary wastes will be contained and evacuated from the site for disposal at approved facilities.

5. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem

Lower Lake Pleasant is a wetland habitat consisting of cattail-bulrush marsh bordering a shallow pool. The water released from Waddell Dam flows about one-half mile into Lower Lake Pleasant, thus erecting both lentic and lotic aquatic habitat at the Lower Lake. Riparian woodland, including mesquite and cottonwood, intermingles with the wetland habitat in several pockets along the shoreline.

A variety of wildlife species are associated with the Lower Lake Pleasant aquatic and wetland habitats, including snowy egret, black-crowned night heron, wood ibis, and various other marsh birds, shorebirds, and waterfowl. Several species of game fish occur in the Lower Lake.

Lower Lake Pleasant would be drained during the project construction period. The aquatic communities and wetland habitat would cease to exist during construction.

The Lower Lake would subsequently be refilled following construction. Since dredge and fill excavation obviously will disrupt the landscape, the siltation-sedimentation process will retard recovery of aquatic communities at the onset of the operation phase. Disturbed sites will be reclaimed following construction; hence, siltation and sedimentation should decline within the first several years of operation due to restoration of vegetation cover at reclaimed sites. As the algal growth and invertebrate fauna recover, sports fish can again be stocked in the Lower Lake.

The Gila topminnow, peregrine falcon, and bald eagle are federally designated endangered species that have been reported in the vicinity of Lake Pleasant. A small population of Gila topminnows occurs upstream of the study area in Tule Creek, which is a tributary to the Agua Fria River. An unconfirmed sighting of a peregrine falcon was made during the CAWCS study; also, unconfirmed sightings of the bald eagle have been reported. A nest site, possibly that of a bald eagle, is located in a cottonwood tree along the Agua Fria River upstream of Lake Pleasant.

The disposal of dredged and fill materials associated with construction of new Waddell Dam is not expected to adversely affect these species.

The typical-year scenario is based on the assumed typical-year operation as depicted in the Project Action Descriptions (PAD) --Water Surface Elevation for a Typical Year Reservoir. Two kinds of data were used to analyze impacts: 1) typical-year pool elevations and 2) drawdown rates.

Typical-year elevations were used to determine time at which conditions were met or exceeded as shown in the attached table. The percent data were interpreted from the PAD--Elevation-Duration Curves. It was determined that the actual habitat distribution at existing reservoirs most closely approximate the typical-year/future-without scenario. Therefore, the typical-year/future-with scenario is presumed to be valid in all cases where the typical-year pool exhibits similar time duration curves.

B. Cliff Site

1. General Description of Proposed Activity

A new earthen dam 348 feet in height will be constructed across the Verde River to provide for replacement and enlargement of the reservoir at the existing Horseshoe Dam located 6 miles upstream of the Cliff Dam site. The new dam will include water supply outlets, flood outlets, and a detached emergency spillway through the left abutment.

2. Description of the Proposed Discharge of Dredged or Fill Material

The fill material will consist of impervious and pervious soils required to construct a zoned earthfill dam along with graded rock riprap to protect the dam faces. The material would be obtained from within the borrow

areas as shown on the map. Approximately _____ cubic yards of material will be used to construct the dam.

All unsuitable material (debris, unusable soils, etc.) encountered during the foundation excavation and subsequent construction will be disposed of away from the wetland habitat or within the proposed reservoir area between the old and new dams where it would be covered with suitable natural materials.

Stockpiling of materials for construction would be within the designated borrow areas but away from the river channel.

Other materials needed to construct the embankment and related facilities would include concrete aggregates, cement, and other construction materials as needed. All commercially available materials used to construct the various elements of the project will be pollution-free.

3. Project-Related Considerations

The upstream existing Horseshoe Dam would capture and detain in the conservation pool all but major flood flows from the upper watershed. Runoff from the watershed between the Horseshoe and Cliff Dam sites would be isolated from the construction area by a cofferdam. The cofferdam would direct the water through the low-level outlets which would be installed first during the dry season. All construction would be completed under dry conditions. Conventional equipment and methods will be employed in constructing the project. Releases from Horseshoe Dam would be timed with the new dam construction so they could be diverted around the active construction site and

not pick up pollution caused by the construction activities. The construction will take 6 years to complete.

4. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem

A detailed discussion of the environmental setting, project-related impacts, and proposed mitigation measures is contained in the final environmental impact statement for the combined project. This and following subsections will briefly outline anticipated impacts and proposed mitigation measures.

Water used during the construction and rainfall on the site may be degraded in quality by the construction activities. Increases in suspended materials and turbidity are probable for the runoff from the construction site. There may also be occasions where overland flow may pick up oil, grease, or small quantities of chemicals used during construction. Runoff from construction-related sites will be diverted into detention basins to prevent degradation of flows in the river channel downstream from the site. All sanitary wastes will be contained and evacuated from the site for disposal at approved facilities.

5. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem

The reach of the Verde River downstream of Horseshoe Dam supports a good riverian fishery due to the cobble and gravel substrate, flows, and associated reservoirs (Horseshoe Reservoir upstream and Bartlett Reservoir downstream). Stands of cottonwood-willow and mesquite habitat occur on

alluvial terraces where the tributaries enter the river and at river bends of the Verde River. Where the river borders canyon walls the riparian habitat is absent.

Wildlife associated with this reach of the Verde River include a variety of fish species which breed in the river or migrate from the reservoirs. Large channel catfish have been caught in this reach of the Verde. A blue heron rookery is located near the KA Ranch downstream of Horseshoe Dam. Osprey, black hawk, and numerous other wildlife species use the canyons, river, riparian habitat, and reservoirs of this reach of the Verde River.

Fill material will be excavated from the river channel and adjacent terraces. Approximately 10 miles of river will be disrupted downstream of Horseshoe Dam during construction of the new Cliff Dam. The excavation will essentially eliminate the riverine aquatic communities and river fishery within this 10-mile segment during construction. Six miles of the river will become part of Cliff Reservoir; the remaining river is expected to recover following construction.

Bald eagles occur at the Cliff site; a breeding area is located upstream of Horseshoe Reservoir. Dredge and fill excavation during construction would deprive eagles of potential fish prey. The Horseshoe Dam to Bartlett reach of the Verde River, however, is not a prime eagle foraging area, and therefore the welfare of this breeding area is not expected to be compromised.

C. Roosevelt Site

1. General Description of Proposed Activity

A new concrete dam 297 feet in height would be constructed across the Salt River to provide for replacement and enlargement of the existing reservoir, or the existing dam would be raised for the same purpose. Either alternative would include water supply outlets, flood outlets, and an emergency spillway as part of the dam.

2. Description of the Proposed Discharge of Dredged and Fill Material

Only concrete-based materials would be used in the construction or modification at the Roosevelt site. Any unusuitable materials excavated during foundation preparation for the new dam would be placed between the old and new dams in the proposed reservoir.

3. Project-Related Considerations

If the new dam were constructed, the existing dam would capture and detain in the conservation pool all but major flood flows from the upper watershed. With the modified dam, construction would be timed with periods when the reservoir is normally drawn down or the reservoir would be drawn down during construction. All placement of materials would be accomplished under dry conditions. Conventional equipment and methods would be employed in constructing the project. Releases from the existing dam would be timed with the construction so that they would be isolated from any construction sites and not pick up pollution caused by the construction activities. New

dam construction would take 6 years to complete, while the modifications to the existing dam would take 3-1/2 years.

4. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem

A detailed discussion of the environmental setting, project-related impacts, and proposed mitigation measures is contained in the final environmental impact statement for the combined project. This and following subsections will briefly outline anticipated impacts and proposed mitigation measures.

Water used during the construction and rainfall on the site may be degraded in quality by the construction activities. Increases in suspended materials and turbidity are probable for the runoff from the construction site. There may also be occasions where overland flow may pick up oil, grease, or small quantities of chemicals used during construction. Runoff from construction-related sites will be diverted into detention basins to prevent degradation of flows in the river channel downstream from the site. All sanitary wastes will be contained and evacuated from the site for disposal at approved facilities.

5. Potential Impacts on Biological Characteristics of the Aquatic Ecosystem

The Salt River downstream of Roosevelt Dam is subjected to periodic modification from inundation due to water storage in Apache Lake. The river fishery is essentially an extension of the Apache Lake fishery. The aquatic community in this reach of the Salt River is not continuous and stable due to periodic inundation.

A bald eagle breeding area is located upstream of Roosevelt Lake on the Salt River and a tributary to the river. Foraging sites of this breeding area include a small diversion at Medler Point some 2 miles upstream of the lake. Fish congregate in the vicinity of the diversion dam and are preyed upon by eagles.

Construction of the new dam includes excavation of fill at Medler Point. The removal of fill will occur downstream of the diversion dam and is not expected to impede movement of fish in the river. Siltation and sedimentation resulting from nearby excavation is not expected to modify the fishery or biotic communities to the extent that long-term impact results.

D. Stewart Mountain Site

1. General Description of Proposed Activity

A new concrete gravity structure 200 feet in height will be constructed across the Salt River to replace the existing dam or a new spillway would be added to the existing dam. Either alternative will include water supply outlets and an emergency spillway as part of the dam.

2. Description of the Proposed Discharge of Dredged or Fill Material

Only concrete-based materials would be used in the construction or modification at the Stewart Mountain site. Any unsuitable materials excavated during foundation preparation for the new dam or excavated for the new emergency spillway would be placed in the existing reservoir behind Steward Mountain Dam. Estimates show about 470,000 cubic yards would be dumped as a result of the spillway excavation for either alternative. An additional

140,000 cubic yards would be dumped if the new dam were constructed. This material would mostly be clean broken rock very similar to the material that is now on the lake bottom.

3. Project-Related Considerations

The existing dam and reservoir would remain in place and continue to function throughout the construction period regardless of whether the new dam is built or the old dam modified. The existing dam would capture and detain in the conservation pool all but major flood flows from the upper watershed. All placement of materials would be accomplished under dry conditions. Conventional equipment and methods would be employed in constructing the project. Releases from the existing dam would be timed with the construction so that they would be isolated from any construction sites and not pick up pollution caused by the construction activities. New dam construction would take 4 years to complete, while the modifications to the existing dam would take 2 years.

4. Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem

A detailed discussion of the environmental setting, project-related impacts, and proposed mitigation measures is contained in the final environmental impact statement for the combined project. This and following subsections will briefly outline anticipated impacts and proposed mitigation measures.

Water used during the construction and rainfall on the site may be degraded in quality by the construction activities. Increases in suspended

materials and turbidity are probable for the runoff from the construction site. There may also be occasions where overland flow may pick up oil, grease, or small quantities of chemicals used during construction. Runoff from construction-related sites will be diverted into detention basins to prevent degradation of flows in the river channel downstream from the site. All sanitary wastes will be contained and evacuated from the site for disposal at approved facilities.

The area where the excavated material is dumped into the reservoir will experience short-term and localized increases in suspended materials and turbidity. Because the dumped material is very similar to the rock that forms the reservoir bottom, no chemical impacts are anticipated.

5. Potential Impact to Biological Characteristics of the Aquatic Ecosystem

Wetland habitat and extensive riparian habitat occur downstream of Stewart Mountain Dam to the Granite Reef Diversion Dam. The full compliment of central Arizona wildlife utilize the riparian habitat, cliffs, and perennial streams to varying extent within this reach of the Salt River and its confluence with the Verde River. A large population of river sucker species as well as sport fish inhabit the river. Sport fish such as rainbow trout are stocked (on a put-and-take basis) by the Arizona Game and Fish Department.

Saguaro Lake is one of the Salt River fisheries. Wetland and riparian habitat are limited in distribution to the small stands at the upstream end of the lake and at several tributary canals. Waterfowl in the

lake proper -- marsh and shorebird habitat is somewhat limited to immediate shoreline due to the surrounding canyon slope.

The construction will include dumping fill into Saguaro Lake. Turbidity, sedimentation, and siltation will adversely affect the substrate invertebrates and algae. The area immediate to the dumping site will probably be unsuitable for fish occupation. Subsequent long-term impact, following dumping, is expected to be negligible due to the propensity of aquatic life to re-occupy environment once turbidity and siltation lessen.

The dumping is not expected to cause long-term turbidity to waters released into the Salt River. Impact to the river is not expected to jeopardize riverine, wetland, and aquatic habitat.

APPENDIX F

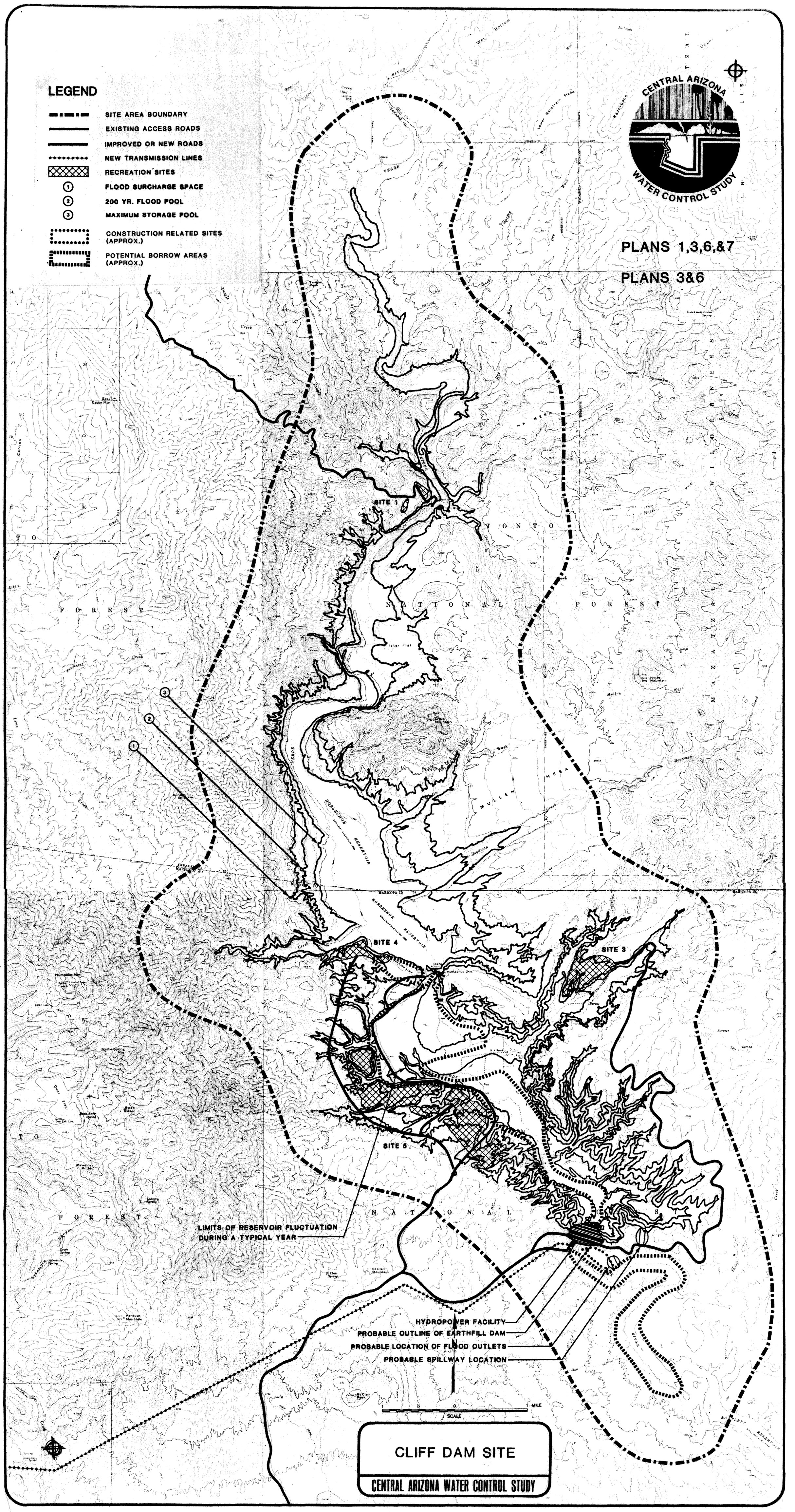
RELATIONSHIP OF POOL ELEVATIONS AND STORAGE LEVELS BASED ON ELEVATION - DURATION CURVE DATA

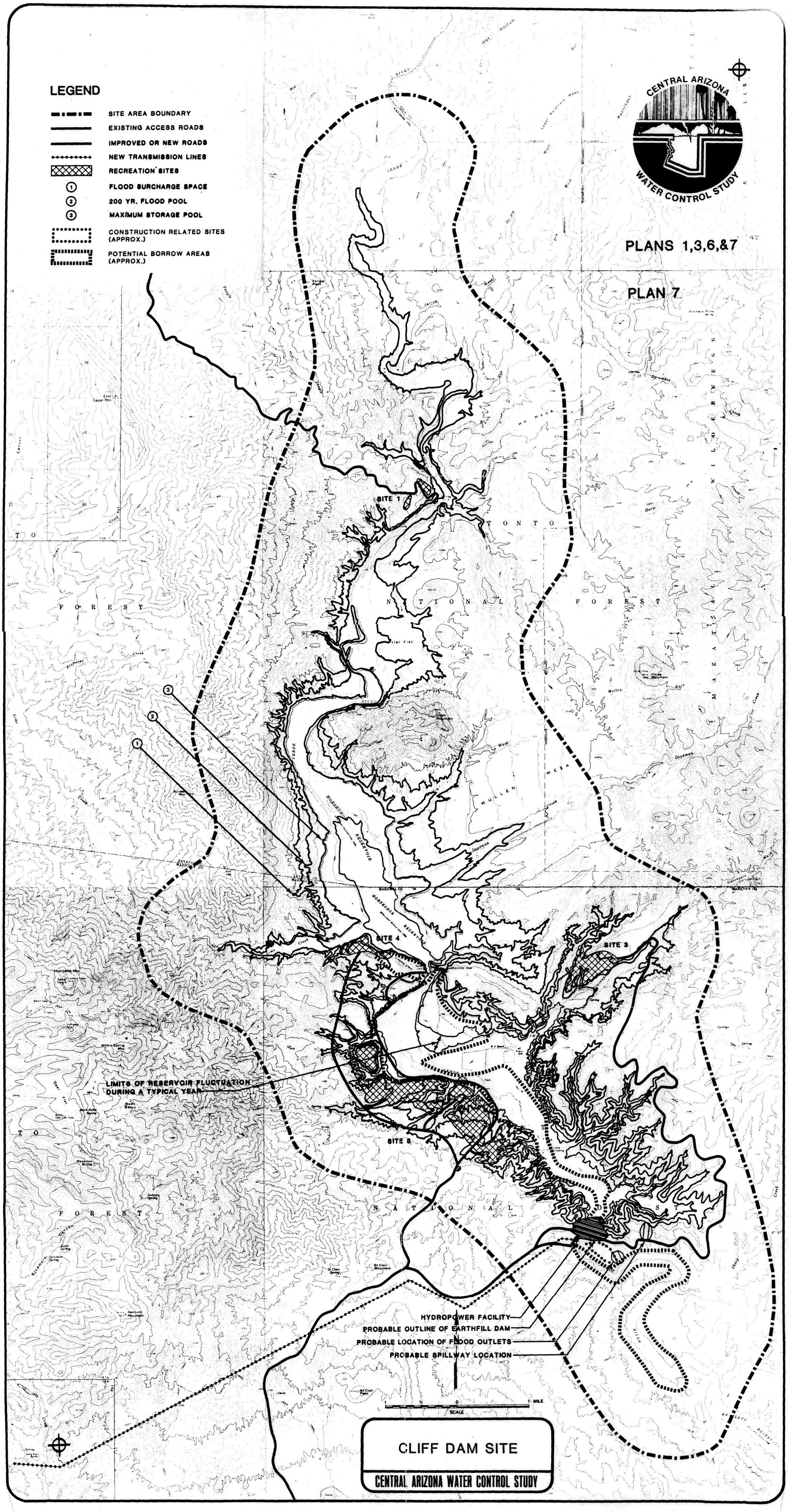
Data showing typical-year low, typical-year high, and maximum storage pool elevations for reservoirs included in alternative plans are given in Table F-1. Percent of time in which water is expected in the various pools is also shown.

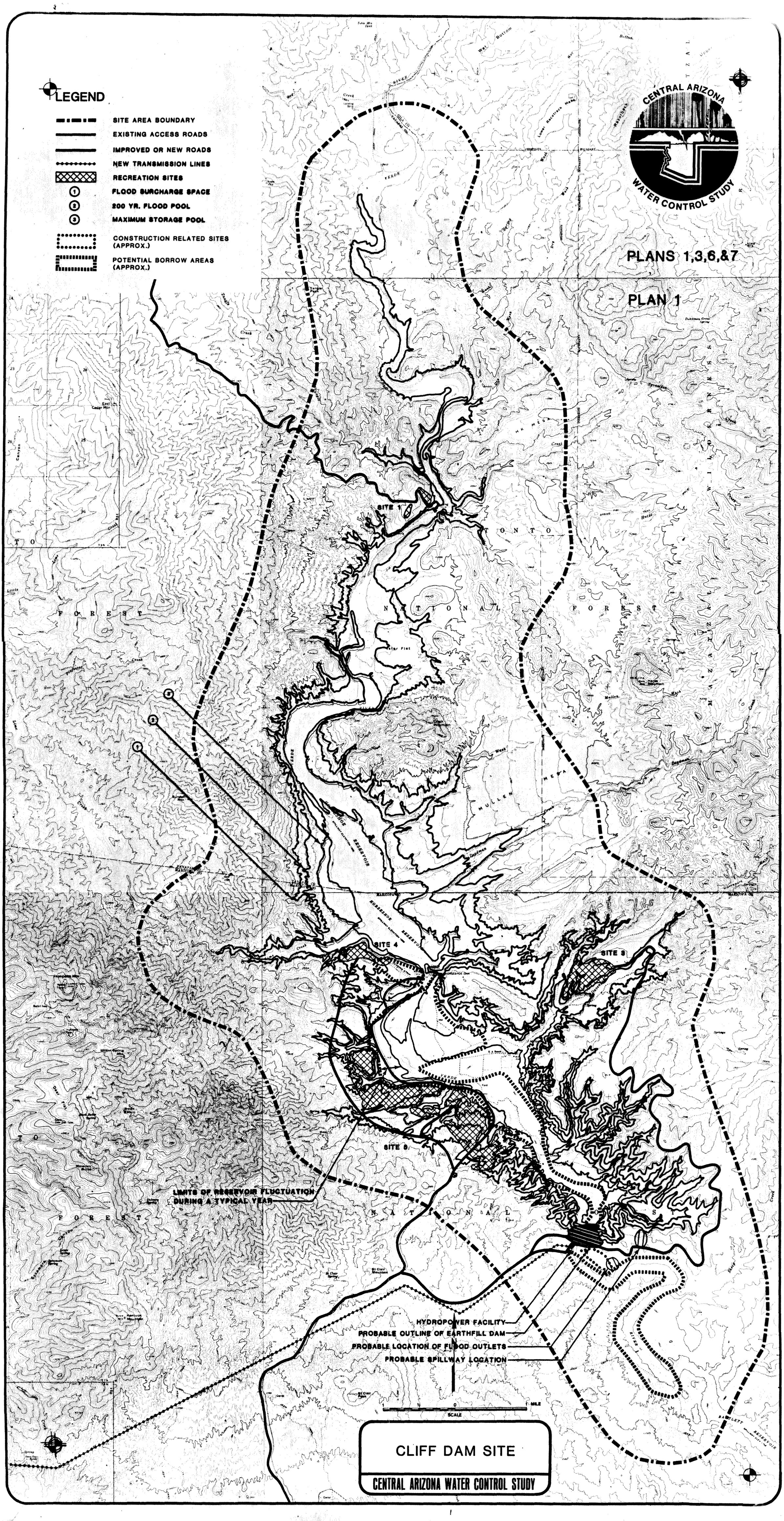
TABLE F-1

RELATIONSHIP OF POOL ELEVATIONS AND STORAGE LEVELS BASED ON ELEVATION-DURATION CURVE DATA

Plan	Element	Pool Elevations			Pool Elevations at X% of Time			Percent Time of X Level of Storage					
		TYL	TYH	MSP	4%	5%	10%	X<TYL	X>TYL	X>TYH	TYL<X<TYH	X>MSP	TYH<X<MSP
1	Cliff	1,891	1,962	2,001	2,001	2,000	1,988	25	75	21	54	4	17
	Roosevelt	2,085	2,107	2,147	2,137	2,134	2,121	38	62	14	48	2	12
2	Cliff	1,847	1,917	1,952	1,948	1,945	1,939	25	75	21	54	0	21
	Roosevelt	2,085	2,107	2,147	2,127	2,125	2,115	38	62	14	48	2	14
3	Cliff	1,880	1,928	2,001	1,993	1,987	1,962	30	70	20	50	2	18
	Roosevelt	2,085	2,107	2,147	2,137	2,134	2,121	38	62	14	48	2	12
	Confluence	1,380	1,426	1,431	1,431	1,429	1,425	25	75	8	67	4	4
6	Cliff	1,880	1,928	2,001	1,993	1,987	1,962	30	70	20	50	2	18
	Roosevelt	2,085	2,107	2,147	2,137	2,134	2,121	38	62	14	48	2	12
	Waddell	1,571	1,694	1,702	1,702	1,700	1,697	22	78	12	66	4	8
7	Cliff	1,915	1,954	2,001	2,001	2,000	1,988	54	46	24	22	4	20
	Roosevelt	2,093	2,109	2,147	2,147	2,144	2,138	35	65	46	19	4	42
	Waddell	1,571	1,694	1,702	1,702	1,700	1,697	22	78	12	66	4	8
8	Horseshoe	1,950	1,997	2,026	2,021	2,019	2,010	38	62	18	44	0	18
	Roosevelt	2,085	2,108	2,134	2,127	2,125	2,110	38	62	14	48	0	14
	Lake Pleasant	1,525	1,555	1,601	1,596	1,594	1,582	45	55	28	27	0	27


LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
IMPROVED OR NEW ROADS
NEW TRANSMISSION LINES
RECREATION SITES
FLOOD SURCHARGE SPACE
200 YR. FLOOD POOL
MAXIMUM STORAGE POOL
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
CENTRAL ARIZONA WATER CONTROL STUDY
PLANS 1,3,6,&7
PLANS 3&6
SITE 1
SITE 3
SITE 4
SITE 5
TONTO NATIONAL FOREST
MULLEN MESA
HORSESHOE RESERVOIR
LIMITS OF RESERVOIR FLUCTUATION DURING A TYPICAL YEAR
HYDROPOWER FACILITY
PROBABLE OUTLINE OF EARTHFILL DAM
PROBABLE LOCATION OF FLOOD OUTLETS
PROBABLE SPILLWAY LOCATION
SCALE
1 MILE
CLIFF DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY


LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
IMPROVED OR NEW ROADS
NEW TRANSMISSION LINES
RECREATION SITES
1 FLOOD SURCHARGE SPACE
2 200 YR. FLOOD POOL
3 MAXIMUM STORAGE POOL
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
CENTRAL ARIZONA WATER CONTROL STUDY
PLANS 1,3,6,&7
PLAN 7
SITE 1
SITE 3
SITE 4
SITE 5
TONTO NATIONAL FOREST
MAZATZAL WILDERNESS
MULLEN MESA
HORSESHOE RESERVOIR
VERDE RIVER
LIMITS OF RESERVOIR FLUCTUATION DURING A TYPICAL YEAR
HYDROPOWER FACILITY
PROBABLE OUTLINE OF EARTHFILL DAM
PROBABLE LOCATION OF FLOOD OUTLETS
PROBABLE SPILLWAY LOCATION
1 ½ 0 1 MILE
SCALE
CLIFF DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY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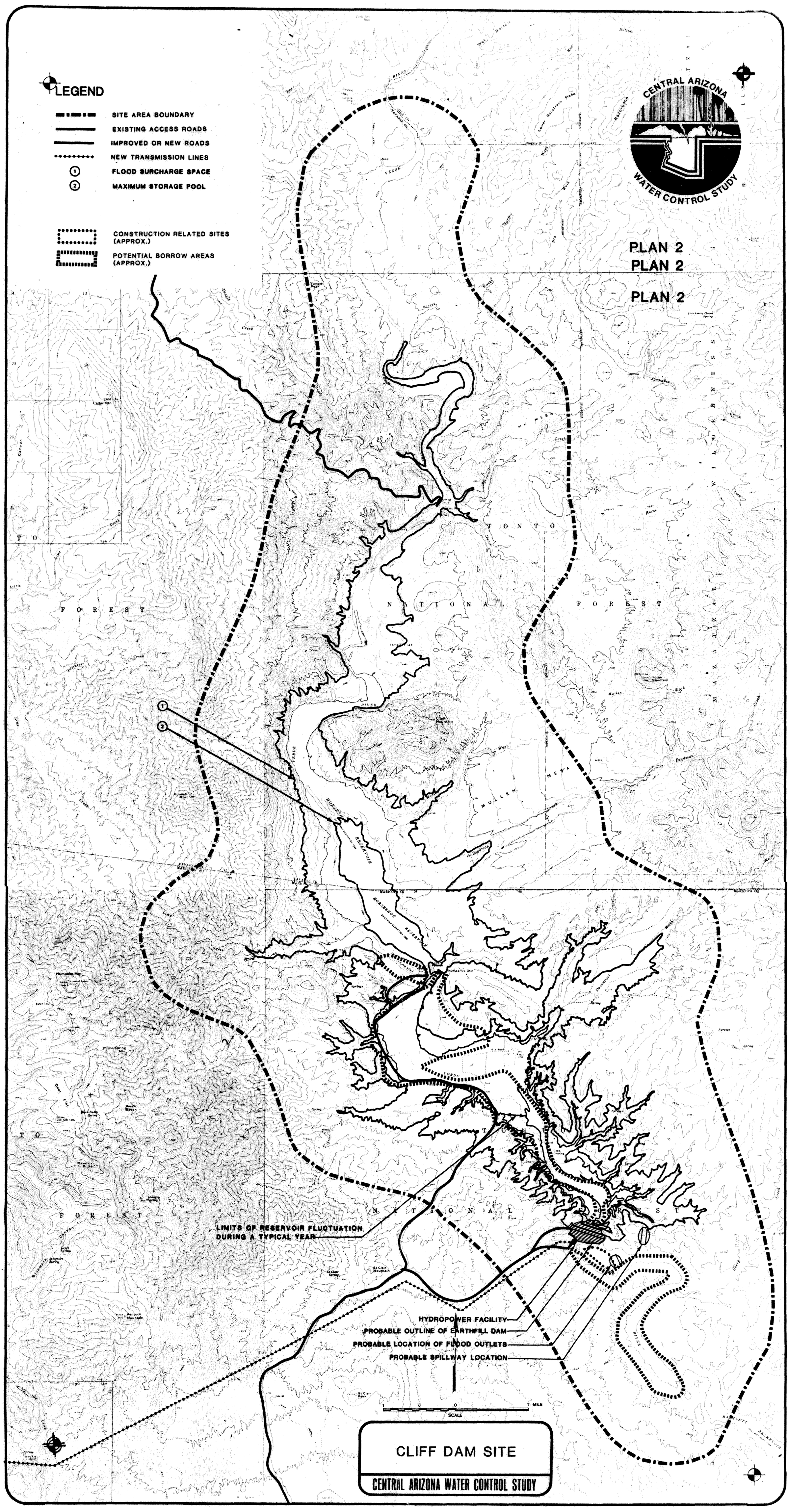
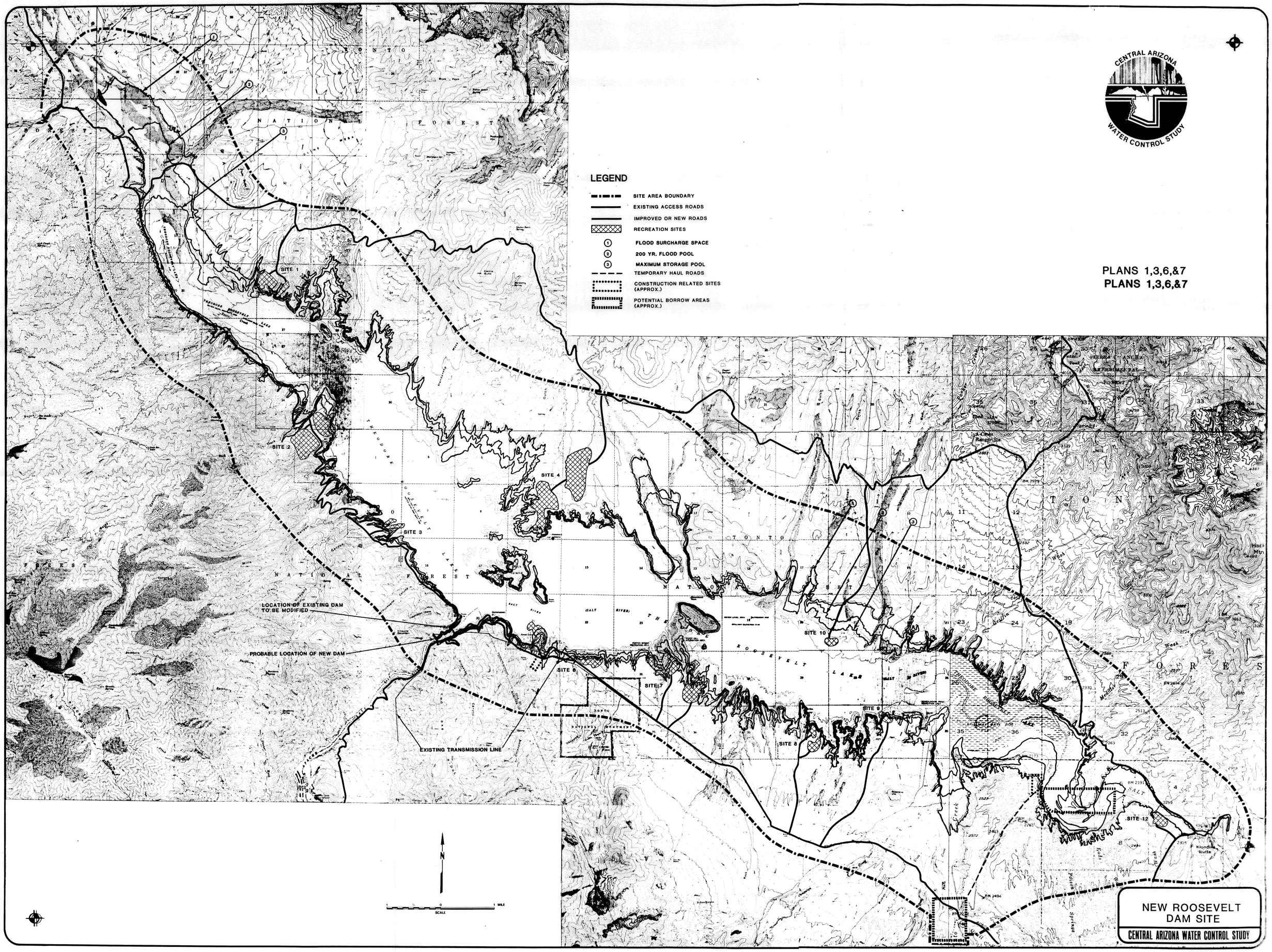
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
IMPROVED OR NEW ROADS
NEW TRANSMISSION LINES
RECREATION SITES
FLOOD SURCHARGE SPACE
200 YR. FLOOD POOL
MAXIMUM STORAGE POOL
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
CENTRAL ARIZONA WATER CONTROL STUDY
PLANS 1,3,6,&7
PLAN 1
SITE 1
SITE 3
SITE 4
SITE 5
TONTO NATIONAL FOREST
MULLEN MESA
LIMITS OF RESERVOIR FLUCTUATION DURING A TYPICAL YEAR
HYDROPOWER FACILITY
PROBABLE OUTLINE OF EARTHFILL DAM
PROBABLE LOCATION OF FLOOD OUTLETS
PROBABLE SPILLWAY LOCATION
SCALE
MILE
CLIFF DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY


LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
IMPROVED OR NEW ROADS
NEW TRANSMISSION LINES
1 FLOOD SURCHARGE SPACE
2 MAXIMUM STORAGE POOL
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
CENTRAL ARIZONA WATER CONTROL STUDY
PLAN 2
PLAN 2
PLAN 2
TONTO NATIONAL FOREST
MAZATZAL WILDERNESS
MULLEN MESA
HORSESHOE RESERVOIR
HOPSESHOE RESERVOIR
VERDE RIVER
LIMITS OF RESERVOIR FLUCTUATION DURING A TYPICAL YEAR
HYDROPOWER FACILITY
PROBABLE OUTLINE OF EARTHFILL DAM
PROBABLE LOCATION OF FLOOD OUTLETS
PROBABLE SPILLWAY LOCATION
1 ½ 0 1 MILE
SCALE
CLIFF DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY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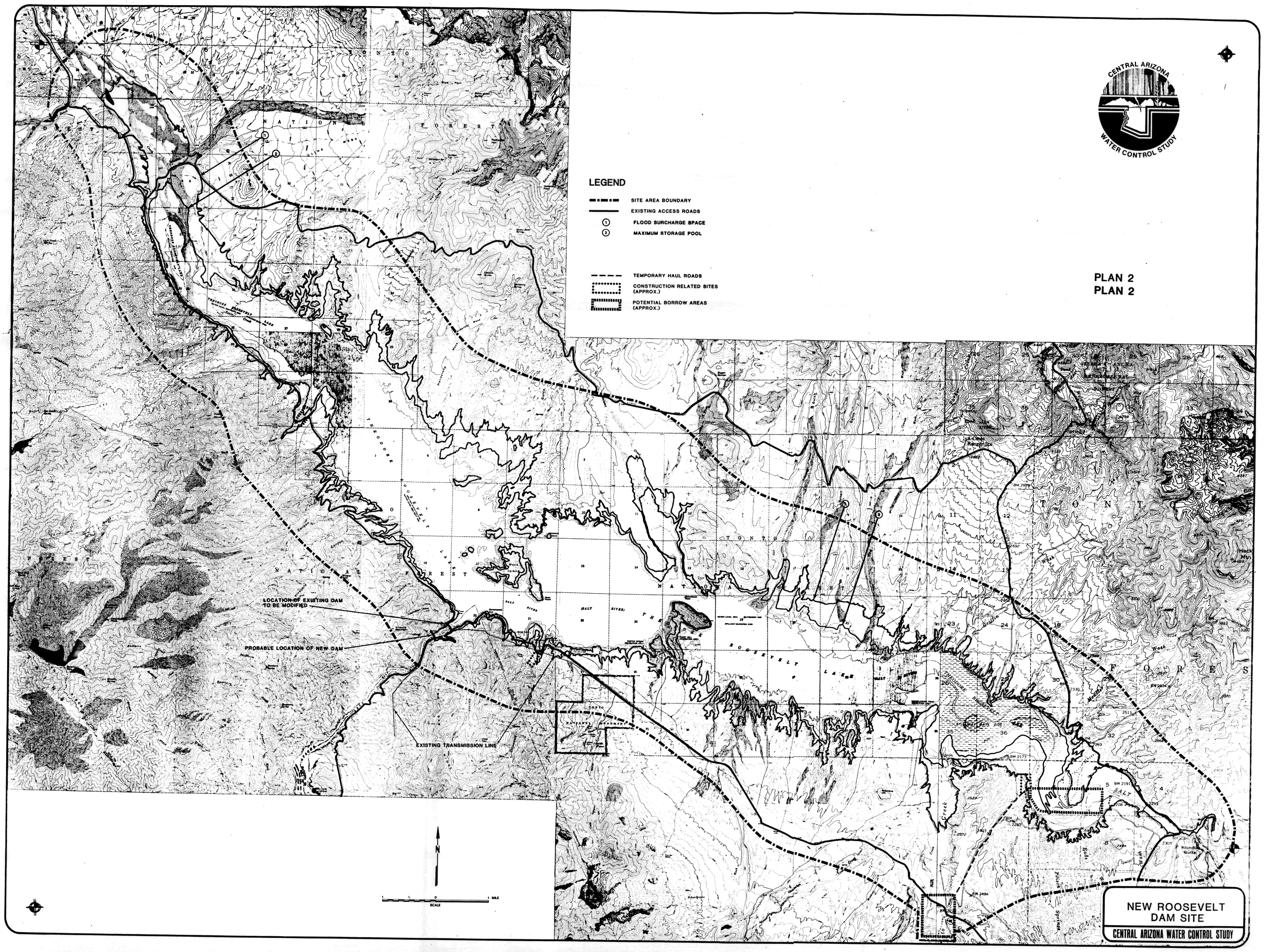
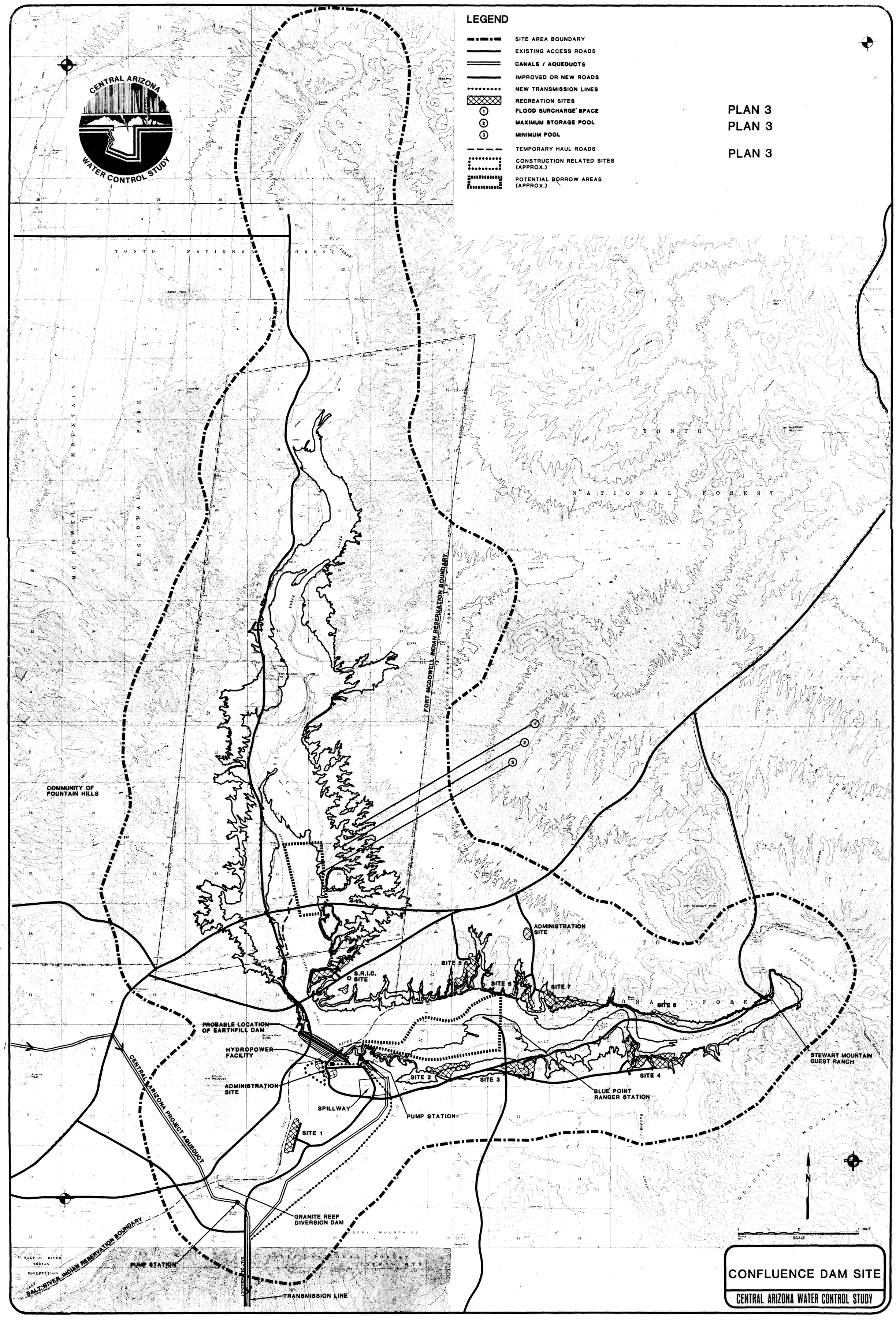
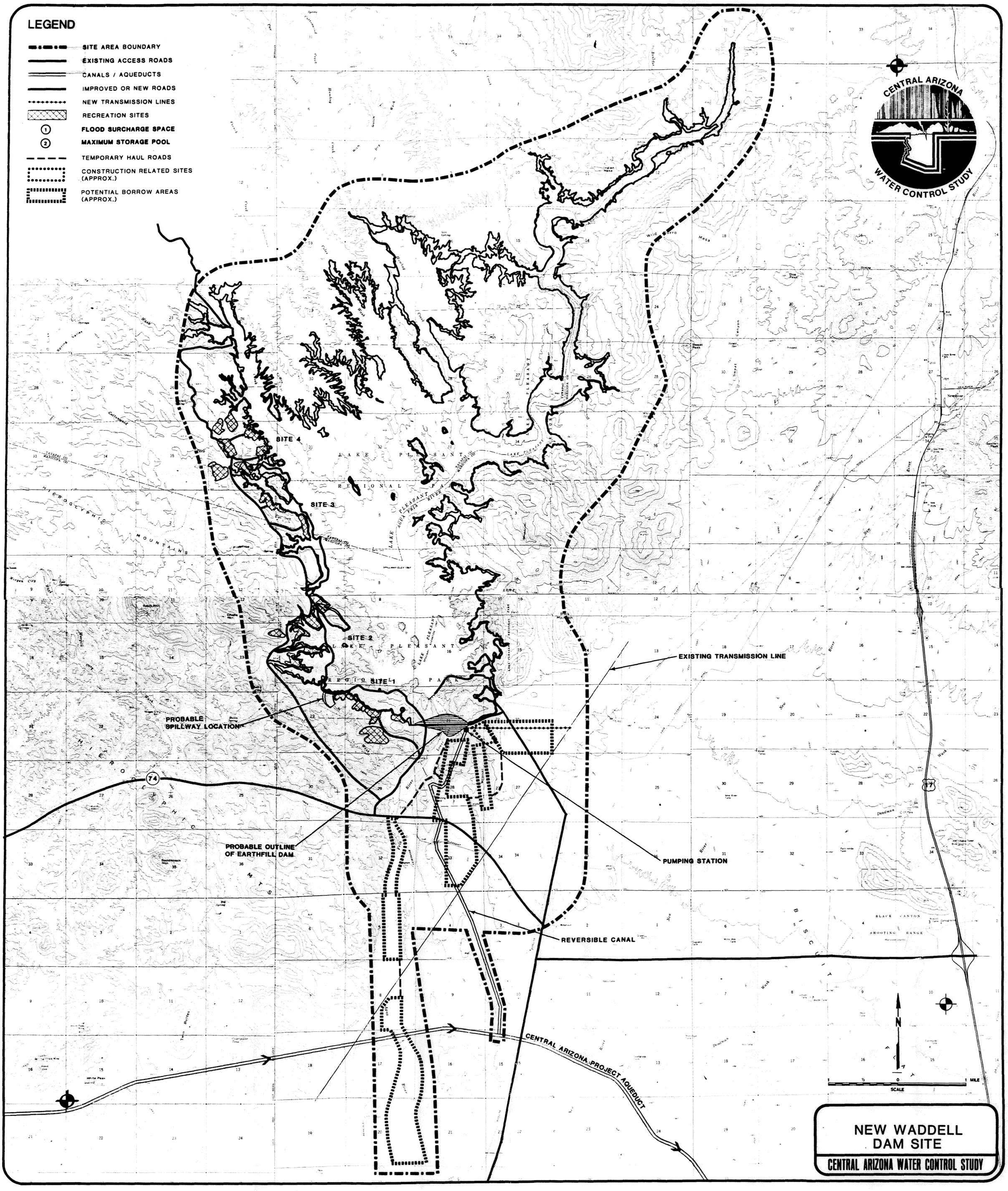
LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
IMPROVED OR NEW ROADS
RECREATION SITES
1 FLOOD SURCHARGE SPACE
2 200 YR. FLOOD POOL
3 MAXIMUM STORAGE POOL
TEMPORARY HAUL ROADS
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
PLANS 1,3,6,&7
PLANS 1,3,6,&7
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
SITE 9
SITE 10
SITE 12
LOCATION OF EXISTING DAM TO BE MODIFIED
PROBABLE LOCATION OF NEW DAM
EXISTING TRANSMISSION LINE
TONTO NATIONAL FOREST
ROOSEVELT LAKE
(SALT RIVER)
N
SCALE
NEW ROOSEVELT DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY


CENTRAL ARIZONA WATER CONTROL STUDY
LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
FLOOD SURCHARGE SPACE
MAXIMUM STORAGE POOL
TEMPORARY HAUL ROADS
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
PLAN 2
PLAN 2
LOCATION OF EXISTING DAM TO BE MODIFIED
PROBABLE LOCATION OF NEW DAM
EXISTING TRANSMISSION LINE
SCALE
1 ½ 0 1 MILE
NEW ROOSEVELT DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY


LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
CANALS / AQUEDUCTS
IMPROVED OR NEW ROADS
NEW TRANSMISSION LINES
RECREATION SITES
FLOOD SURCHARGE SPACE
MAXIMUM STORAGE POOL
MINIMUM POOL
TEMPORARY HAUL ROADS
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
PLAN 3
PLAN 3
PLAN 3
CENTRAL ARIZONA WATER CONTROL STUDY
TONTO NATIONAL FOREST
MCDOWELL MOUNTAIN REGIONAL PARK
FORT MCDOWELL INDIAN RESERVATION BOUNDARY
COMMUNITY OF FOUNTAIN HILLS
ADMINISTRATION SITE
S.R.I.C. SITE
SITE 5
SITE 6
SITE 7
SITE 8
SITE 4
SITE 3
SITE 2
SITE 1
STEWART MOUNTAIN GUEST RANCH
BLUE POINT RANGER STATION
PROBABLE LOCATION OF EARTHFILL DAM
HYDROPOWER FACILITY
ADMINISTRATION SITE
SPILLWAY
PUMP STATION
CENTRAL ARIZONA PROJECT AQUEDUCT
GRANITE REEF DIVERSION DAM
PUMP STATION
TRANSMISSION LINE
SALT RIVER INDIAN RESERVATION BOUNDARY
SALT GILA AQUEDUCT
USERY MOUNTAINS
GOLDFIELD MOUNTAINS
SAGUARO LAKE
SALT RIVER
VERDE RIVER
N
SCALE
1 MILE
CONFLUENCE DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY


LEGEND
SITE AREA BOUNDARY
EXISTING ACCESS ROADS
CANALS / AQUEDUCTS
IMPROVED OR NEW ROADS
NEW TRANSMISSION LINES
RECREATION SITES
1 FLOOD SURCHARGE SPACE
2 MAXIMUM STORAGE POOL
TEMPORARY HAUL ROADS
CONSTRUCTION RELATED SITES (APPROX.)
POTENTIAL BORROW AREAS (APPROX.)
CENTRAL ARIZONA WATER CONTROL STUDY
SITE 4
SITE 3
SITE 2
SITE 1
LAKE PLEASANT REGIONAL PARK
EXISTING TRANSMISSION LINE
PROBABLE SPILLWAY LOCATION
PROBABLE OUTLINE OF EARTHFILL DAM
PUMPING STATION
REVERSIBLE CANAL
CENTRAL ARIZONA PROJECT AQUEDUCT
HIEROGLYPHIC MOUNTAINS
BLACK CANYON SHOOTING RANGE
74
N
SCALE
1 ½ 0 1 MILE
NEW WADDELL DAM SITE
CENTRAL ARIZONA WATER CONTROL STUDY