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 the 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. This process is described in detail in Plan Formulation Supporting Document (USBR, 1982g).

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 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 which would be located 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 New Granite Reef Dam, 4 miles downstream. New Granite Reef Dam was eliminated because geology and cost significantly favored the Confluence site, while environmental and social impacts were essentially the same at both sites.
- 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.

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 Confluence	o			o
Salt-Gila Confluence to Gillespie Dam	o		o	
CHANNEL CLEARING	o		o	
WATER EXCHANGE WITH SRP		o	o	
SRP REREGULATION	o		o	
NONSTRUCTURAL MEASURES	o		o	
GROUNDWATER RECHARGE	o	o	o	
NO ACTION			o	

- 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 - an existing flood control dam on Santa Rosa Wash. The analysis showed that on the basis of site suitability, 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 questionable. As a result, New Roosevelt Dam was added for flood control, SOD, and CAP storage on the Salt River. A New Stewart Mountain Dam was also added, for the same purposes.

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:

- 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, ground water recharge was retained as possible mitigation for SRP Reregulation water losses and also as 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 was provided in upstream reservoirs.

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 WITH 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[a] + 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[a] + 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 MEASURES
6	Nonstructural Flood Damage Reduction Measures + SRP Exchange

[a]Multipurpose

3. Stage III Alternatives

At the start of Stage III, ten 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, Reclamation widened the focus on 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 Plan Formulation Supporting Document (USBR, 1982g). 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

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, Plans 4 and 5 were eliminated from consideration because the benefits derived from the plans were not sufficient to offset their high cost and adverse social and environmental impacts. A more detailed discussion of plan development and selection is contained in Plan Formulation Supporting Document (USBR, 1982g), and is also presented in Reclamation's Stage III Report (USBR, 1982i).

B. Alternatives Analyzed in Detail

During the first part of Stage III plans 1, 2, 3, 6, 7, and 8 were analyzed in detail. In October 1981, the CAWCS 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.

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 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, Reclamation 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 Dam in the EIS. Consequently, both the Modified and New Stewart Mountain Dam 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 to provide flood control for the Salt River; therefore, both New and Modified Roosevelt Dam appear in the EIS in all action plans except Plan 2. Plan 2 is a SOD-only plan which provides no dedicated flood control or regulatory storage space. Designs for Roosevelt Dam indicate that the existing dam can be raised to elevation 2,185 feet to accomplish dam safety objectives (surcharge space for the Inflow Design Flood (IDF)). New Roosevelt Dam or a larger Modified Roosevelt Dam would be required in plans which contain dedicated flood control space at Roosevelt Lake.

Impacts are assessed for construction of new dams at both the Roosevelt and Stewart Mountain sites (except Plan 2), with the difference in impact from modification also noted.

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

The Draft EIS was filed April 29, 1983. Three public hearings were held. Numerous oral and written comments were received. One of the major concerns expressed was that all of the candidate plans displayed in the Draft EIS, except Plan 8, included Cliff Dam. In response to these concerns, it was decided to include in the Final EIS a plan (Plan 9) that did not include Cliff Dam. This plan had been studied earlier in Stage III and eliminated from further consideration. Plan 9 was then analyzed again to assure the information developed for it was at a level of detail comparable to the other candidate plans. After examining Plan 9, the agency proposed action remains Plan 6.

All plans, except the No Action alternative, and Plan 9 share common components. These are Cliff, New/Modified Roosevelt, and New/Modified Stewart Mountain Dams. Cliff and New/Modified Roosevelt Dams would be the same structure in Plans 1, 3, 6, and 7; they differ significantly in Plan 2 (SOD only). New/Modified Stewart Mountain Dam would be the same in all plans. Details of dam and reservoir designs can be found in Designs and Estimates Supporting Document (USBR, 1982e). For purposes of brevity in the EIS, Cliff, Roosevelt, and Stewart Mountain Dams are described once and referenced in plans in which they are the same.

1. Major Project-Related Activities

With the implementation of any CAWCS action plan there would be activities associated with construction and operation that would cause environmental and social impacts. The impacts are described in Chapter IV. The activities are described in the following subsections.

a. Construction Activities

The size of construction areas at each affected site area was estimated for the purpose of impact assessment. A summary of these construction impact areas is presented on Table II-4. Construction areas are described for each site as are sizes of the areas in different plans. These areas are shown in green on the plates in the map pockets at the end of the Draft EIS.

Lands would be acquired by the federal government (as required) at each site for the dam, spillway, canals or aqueducts, power plant, pumping plant, borrow areas, waste areas, construction staging areas, recreation sites, access roads, land within the reservoir area to the top of the flood surcharge pool. Land acquisition and any required relocations of people and facilities would occur in accordance with Public Law 91-646, the Uniform Relocation Assistance and Land Acquisition Policies Act of 1970. This act also covers any relocations of homes or businesses that would be necessary. Relocation compensation would be either monetary or by replacement-in-kind. The government would acquire in fee an area which would be to the top of the surcharge (IDF) pool of the reservoir. Lands within the IDF area but above normal pool levels could be leased for agricultural or grazing purposes. Lands which are above the maximum storage pool (MSP) and which are not leased for these purposes or set aside for recreation purposes would be unaffected by the project construction and would remain in a natural state except for possible infrequent inundation by floodwater.

There would be permanent site modification from the construction of the dam, spillway, power facilities, recreation facilities, and access roads. These areas would be subject to removal of vegetation, excavation, possible blasting, and heavy vehicular traffic. Vegetation within the conservation pool would be cleared, piled, and burned onsite. Vegetation within the flood pool would not require modification, except where access to the conservation pool was necessary.

The borrow areas, waste areas, construction staging areas, and haul road areas would be temporarily modified. Haul roads would be 30 feet wide, requiring a 60-foot-wide right-of-way; access roads would be 24 feet wide requiring a 30 foot right-of-way. All construction areas and haul roads not converted to access roads and not ultimately within the reservoir would be returned to natural grade and revegetated upon completion of construction. Construction and installation of transmission towers for the new transmission lines would cause minimal site disturbance. Chain link fencing would be installed on both sides of reversible canals upon completion of construction. Natural drainage may be modified to bypass the open canal. Construction areas outside of the fenced area would be graded and revegetated.

Table II-4
CONSTRUCTION IMPACT AREAS[a]

	Units	Cliff Plans 1,3,6&7	Cliff Plan 2	Roosevelt Plans 1,3,6,7,9	Roosevelt Plan 2	Stewart Mountain Plans 1,2,3,6,7,9 Modified	Stewart Mountain Plans 1,2,3,6,7,9 New	Confluence Plan 3	New Waddell Plans 6,7,9	CAP Pumping Plant Plans 1,6,7,9	Verde River Dams Modifications Plan 9
Total Area Within Take Line (IDF area)	Acres	14,246	10,970	29,854	27,391	--	--	12,975	12,680	--	6,880
Total Area of Dam Site (Includes detached spillways and outlets)	Acres	110	110	15	15	10	20	110	150	--	70
Total Area for New Pump Station	Acres	--	--	--	--	--	--	--	--	5.0	--
Total Length of New Canal/ Aqueduct (200 foot right-of-way)	Miles	--	--	--	--	--	--	3.2	4.8	0.2	--
Total Length of New Transmission Lines (200-foot easement)	Miles	--	--	0.6	0.6	--	--	4.4	1.5	b	--
Total Area of Construction Related Sites (includes offices, storage areas, maintenance areas, and parking for heavy equipment and automobiles	Acres	89	89	56	56	9	9	40	37	c	10
Total Area of Borrow Pits	Acres	2,080	2,080	680	680	--	--	1,250	1,872	--	20
Total Length of New Haul Roads (60-foot ROW)	Miles	--	--	8.8	8.8	--	--	3.3	2.6	--	--
Total Length of New ROW for Access Roads (30-foot ROW, length does not include ROW for existing roads)	Miles	16.3	3.4	12.3	--	--	--	8.0	6.6	--	--
Total Length of Relocated Road	Miles	--	--	2.5[d]	d	--	--	9.2	--	--	--

[a]Sizes of construction areas were estimated for purposes of this impact assessment. All lengths and areas refer to impacts as shown on the respective Site Maps in the map pockets.

[b]Transmission line would be installed along the aqueduct ROW.

[c]Construction related sites would be included in pump station area.

[d]Some minor relocation of State Routes 88 and 188 would also be required and is not included here.

Removal of rock during construction would require drilling, blasting, and ripping. The blasting generally would be limited to a series of small charges. There would be placement of new material for the new dam. Concrete would be produced onsite. These operations would require a substantial amount and variety of heavy equipment. The equipment and the borrow areas would probably not be covered to minimize dust, but dust suppression controls such as periodically wetting haul roads would be used whenever possible.

b. Operation Activities

Operational activities primarily concern reservoir filling and use. Reservoir levels can vary from minimum conservation and regulatory storage pools to the maximum Inflow Design Flood (IDF) pool due to highly variable year-to-year runoff of central Arizona rivers. To anchor the operational impact assessment, a "representative" pool was needed. In response to this need for assessing likely impacts, a "typical-year" scenario was developed from elevation-duration curves based on Reclamation's operation studies for each reservoir included in the CAWCS plans. The typical-year pool fluctuates during a year because of seasonal inflow and demand; this annual fluctuation provides the basis for analyzing impacts of regular variation in water elevations. Reservoir elevation levels, associated volume and acreages, and percent of time the reservoirs are expected to fill to the various levels are given in Appendix C. Pool levels are shown on the plates that depict the reservoirs for the elements (see the map pocket at the back of the draft EIS. The pools shown are the typical-year high and low pools, the maximum storage pool (MSP), the 200-year flood pool, and the IDF pool. The MSP is the pool that includes conservation storage and/or CAP regulatory storage. The other pools are self-explanatory or have been defined.

2. 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. (A detailed projection of future conditions in the CAWCS area is contained in Regional Future Without the Project, Dames & Moore, 1981b.) Under Plan 8, 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. Reclamation 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 Modified 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 Safety of Dams Supporting Document (USBR, 1982c).

- Twelve bridges on the Salt and Gila Rivers would withstand flows of up to 200,000 cubic feet per second (cfs) after proposed construction or modification. None would be large enough to remain open should larger 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 and would be constructed. 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, and 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, Tucson Aqueduct, and Hooker Dam or a suitable alternative.

- Floodplain management is assumed, including enforcement of existing laws and regulations. No existing structures in the flood plain would be abandoned, but new structures in 100-year flood plain 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 River 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. This channel clearing program is an interim (25-year) measure to provide increased flood protection until upstream flood control is provided.

- Flood warning systems maintained by, and coordinated among, the State of Arizona, Salt River Project, and the Flood Control District of Maricopa County would be continued and improved.

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

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

- 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 flood plain through Phoenix. Studies for the Rio Salado Development District are progressing at a reconnaissance level.

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

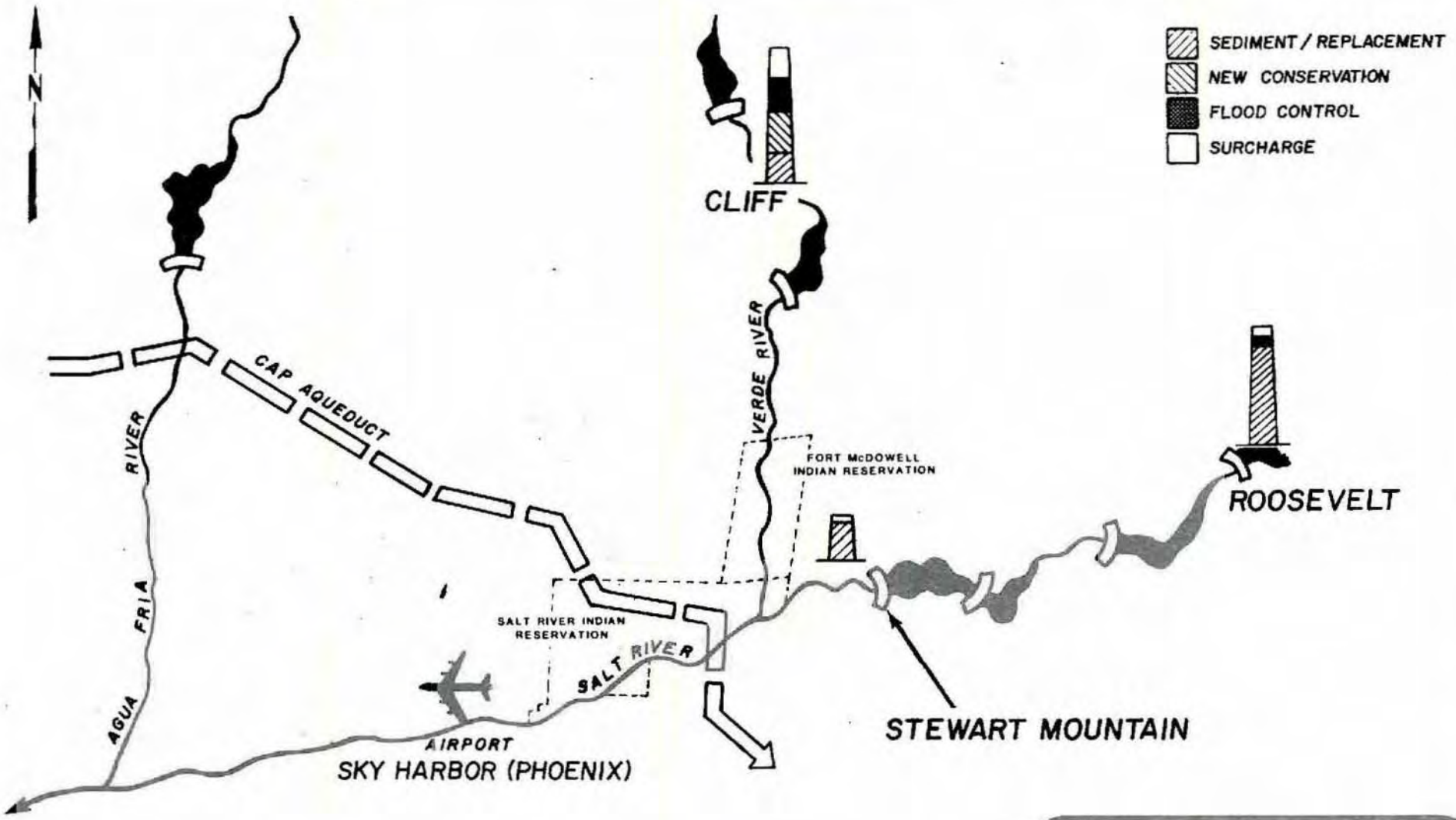
This plan consists of construction of Cliff Dam on the Verde River and New or Modified Roosevelt Dam on the Salt River to provide flood control, additional water conservation, hydropower, recreation and dam safety, and New or Modified Stewart Mountain Dam on the Salt River for dam safety purposes. The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

This plan would provide 170,000 af of new water conservation space at Cliff Dam and would use one half of the sediment pool at Roosevelt Lake to increase the average annual amount of available CAP water (CAP yield) by 107,000 af/yr. Projected average annual CAP water yield for this plan is 1,113,000 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. In Plan 1, and in all other plans, these target flows represent flows which are expected to occur at the designated location under 200-year or 100-year flood conditions. Should events larger than the 200-year flood occur, flows in the river would be higher than the target flow. Flows lower than the target flow could occur in the river in events smaller than a 100-year flood because water would be released from the dams as soon as the dedicated flood control space begins to fill. Additionally, flows could occur if a storm occurred on the watershed downstream of the flood control structures.

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 limited 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 new dams are built or the existing dams are modified. If new dams are built at these sites, the existing dams would be breached. All action plans, including Plan 1, require relocation of some residents living around Roosevelt Lake. On the Verde River, Horseshoe Dam would be breached, and the storage replaced in Cliff Reservoir. The recreation facilities and dam tender facilities at Horseshoe Dam would be inundated. These facilities would be replaced at the new dam. The ranch below Horseshoe Dam (KA Ranch) would also be inundated, requiring relocation of the residents.



CAP YIELD	107,000 af/yr
FLOOD CONTROL	
200-YEAR at AIRPORT	92,000 cfs
100-YEAR at AIRPORT	55,000 cfs

FIGURE II-1

PLAN 1
CLIFF + ROOSEVELT +
STEWART MOUNTAIN DAM

Design information on dams and related features included in Plan 1 is displayed in Table II-5. Total construction cost of Plan 1 would be between $694,940,000 and $874,230,000 depending upon whether new or modified Roosevelt and Stewart Mountain Dams are constructed.

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 delineated for impact assessment purposes includes approximately 52,800 acres. Most of the land required for the project is currently under Federal ownership.

Cliff Dam would be an embankment (earthfill/rockfill, etc.) structure and would include flood and water supply outlet works. All releases would be to the Verde River channel.

Conceptual Recreation Plans have been developed by the U.S. Army Corps of Engineers and Reclamation for all reservoirs included in alternative plans. Details of these recreation plans are described in Recreation Planning Supporting Document (USBR, 1982f). Recreation sites at Cliff Reservoir in Plans 1, 3, 6, and 7 include four sites totaling 332,5 acres.

Plate 1 ("Cliff Site - Plan 1") in the map pocket in the back of the Draft EIS 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 200-year flood pool, the IDF level, and the typical-year high and typical-year low pools.

(1) Construction Considerations

A temporary Reclamation construction field office would be installed at the construction related site near the dam. The construction contractor would also be expected to establish temporary construction offices in the same location. These offices together with storage and parking would require about 90 acres.

Local transportation would not be affected by the construction of Cliff Dam. The existing road to Horseshoe Dam would serve for access to the site area. A new 4.5 mile-long access road would connect the existing road to the dam site. Haul roads for the earth materials for the dam would be limited to the borrow areas.

Table II-5

DESIGN DETAILS - PLAN 1

	CLIFF DAM
DAM STRUCTURE:	
Height	338 feet
Crest Length	2,900 feet
Embankment Dam Volume	15,000,000 cubic yards
SPILLWAY:	(perched and ungated)
Crest Length	125 feet
Head	47 feet
Capacity	150,000 cfs
APPURTENANT WORKS:	
Hydroelectric Powerplant	none
Pumping Plant	1,600 cfs combined for Cliff and Roosevelt (located at Granite Reef)
Service Outlet	4,000 cfs
Flood Outlet:	
Capacity in Flood Pool	25,000 cfs
Capacity at MWS[a]	36,000 cfs
Reversible Canal:	none
Capacity	
Length	

STORAGE ALLOCATION:

	Incremental 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-5 (Continued)

	ROOSEVELT DAM	
	New	Modified
DAM STRUCTURE:		
Height	299 feet	299 feet
Crest Length	1,250 feet	1,220 feet
Concrete Dam Volume	340,000 cubic yards	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:		
Hydroelectric Powerplant	replace existing capacity	existing plant remains
Pumping Plant	...1,600 cfs combined for Cliff and Roosevelt (located at Granite Reef)...	
Service Outlet	11,000 cfs	11,000 cfs
Flood Outlet:	.....spillway to be used as flood outlet.....	
Capacity in Flood Pool		
Capacity at MWS[a]		
Reversible Canal:	none	none
Capacity		
Length		

STORAGE ALLOCATION:

	Incremental 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-5 (Continued)

	STEWART MOUNTAIN DAM			
	New		Modified (same as existing)	
DAM STRUCTURE:				
Height	118 feet		116 feet	
Crest Length	1,300 feet		1,260 feet	
Concrete Dam Volume	130,000 cubic yards		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:				
Hydroelectric Powerplant	replace existing capacity		existing plant remains	
Pumping Plant	none		none	
Service Outlet	4,000 cfs		4,000 cfs	
Flood Outlet:	none		none	
Capacity in Flood Pool				
Capacity at MWS[a]				
Reversible Canal:	none		none	
Capacity				
Length				

STORAGE ALLOCATION:

	Incremental 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]Maximum Water Storage

Earthen materials for the embankment construction would be obtained from the borrow areas in the vicinity of the dam. Any concrete required during construction would be produced at a batch plant located at the site. Any other materials would be delivered to the site over the access road. Any waste material would be hauled to approved existing disposal sites or buried in the reservoir area according to construction specifications. All disposals will be approved by the Arizona Department of Health Services.

Contractors would be responsible for obtaining water for construction activities. The sources would be from existing surface water supplies or wells near the site. The water would be transported to the construction site by pipelines or trucks.

Periodic flows in the Verde River would be controlled by the upstream Horseshoe Dam until the dam is breached. Service releases from Horseshoe Reservoir would flow through the construction site in a temporary pipeline until the low-level outlets are completed and the dam constructed high enough to divert water through the outlets. A temporary earthfill coffer dam would be installed just upstream of the dam site to control floodwaters originating from the drainage area below Horseshoe Dam.

The only existing services and facilities which would be affected would be Horseshoe Dam, dam tender facilities, recreational facilities, an air strip near the dam, and Tangle Creek gaging station. Except for the air strip, these would be left intact until the replacement facilities were completed at Cliff Dam. The air strip is located in a potential borrow site and may be closed early during the construction period.

(2) Cliff Dam Water Supply Operation

Cliff Dam would be operated in a manner similar to current SRP operation of Horseshoe Dam. During the summer, water would be stored in Cliff Reservoir only when Bartlett Reservoir is full. The winter operation is to split the Verde River storage between the two reservoirs. Therefore, the conservation pool would normally be at its highest level during late winter-early spring, and lowest in the late summer. In a typical-year, the water surface elevation would fluctuate 71 feet.

The CAP Granite Reef Aqueduct would not be directly connected to Cliff Reservoir. CAP storage space in Cliff Reservoir would be created "on paper" by exchange with the SRP system. When CAP demand is less than the flow in the aqueduct, excess CAP water could be delivered to SRP users in lieu of releases from SRP storage, with an equal amount of SRP water credited to CAP and retained in storage in the new Cliff Reservoir. When CAP demand exceeds the flow in the aqueduct, the stored water could be delivered to CAP users through SRP facilities or to the CAP aqueduct for delivery to downstream CAP users.

To deliver water from Cliff Reservoir to the CAP system, 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 conveying a flow of approximately 1,600 cfs. A new transmission line would connect the pumping plant with the existing CAP power system. These facilities are shown on Plate 2 ("New CAP Pumping Facilities") in the map pocket at the back of the draft EIS.

The operation of this exchange would alter the historic flow regime in the Verde River below Bartlett Dam. Currently, flows typically average 425 cfs and usually range between 50 cfs and 1,450 cfs; however, there are as many as 60 days per year, in the early winter, when no flow occurs in the river. Under Cliff Dam operation, flow in the Verde would be reduced during the months of November through mid-March, 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.

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 Cliff and Roosevelt Reservoirs because it is desirable to keep the percentage of available flood control space in each 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 areas, roads, and pool levels are shown on Plate 3 ("Roosevelt Site - Plans 1, 3, 6, 7") in the map pocket at the end of the Draft EIS. Typical-year low and high pools are not shown because both are below the MSP level of the existing Roosevelt Lake as shown on the plate.

The differences between New and Modified Roosevelt 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 on the watershed.

Existing recreation facilities at Roosevelt Lake would be replaced with ten new and expanded recreation sites covering 638 acres in Plans 1, 3, 6, 7, and 9 (see USBR, 1982f).

(1) Modified Roosevelt Dam

Modification of existing Roosevelt Dam would include increasing the dam's height approximately 59 feet to provide additional sediment storage, flood storage space, and surcharge space for the IDF beyond the existing storage allocations. The storage allocations and elevations would be the same for the modified or the new dam. Modifications would take approximately 3-1/2 years to complete.

The section added to the dam would be concrete, either with or without rock facing to match the existing dam. Removal of the existing dam down to elevation 2,100 is anticipated. 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 existing spillways would be removed and reconstructed with a total maximum capacity of 150,000 cfs. Spillway capacity would be as low as 92,000 cfs depending on the results of ongoing design studies. Some rock excavation would be required in the upstream and downstream spillway channels. Concrete work would be required for the spillway chutes and walls. The access bridges at either end of the dam would be removed and reconstructed. An alternative means of routing traffic would be required; a permanent or temporary bridge upstream of the dam is an option.

There would be drawdown of the reservoir during various stages of the construction. A preliminary construction schedule calls for the reservoir to be drawndown to elevation 2,100 feet from about August to February during each year of construction. Between October and January during the second year of construction the drawdown would be to elevation 2,065 feet for modifications to the low elevation concrete works.

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. If water does need to be released, it would be at a rate similar to normal summer discharges. If unusually high runoff occurs, releases could be at a higher than normal rate.

(2) New Roosevelt Dam

New Roosevelt Dam would be located on the Salt River 1,000 feet downstream from the existing Roosevelt Dam. Most required land, 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 double curvature concrete arch structure and would include flood and water supply outlet works. All releases would be to the Salt River channel. Preliminary designs indicate that gated spillways would be located at either end of the dam, with a total capacity of 150,000 cfs.

While New Roosevelt Dam is under construction, the existing Roosevelt Dam would control normal flows in the river. The outlet works of the new dam would be constructed first and then flows released from the existing Roosevelt Dam would be diverted through these outlet works while the new dam is under construction. Upon completion of the new dam, the existing dam would be breached. It is assumed that the Salt River Project would experience no loss of water due to the construction of New Roosevelt Dam.

A hydroelectric powerplant 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 to connect to existing lines.

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 could be routed across a new bridge constructed over the foundation of the old dam or just upstream of the old dam.

(3) Construction Considerations

A temporary Reclamation construction field office would be installed at the construction-related site near the dam. The contractor would also be expected to establish temporary construction offices in the same location. These offices together with storage and parking would require about 60 acres.

The existing road to Roosevelt Dam (State Route 188) would serve for access to the dam site. Approximately 8.8 miles of new haul road would be required to connect the borrow sites to the existing roads.

Concrete aggregate for the construction of the new dam or modification of the existing dam would be obtained from the designated borrow areas. The concrete would be batched at the dam site or at the construction-related site and delivered to the dam site by truck or pipeline. All other construction materials would be delivered over the access roads.

Any waste material would be hauled to approved existing disposal sites or buried in the reservoir area according to construction specifications. All disposals will be approved by the Arizona Department of Health Services.

Contractors would be responsible for obtaining water for construction activities. The sources would be from existing surface water supplies or wells near the site. The water would be transported to the construction site by pipelines or trucks.

There will be a heavy volume of construction vehicles in the vicinity of the dam site and this may reduce the effective flow of local traffic. If the existing dam is raised, a new bridge would be opened to traffic before dam construction starts. If a new dam is constructed, the existing dam would continue to handle local traffic throughout the construction period.

Normal releases through the existing dam would not be affected by the dam modifications. Releases from the existing dam would have to be diverted through the new dam construction site. This would require temporary construction of an earthen coffer dam and a pipeline until the new dam's low-level outlets were operational and the dam was completed to an elevation high enough to divert water through the outlets.

All existing services and facilities would be maintained throughout the construction period. For those facilities which would be replaced after the construction period, the new facilities would become operational before the existing facilities are taken out of operation.

(4) 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.

Exchanges 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.

(5) 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. Construction of 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 included within the Confluence site area, and is detailed on Plate 4 ("Stewart Mountain Site and Potential Sources of Construction Materials") in the map pocket at the back of the draft EIS.

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 af. Spillway construction material would be acquired from one or more Reclamation approved commercial sources shown on Plate 4. These materials would be hauled to the site using Bush Highway

and/or Highway 87 (Beeline Highway). Neither highway would 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 from its current level. 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 downstream base of the existing dam, and would be a concrete dam about 118 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 spillway capacity of the new dam 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. The hydroelectric powerplant at the existing dam would be replaced. 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 spillway alone. In addition to the spillway excavation, about 140,000 additional cubic yards of earth and rock would be excavated and disposed of during construction (total of 510,000 cubic yards). This material would be wasted in the reservoir, causing an additional loss of 90 acre-feet in storage capacity (total of 390 acre-feet). 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 feet. During construction, 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) Construction Considerations

A temporary Reclamation construction field office would be installed at the construction-related site near the dam. The contractor would also be expected to establish temporary construction offices in the same location. These offices together with storage and parking would require about 7 acres.

All access to the Stewart Mountain site would be provided by existing roads. All aggregate for construction would be brought to the site from existing sources in the Salt River below Granite Reef Diversion Dam. Concrete would be batched onsite. All other construction materials would be delivered over the access roads. There will be a heavy volume of construction vehicles in the vicinity of the dam site and this may reduce the effective flow of local traffic along parts of the Bush and/or Beeline Highway.

Any waste material would be hauled to approved existing disposal sites or buried in the reservoir area according to construction specifications. All disposals will be approved by the Arizona Department of Health Services.

Contractors would be responsible for obtaining water for construction activities. The sources would be from existing surface water supplies or wells near the site. The water would be transported to the construction site by pipelines or trucks.

All normal flows in the river would be controlled by the existing Stewart Mountain Dam. Any service releases from the existing dam would be passed through the new dam site in a temporary pipe until the new dam's service outlets are completed. All existing services and facilities would be maintained throughout the construction period.

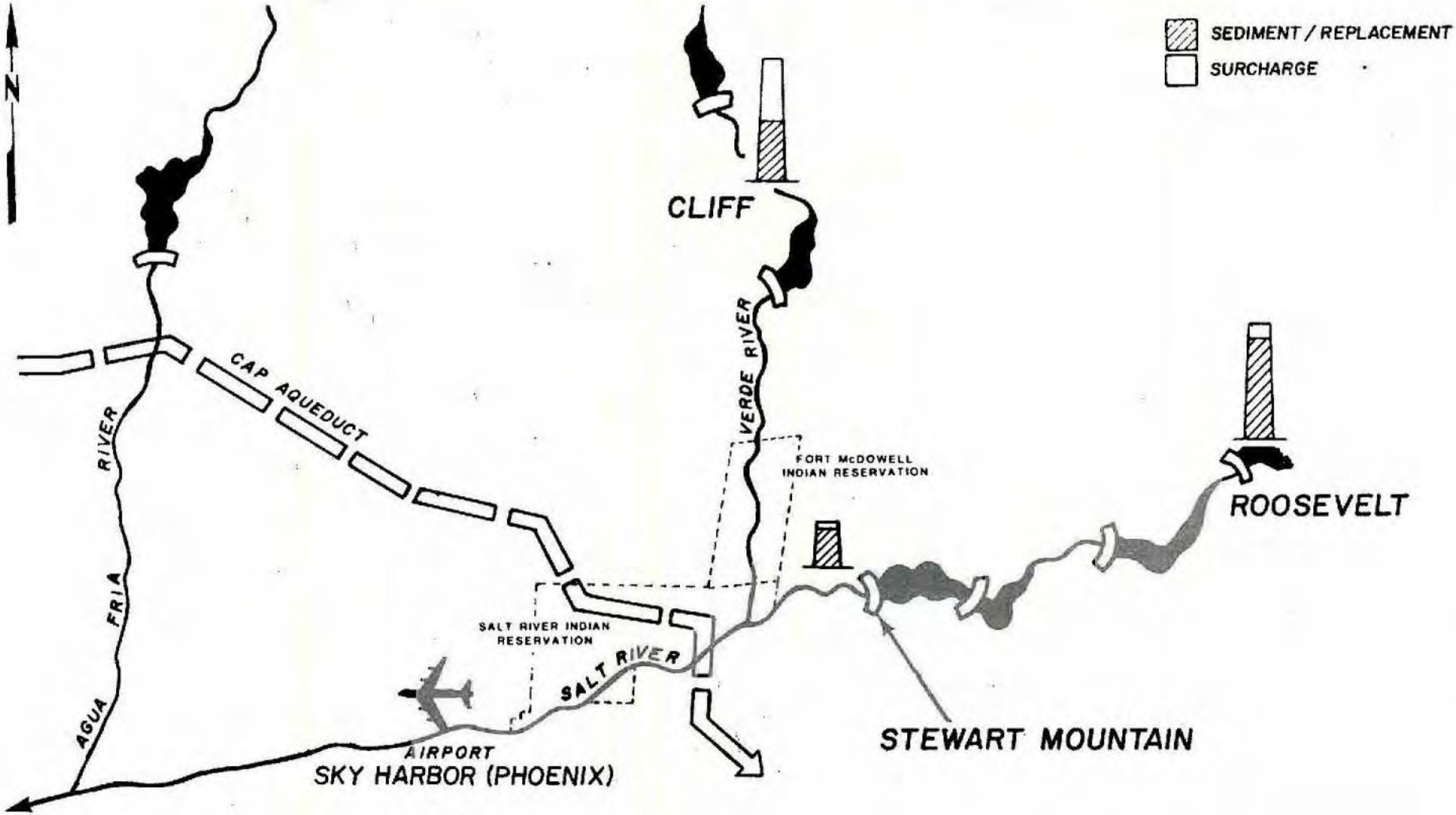
4. Plan 2: Cliff + Roosevelt + Stewart Mountain Dams + Nonstructural Measures

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-2.

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 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 (see Nonstructural Supporting Document, USBR, 1982a). 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



CAP YIELD	16,000 af/yr
FLOOD CONTROL	
200-YEAR at AIRPORT	157,000 cfs
100-YEAR at AIRPORT	150,000 cfs

FIGURE II-2

PLAN 2
CLIFF + ROOSEVELT +
STEWART MOUNTAIN +
NONSTRUCTURAL

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. Existing water supply, hydropower, and recreation facilities at Roosevelt and Stewart Mountain Dams would be maintained at the sites. New Roosevelt Dam is not included as an option in Plan 2 because existing Roosevelt Dam can be raised to elevation 2,185 feet to provide surcharge space for the Inflow Design Flood and solve dam safety problems.

Design information on the dams and related features is displayed in Table II-6. Total construction cost of Plan 2 would be between $541,570,000 and $713,840,000 depending upon whether new or modified dams are constructed.

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, construction staging areas, roads, and pool levels are shown on Plate 5 ("Cliff Site - Plan 2") in the map pocket at the end of the Draft EIS.

No Conceptual Recreation Plan has been developed for this safety of dams element in Plan 2. 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. Modified Roosevelt Dam and Reservoir

In Plan 2, 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 Plate 6 ("Roosevelt Site - Plan 2") at the end of the Draft EIS.

TABLE II-6

DESIGN DETAILS - PLAN 2[a]

	CLIFF DAM
DAM STRUCTURE:	
Height	299 feet
Crest Length	2,550 feet
Embankment Dam Volume	11,000,000 cubic yards
SPILLWAY:	(ungated)
Crest Length	125 feet
Head	44 feet
Capacity	131,000 cfs
APPURTENANT WORKS:	
Hydroelectric Powerplant	none
Pumping Plant	none
Service Outlet	4,000 cfs
Low-Level Outlets:	
Capacity at Top of Conservation	37,500 cfs
Capacity at MWS[b]	55,000 cfs
Reversible Canal:	none
Capacity	
Length	

STORAGE ALLOCATION:

	Incremental 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-6 (Continued)

	ROOSEVELT DAM Modified (no New Roosevelt in Plan 2)
DAM STRUCTURE:	
Height	283 feet
Crest Length	1,210 feet
Concrete Dam Volume	250,000 cubic yards
SPILLWAY:	
Crest Length	200 feet
Head	70 feet
Capacity	150,000 cfs
APPURTENANT WORKS:	
Hydroelectric Powerplant	existing plant remains
Pumping Plant	300 cfs
Service Outlet	11,000 cfs
Low-Level Outlets:	
Capacity at Top of Conservation	--
Capacity at MWS	--
Reversible Canal:	
Capacity	--
Length	--

STORAGE ALLOCATION:

	Incremental 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

[a]Stewart Mountain Dam same as Plan 1

[b]Maximum Water Storage

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. There would be no direct connection between the CAP Granite Reef Aqueduct and Roosevelt Lake. The Roosevelt water yield would be delivered to CAP users in the SRP service area through the existing SRP canals. 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

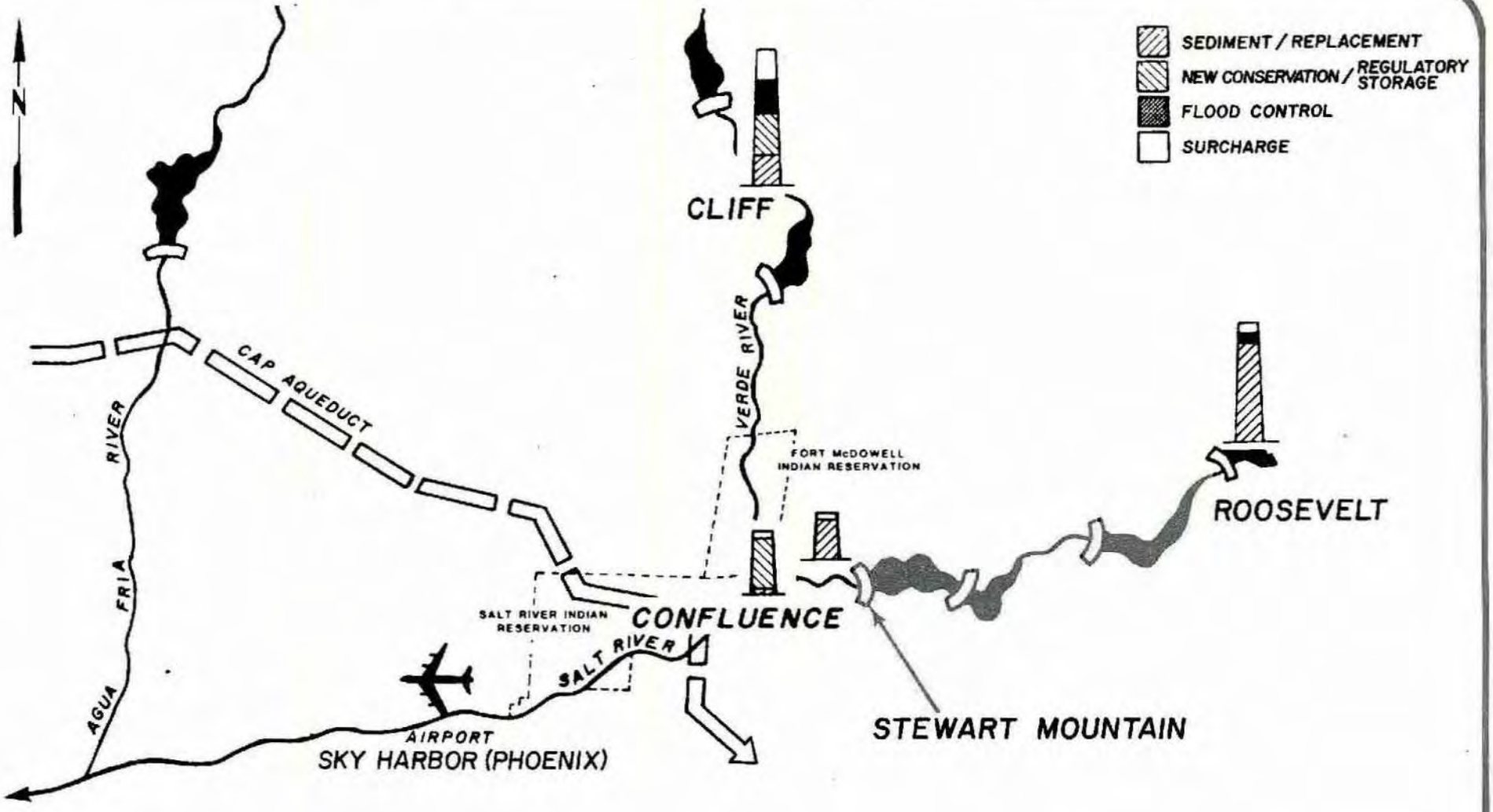
This element would be the same as described in Plan 1 and shown on Plate 4.

5. 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-3.

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 could use one half of the sediment pool at Roosevelt Lake to increase CAP yield by 163,600 af/yr. Projected average annual CAP water yield for this plan is 1,169,600 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 provide some additional reduction in flows compared to other plans. This plan would alleviate the hydrologic safety problems at the existing Salt and Verde River dams within the SRP system.



CAP YIELD	163,000 af/yr
FLOOD CONTROL	
200-YEAR at AIRPORT	80,000 cfs
100-YEAR at AIRPORT	50,000 cfs

FIGURE II-3

PLAN 3
CONFLUENCE + CLIFF +
ROOSEVELT +
STEWART MOUNTAIN DAM

Plan 3 would 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-7. Total construction cost of Plan 3 would be between $1,116,250,000 and $1,295,540,000 depending upon whether new or modified dams are constructed.

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 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 Plate 7 ("Confluence Site - Plan 3") in the map pocket at the end of the Draft EIS. Land requirement for the project, as well as necessary easements and rights-of-way, would be acquired by the Federal government. Approximately 8,295 acres would be purchased from the Fort McDowell Indian Reservation and 1,164 acres from the Salt River Indian Reservation. The land needed for the reversible canal and transmission line is already government owned.

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 connected to the Salt-Gila Aqueduct. A minimum pool would be maintained in Confluence Reservoir for fish and wildlife enhancement and recreation.

A new hydroelectric powerplant would be constructed at the base of the dam. A new transmission line would connect the powerplant and the pump-generation facility to the CAP power transmission system. The new reservoir would back water up on the face of the existing Stewart Mountain Dam and this could cause damage to the power plant, outlet works, spillway, and the dam. Modifications would be made to these facilities to prevent damages unless Stewart Mountain Dam was replaced for dam safety purposes. In this plan, New Stewart Mountain Dam would be designed to be compatible with the Confluence Dam.

On the Fort McDowell Indian Reservation, facilities that would be inundated and require relocation would include churches, community and commercial buildings, utilities, roads, irrigation facilities and housing. Five miles of the Bush Highway would be inundated requiring the construction of 3.4 miles of new road. The inundation of 2.5 miles of State Highway 87 would require the construction of 5.8 miles of road and a new bridge over the Verde River. The Heber-Teno stock crossing trail at Blue Point Bridge on the

TABLE II-7

DESIGN DETAILS - PLAN 3[a]

	CONFLUENCE DAM
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:	
Hydroelectric Powerplant	12,220 KW
Pumping/Generating Facility	3,000 cfs
Service Outlet	4,700 cfs
Flood Outlet:	none
Capacity in Flood Pool	
Capacity at MWS[b]	
Reversible Canal:	
Capacity	3,000 cfs
Length	4 miles

STORAGE ALLOCATION:

	Incremental 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

[a]Cliff, Roosevelt, and Stewart Mountain Dams same a Plan 1.

[b]Maximum Water Storage

Bush Highway, two USGS gaging stations, U.S. Forest Service Blue Point Administrative Facilities, SRP operator residences near Stewart Mountain Dam, some utilities, and a privately-owned guest ranch below Stewart Mountain Dam would have to be relocated. The City of Phoenix well field and infiltration gallery would be inundated; future water would be supplied from Confluence Reservoir, but could require treatment, which the existing supply does not.

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 facilties 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, equestrain, and swimming facilities.

(1) Construction Considerations

A temporary Reclamation construction field office would be installed at the construction-related site near the dam. The contractor would also be expected to establish temporary construction offices in the same location. These offices together with storage and parking would require about 40 acres.

The existing roads would provide access to the dam site. About 3.3 miles of new haul roads would be required to connect the borrow areas to the existing road.

Earthen materials from the embankment construction would be obtained from the borrow areas in the vicinity of the dam. Any concrete required during construction would be produced at a batch plant located at the site. Any other materials would be delivered to the site via the access road. Any waste material would be hauled to approved existing disposal sites or dumped in the reservoir area according to construction specifications. All disposals will be approved by the Arizona Department of Health Services.

Contractors would be responsible for obtaining water for construction activities. The sources, would be from existing surface water supplies (Saguaro Lake) or wells near the site area. The water would be transported to the construction site by pipeline or trucks.

There will be a heavy volume of construction vehicles in the vicinity of the dam site and this may reduce the effective flow of local traffic.

All normal flows in the river would be controlled by the existing upstream dams. Any service releases from the existing dams would be passed through the new dam site in a temporary pipe until the new dam's service outlets are completed and the new dam is raised to ann elevation high enough to direct water through the outlets.

All existing services and facilities would be maintained throughout the construction period. New facilities would become operational before the existing facilities were taken out of operation.

(2) 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 pumping/generating facility before it enters the regulatory storage pool of the reservoir. The pumping/generating 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 pumping/generating 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.

(3) 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 Plate 8 ("Cliff Site - Plans 3 and 6") at the end of the Draft EIS.

(1) Cliff Dam Water Supply Operation

Cliff Dam would be operated for water supply similar to the operation 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 Salt-Gila Aqueduct. Typical-year water fluctuations would also differ from those in Plan 1 and would be 48 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 Plate 3.

(1) Roosevelt Dam Water Supply Operation

Water supply operations at Roosevelt Dam would be similar to those 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 Plate 4.

6. 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, 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-4.

This plan would provide 660,000 af of regulatory storage space at New Waddell Reservoir, 170,000 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 137,600 af/yr. Projected average annual CAP water yield for this plan is 1,172,000 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 at the new reservoir.

Design information on the dams and related features included in this plan is displayed in Table II-8. Total construction cost of Plan 6 would be between $978,430,000 and $1,157,720,000 depending upon whether new or modified dams are constructed.

a. New Waddell Dam and Reservoir

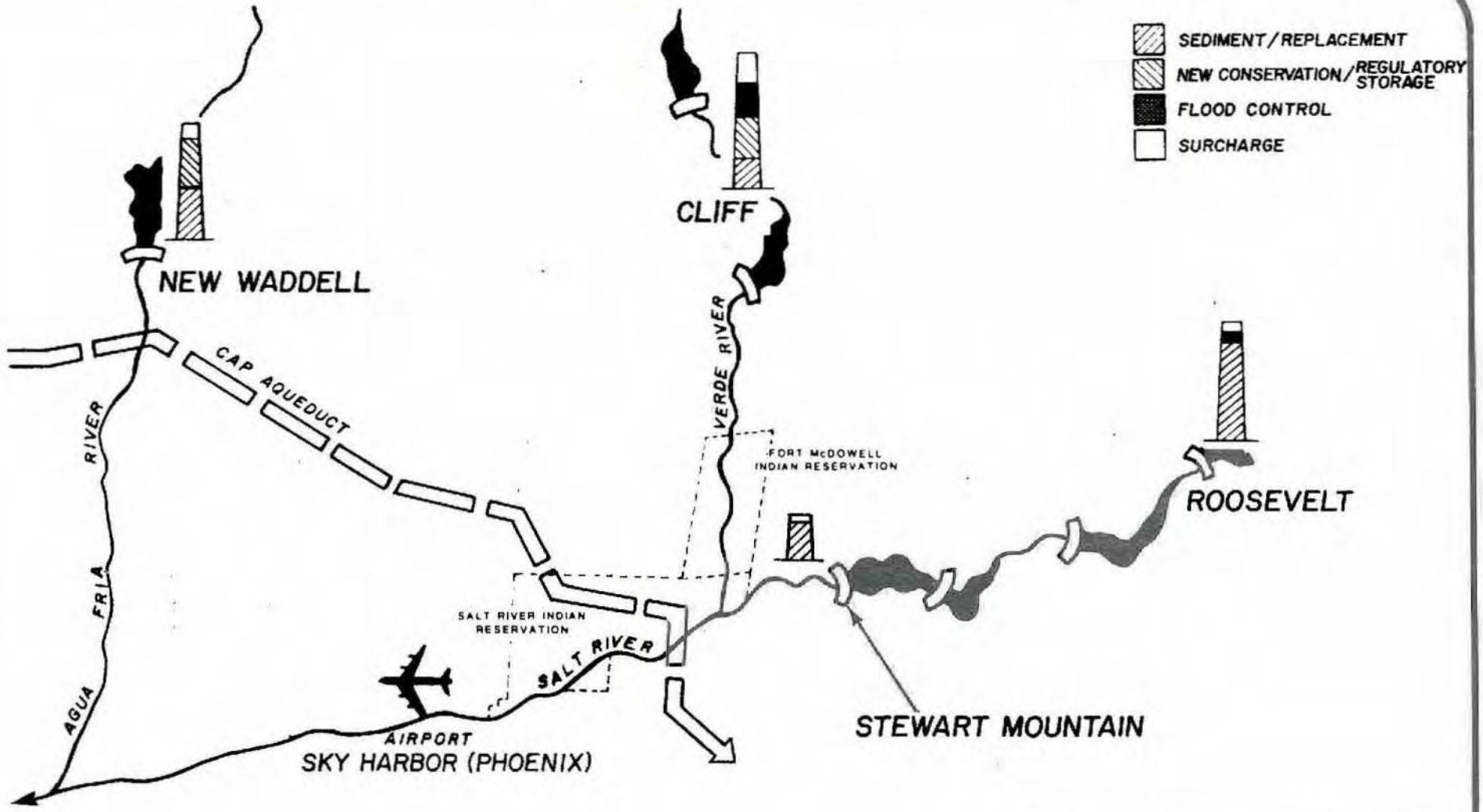
The New Waddell Dam would be located approximately one-quarter mile downstream from the existing Waddell Dam within the Lake Pleasant Regional Park. The site area includes 41,080 acres. The dam, spillway, reservoir area, canal, pumping/generating facility, and transmission facilities, as well as roads, borrow areas, areas for other construction-related activities, recreation sites, and pool levels are shown on Plate 9 ("New Waddell Site - Plan 6 and 7") in the map pocket at the end of the Draft EIS. 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 maximum storage pool 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 a gated or ungated spillway. Discharges from the spillway would occur only in events in excess of a 200-year flood, and would be to the Morgan City Wash which flows into the Agua Fria River about 3/4 mile downstream of the new dam location. Incidental flood control of the Agua Fria River 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, which would be reduced in area from 75 acres to 40 acres as a result of the project. The water would then be diverted into the existing Beardsley Canal. The other service outlet would be to a reversible canal which would connect the Granite Reef Aqueduct to the base of the dam.

A minimum pool would be maintained 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.

Lower Lake Pleasant would be drained during the construction period. The existing Waddell Dam would control normal flows in the river during construction. The contractor would first devise a means of diverting any releases from the existing dam and also of making MCMWDC#1 deliveries to the Beardsley Canal while the new dam is under construction. When construction of the new dam is completed, the existing dam would then be partially breached by removing approximately the top third of the dam and then removing a small section down to the top of the existing sediment pool to



CAP YIELD 137,600 af/yr
FLOOD CONTROL
200-YEAR at AIRPORT 92,000 cfs
100-YEAR at AIRPORT 55,000 cfs

FIGURE II-4

PLAN 6
NEW WADDELL + CLIFF + ROOSEVELT + STEWART MOUNTAIN DAM

TABLE II-8

DESIGN DETAILS - PLAN 6
(Agency Proposed Action)[a]

	NEW WADDELL DAM
DAM STRUCTURE:	
Height	306 feet
Crest Length	5,000 feet
Embankment Dam Volume	24,000,000 cubic yards
SPILLWAY:	
Crest Length	500 feet
Head	26 feet
Capacity	250,000 cfs
APPURTENANT WORKS:	
Pumping/Generating Facility	3,000 cfs (29.6 MW power production)
Hydroelectric Powerplant	none
Service Outlet	600 cfs
Flood Outlet:	
Capacity in Flood Pool	none
Capacity at MWS[b]	
Reversible Canal:	
Capacity	3,000 cfs
Length	5 miles

STORAGE ALLOCATION:

	Incremental 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 (minimum)	5,000	73,800	2,298	1,506
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

[a]Cliff, Roosevelt, and Stewart Mountain Dams same as Plan 1

[b]Maximum Water Storage

ensure that there could be some flow of water to the outlets when the lake is drawn down. The rest of the dam would be left in place and would serve to catch the sediment. No loss of MCMWCD#1 water is anticipated.

(1) Construction Considerations

A temporary Reclamation construction field office would be installed at the construction-related site near the dam. The contractor would also be expected to establish temporary construction offices in the same location. These offices together with storage and parking would require about 40 acres.

Existing roads would provide access to the dam site. About 2.6 miles of new haul roads would be required to connect the borrow areas to the existing roads.

Earthen materials for the embankment construction would be obtained from the borrow areas in the vicinity of the dam. Any concrete required during construction would be produced at a batch plant located at the site. Any other construction materials would be delivered to the site over the access road. Any waste material would be hauled to approved existing disposal sites or buried in the reservoir area according to construction specifications. All disposals will be approved by the Arizona Department of Health Services.

Contractors would be responsible for obtaining water for construction activities. The sources would be from existing surface water supplies (Lake Pleasant) or wells near the site. The water would be transported to the construction site by pipelines or trucks.

There would be a heavy volume of construction vehicles in the vicinity of the dam site and this may reduce the effective flow of local traffic.

All normal flows in the river would be controlled by the existing dam. Any service releases from the existing dam would be passed through the new dam site in a temporary pipe until the new dam's service outlets are completed and the new dam is raised to an elevation high enough to direct water through the outlets.

All existing services and facilities would be maintained throughout the construction period; the new facilities would become operational before the existing facilities are taken out of operation.

(2) 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, compared to a future-without-project fluctuation of approximately 20 feet.

A 25,600-foot-long reversible canal with a capacity of 3,000 cfs would be constructed with a pumping/generating 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. Power would be produced when CAP diversions from the reservoir flows through the pumping/generating facility and reversible canal and back into the Granite Reef Aqueduct. The canal would be located on the east side of the Agua Fria River. The pumping/generating facility would be located near the left abutment of the dam. Approximately 1.5 miles of transmission line would be required to connect these facilities to existing transmission lines.

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

The potential exists to produce additional hydroelectric power at New Waddell Dam through a pump-back storage facility which would cycle water between the reservoir and Lower Lake Pleasant on a daily basis. While such a facility is not included in Reclamation's design for New Waddell, pump generation could be added to the dam by other governmental agencies or utility companies. Applications and plans to include pump-back storage at the dam would require separate environmental review and compliance by any agency proposing to install such a facility.

(3) New Waddell Dam Flood Operation

New Waddell Reservoir would not include year-round dedication of flood control space. However, Bureau studies of flood control potential at New Waddell Dam showed that substantial flood control on the Agua Fria River could be achieved through operation of the reservoir. Studies have shown that if the reservoir surface remains at or below an elevation of 1,694 feet rather than the maximum elevation of 1,702 feet, releases during the 200-year flood would remain below a target flow of 25,000 cfs. New Waddell Dam would be operated to maintain the water surface elevation below 1,694 feet except when there is low probability of storms occurring, generally during the period from March through June of each year. With this operational regime the annual probability of damaging releases from a 200-year flood is reduced to .0001.

b. Cliff Dam and Reservoir

Cliff Dam would be as described in Plan 1 except there would be no water exchanges. The typical-year fluctuation would be 48 feet.

c. New/Modified Roosevelt Dam and Reservoir

Roosevelt Dam would be the same as in Plan 1, except there would be no water exchanges.

d. New/Modified Stewart Mountain Dam

Stewart Mountain Dam would be as described in Plan 1.

7. 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. CAP water supply would be increased by 114,000 af/yr for an average annual CAP yield of 1,120,000 af/yr.

This plan provides for a minimum pool at Cliff Reservoir as well as at New Waddell for fish and wildlife enhancement and recreation purposes. Typical-year fluctuation would be 39 feet. This is shown on Plate 10 ("Cliff Site - Plan 7") in the map pocket at the end of the Draft EIS.

Design information on the dams and related features in Plan 7 is displayed on Table II-9. Total construction cost of Plan 7 would be between $978,430,000 and $1,157,720,000 depending upon whether new or modified dams are constructed.

8. Plan 9: New Waddell + Roosevelt + Stewart Mountain Dams + Verde River Dams Modifications

This plan would consist of constructing New Waddell Dam on the Agua Fria River for regulatory storage purposes. Roosevelt Dam on the Salt River would be modified for flood control, additional water conservation, and safety of dams purposes. Stewart Mountain Dam on the Salt River would be replaced or modified for SOD only. Bartlett Dam on the Verde River would be raised 27 feet and an auxiliary spillway would be added for SOD purposes. A spillway would also be added at Horseshoe Dam on the Verde River for SOD purposes. The general location of the structures is shown on Figure II-5.

This plan would provide 660,000 af of regulatory storage space at New Waddell Reservoir and would use one-half of the sediment space at Roosevelt Lake to increase the CAP yield by 115,500 af/yr. The projected average annual CAP yield with this plan is 1,149,900 af/yr.

Roosevelt Dam would have sufficient flood control space available to control the 200-year Salt/Verde River flood event to a flow of 215,000 cfs at Sky Harbor Airport, and the 100-year event to 170,000 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.

TABLE II-9

DESIGN DETAILS - PLAN 7[a]

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

STORAGE ALLOCATION:

	Incremental 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

[a]New Waddell Dam same as Plan 6; Roosevelt and Stewart Mountain Dams same as Plan 1.

[b]Maximum Water Storage

Design information of the dams and related features included in this plan is displayed in Table II-10. Total construction cost of Plan 9 would be between $931,790,000 and $1,111,080,000 depending on whether new or modified dams are constructed.

a. New Waddell Dam and Reservoir

New Waddell Dam would be as described in Plan 6.

b. New/Modified Roosevelt Dam and Reservoir

Roosevelt Dam would be as described in Plan 1.

(1) Roosevelt Dam Water Supply Operation

Water supply operations at Roosevelt Dam would be similar to those described under Plan 1; however, no water exchanges would occur. Water yield from the new conservation space, provided by dual use of the sediment space for water storage, would be delivered to CAP users in the SRP service area through the existing SRP canals and to the CAP aqueduct through a 300 cfs pumping plant at the Granite Reef Diversion Dam.

(2) Roosevelt Dam Flood Control Operation

The flood control operation for Roosevelt Dam differs from that described in Plan 1. In Plan 9, Roosevelt Dam is the only dam on the Salt and Verde River System to have dedicated flood control space and would be operated as such.

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

If the water surface elevation of Roosevelt Reservoir is greater than or equal to the maximum conservation storage pool elevation and if the total is less than 25,000 cfs, then the release from the reservoir is equal to the total inflow. If the total inflow is greater than 25,000 cfs, then the flood control release from the reservoir is limited 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.

c. New/Modified Stewart Mountain Dam

Stewart Mountain Dam would be described in Plan 1.

d. Horseshoe Dam Modification

The sole purpose of this element would be to solve dam safety problems. No new flood control space would be provided nor would CAP regulatory storage space be included.

Table II-10
Design Details - Plan 9[a]

	Horseshoe Dam (same as existing)
Dam Structure:	
Height	142 feet
Crest Length	1,140 feet
Embankment Dam Volume	1,082,000 cubic yards

Spillway	Existing (gated)	Auxiliary (gated)
Crest Length	350 feet	712 feet
Head	36 feet	36 feet
Capacity	250,000 cfs	498,000 cfs

Appurtenant Works	
Hydroelectric Powerplant	None
Pumping Plant[b]	None
Service Outlets	2,200 cfs
Flood Outlets	None
Reversible Canal	None

Storage Allocation:	Incremental Storage (af)	Total Storage (af)	Surface Area (Acres)	Elevation (feet)
Streambed	0	0	0	
Conservation	139,000	139,000	2,762	2026
Surcharge	-	-	-	2035
Dam Crest	-	-	-	2040

a New Waddell Dam same as Plan 6. Roosevelt and Stewart Mountain Dams same as Plan 1.

b The Pumping Plant, located at the Granite Reef Diversion Dam, for Roosevelt Dam would have a 300 cfs capacity.

Table II-10

(continued)

	Bartlett Dam
Dam Structure:	
Height	215 feet
Crest Length	1,000 feet
Concrete Dam Volume	260,000 cubic yards

Spillway	Existing (gated)	Auxiliary (gated)
Crest Length	150 feet	412 feet
Head	79 feet	79 feet
Capacity	270,000 cfs	479,000 cfs

Appurtenant Works	
Hydroelectric Powerplant	None
Pumping Plant	None
Service Outlets	4,000 cfs
Flood Outlets	None
Reversible Canal	None

Storage Allocation:	Incremental Storage (af)	Total Storage (af)	Surface Area (Acres)	Elevation (feet)
Streambed	0	0	0	1612
Conservation	178,000	178,000	2,775	1798
Surcharge	-	-	-	1827
Dam Crest	-	-	-	1827

Modification of the existing Horseshoe Dam would involve adding a gated spillway. The exsting spillway and outlet totgether with the additional gated spillway would release a maximum discharge of 764,000 cfs.

During the construction period, activities in the area would include removal of vegetation at the spillway site, excavation, and heavy vehicular traffic. Construction material would be acquired from borrow areas downstream of the existing dam. Approximately 2 years would be required to build the auxiliary spillway. The Horseshoe Dam site and general location of potential sources for construction materials are shown on Figure II-6.

During and after construction, the reservoir operation at Horseshoe Lake would not change.

e. Bartlett Dam Modification

The purpose of this element would also be to solve dam safety problems. No new flood control space or CAP regulatory storage space would be included.

Modification of the existing Bartlett Dam would involve raising the dam 27 feet and adding a concrete-lined auxiliary spillway. The dam crest would be raised to elevation 1827. The existing spillway would be modified to withstand the higher water surface and to regulate releases to the maximum discharge. The existing spillway and outlet, operating under the higher water level, together with the new auxiliary spillway at the existing saddle dike on the left abutment would release a maximum discharge of 755,000 cfs.

Construction activities would be similar to those described for the modification to Horseshoe Dam. It would take about 3½ years to complete modification. The Bartlett Dam site and location of potential sources for construction materials are shown on Figure II-7.

After the modifications are completed, the top of the conservation space would not change, but the top of the surcharge space would. Upon completion, the reservoir would be operated in a manner similar to current operations.

C. Comparative Analysis of Alternatives

Twenty-one evaluation criteria were developed during the CAWCS Stage III to provide a framework for determining which candidate plans were appropriate for consideration as the proposed action. Although all of the criteria were critical to the plan evaluation process, the CAWCS planning team identified the factors which most significantly discriminated among alternatives, and aggregated them into the following categories: performance (ability to meet CAWCS objectives), economics, environmental impacts, social impacts, and public acceptability. Performance of the plans has been discussed in the earlier description of alternatives. Public acceptability is discussed below in Section D. The environmental, social, and economic impacts of alternatives are presented in detail in Chapter IV.

Table II-11 provides a comparative display of the advantages and disadvantages of each plan relative to the significant evaluation criteria identified by the CAWCS study team.

As shown in Table II-11, Plans 1, 3, 6, and 7 provide high levels of flood protection and solve dam safety problems. Plans 2 and 9 also solve dam safety problems but provide less flood protection. Plan 8 does not meet objectives for flood protection, but it does provide for continued studies to develop a plan to make Salt and Verde River Dams safe.

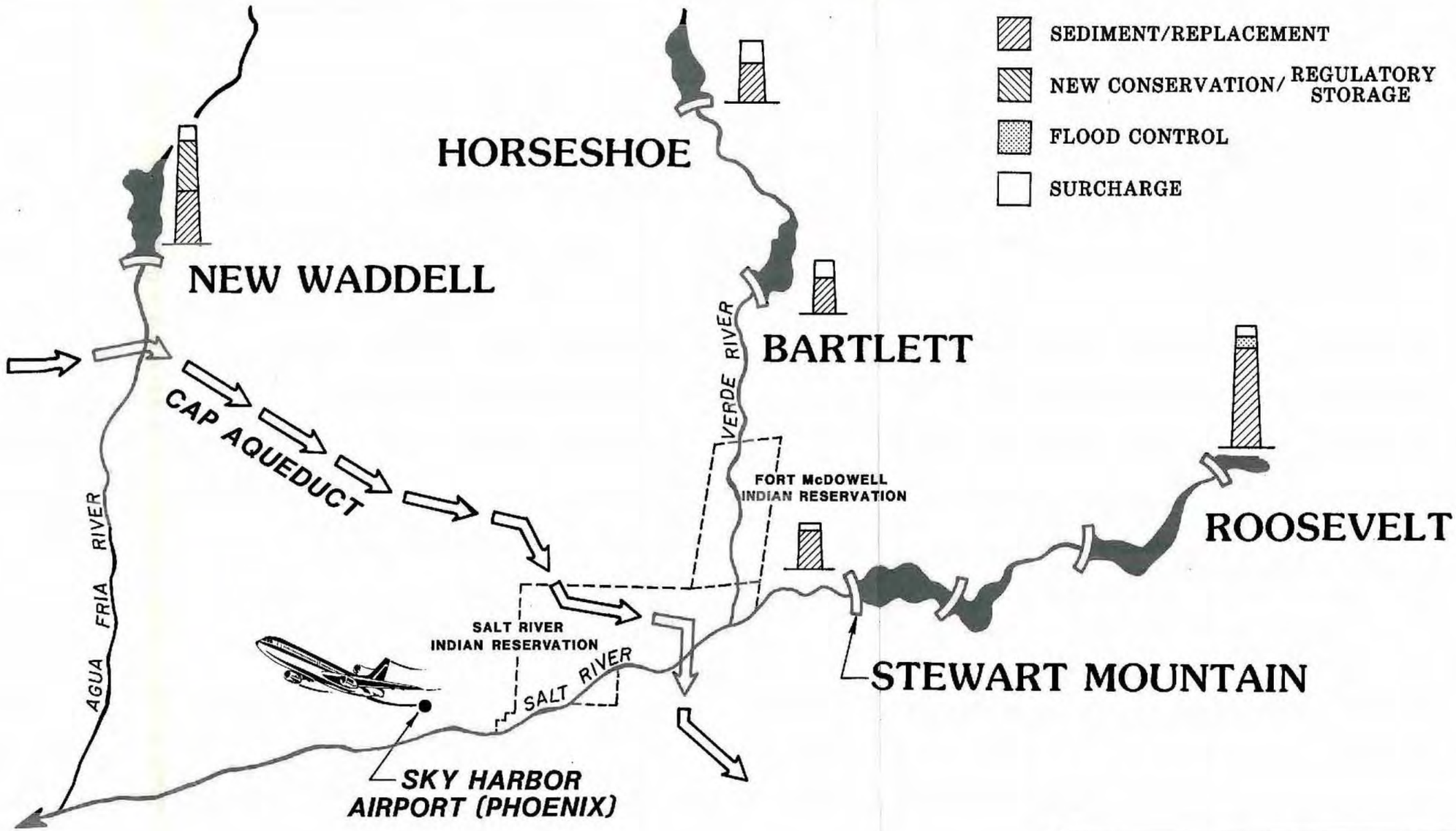
Regulatory storage advantages are strongest with Plans 3, 6, 7, and 9 because they include regulatory storage reservoirs to provide increased CAP yield, added flexibility in the operation of CAP, and energy management benefits. Plan 1 provides some increased yield because of water exchanges but does not have the flexibility or energy management benefits that are associated with a reservoir. Mainly because of energy management opportunities associated with New Waddell Reservoir, Plan 6 provides the highest annual economic benefits of any plan. Plan 8 does not meet project objectives for regulatory storage.

Costs of the action alternatives in rank order from highest to lowest, are: Plan 3, 6 and 7, 9, 1, 2. Plan 8 has no construction costs at this time, but planning for dam safety would continue and ultimately the solution could involve dam construction.

Environmental impacts associated with construction, operation, and maintenance are most severe with Plan 3 because the plan includes Confluence Dam and Reservoir. The reservoir would inundate sensitive habitat and areas of human use, leading to severe impacts to endangered species, riparian habitat, perennial stream habitat, stream recreation, water quality, and cultural (prehistoric and historic) resources. Environmental impacts of Plan 6 include losses of riparian habitat and cultural resources; these same impacts would occur with Plans 1 and 7, which would also adversely affect endangered species. Plan 2 would have lesser impacts to riparian habitat and cultural resources than Plan 6. Plan 9 would have a lesser impact to riparian habitat and endangered species than Plans 1, 2, 3, 6, and 7. Plan 8 would have no project related impacts, but the dam safety solution found in continued studies could result in impacts that cannot be predicted at this time.

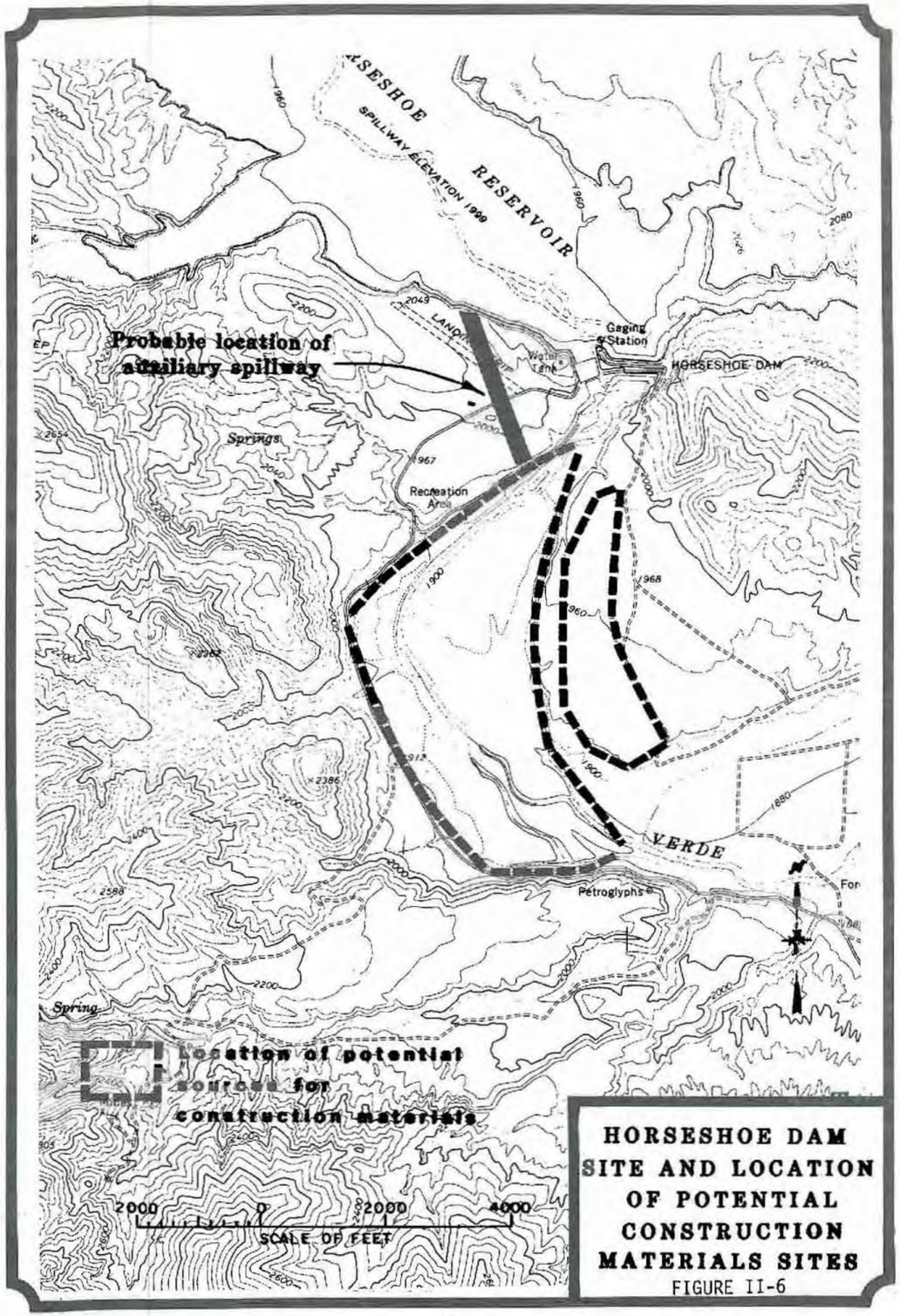
Social impacts are primarily the consequences of relocation because of land acquisition for dams and reservoirs. The most severe social impacts of relocation occur with Plan 3, which would require the relocation of the Fort McDowell Indian Community. No other plans would require the relocation of the community. With Plans 1, 2, 3, 6, and 7, some residents who currently live around the perimeter of Roosevelt Lake and a family who operates a ranch near Horseshoe Dam on the Verde River would be required to relocate. Although all action plans require Roosevelt Lake relocations, Plan 2 requires the fewest number of people to relocate. Plan 9 would not require relocation of the family who operates the ranch near Horseshoe Dam.

Quantification of impacts is provided in Chapter IV, and the impacts are summarized in Table IV-39 and IV-40.



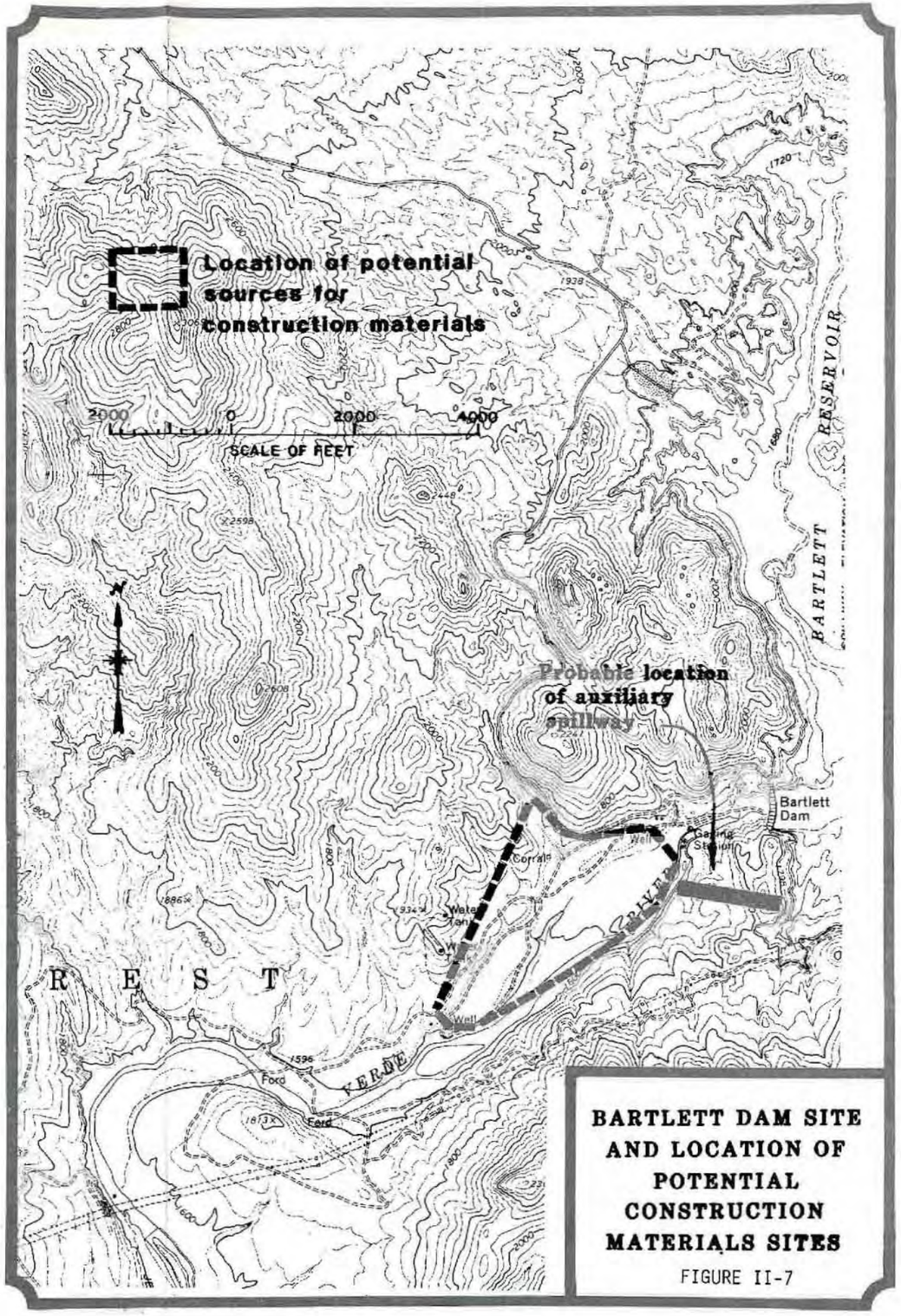
CAP YIELD	115,500 af/yr.
FLOOD CONTROL	
200-YEAR at AIRPORT	215,000 cfs
100-YEAR at AIRPORT	170,000 cfs

PLAN 9
NEW WADDELL + ROOSEVELT + STEWART MOUNTAIN DAM + VERDE RIVER DAMS MODIFICATIONS



HORSESHOE DAM SITE AND LOCATION OF POTENTIAL CONSTRUCTION MATERIALS SITES

FIGURE II-6



BARTLETT DAM SITE AND LOCATION OF POTENTIAL CONSTRUCTION MATERIALS SITES

FIGURE II-7

Table II-11

COMPARATIVE EVALUATION OF PLANS

	Advantages	Disadvantages
Plan 8 (No CAWCS action)	No project-related cost No project-related impacts to Fort McDowell Indian Community No project-related impacts to endangered species, riparian habitat, or cultural resources Moderate public support	No increased flood protection No additional water supply beyond CAP baseline Significantly less power revenues than regulatory storage plans No flexibility in CAP operations Dam safety studies continue
Plan 1	Relatively low cost No impacts to Fort McDowell Indian Community High level of flood protection Moderate increase in CAP yield Solves dam safety problems Moderate public support	Less reliable water supply than regulatory storage plans Significantly less power revenues and other economic benefits than regulatory storage plans No flexibility in CAP operation Adverse impacts to endangered species, riparian habitat, and cultural resources
Plan 2	Lowest cost of all action plans Solves dam safety problems No impacts to Fort McDowell Indian Community Insignificant impacts to endangered species Provides moderate increase in flood protection	Insignificant increase in CAP yield Less reliable water supply than regulatory storage plans Minimal power revenues and other economic benefits No flexibility in CAP operations Adverse impacts to riparian habitat and cultural resources Minimum public support
Plan 3	Highest increase in CAP yield High level of flood protection Significant increase in power revenues and other economic benefits Provides flexible CAP operations Provides reliable water supply Significant increase in lake recreation	Highest cost of all action plans Severe impacts to Fort McDowell Indian Community Severe impacts to endangered species, riparian habitat, and cultural resources Severe impacts to stream recreation Potential for reservoir eutrophication and degradation of water quality Highly controversial - divided public support
Plan 6 (Agency proposed action)	Significant increase in CAP yield High level of flood protection Highest increase in power revenues and other economic benefits Provides reliable water supply Provides flexible CAP operations Significant increase in lake recreation No impacts to Fort McDowell Indian Community Strong broad-based public support	High cost Adverse impacts to endangered species habitat and cultural resources*
Plan 7	Moderate increase in CAP yield High level of flood protection Significant increase in power revenues and other economic benefits Provides flexible CAP operations Provides reliable water supply Significant increase in lake recreation Provides opportunities for fish and wildlife enhancement Provides opportunities for development of Salt River recreation through Phoenix No impacts to Fort McDowell Indian Community Moderate public support	High cost Adverse impacts to endangered species, riparian habitat, and cultural resources

*Jeopardy Biological Opinion under Section 7 of the Endangered Species Act was issued by the Fish and Wildlife Service for the Proposed Action.

Table II-11 (continued)

COMPARATIVE EVALUATION OF PLANS

	Advantages	Disadvantages
Plan 9	Provides reliable water supply Significant increase in power revenue and other economic benefits Moderate increase in CAP yield Significant increases in lake recreation No impacts to Fort McDowell Indian Community Reduced environmental impacts	Lower level of flood protection than with some of the other plans Adverse impacts to cultural resources High cost

D. The Proposed Action - Plan 6

Plan 6 has been selected as the agency proposed action for CAWCS because the plan meets project objectives, has strong public support, and does not have many of the severe social and environmental impacts associated with Plan 3. In particular, Plan 6 avoids impacts to the Fort McDowell Indian Community while still providing high performance for flood protection and CAP regulatory storage. While Plans 1, 2, 7, and 9 also avoid impacts to the Fort McDowell Community, they do not perform as well as does Plan 6.

Strong, broad-based public support for Plan 6 was identified by the CAWCS public involvement program in Stage III. In a series of workshops to assess public values in relation to the plans, 60 groups and agencies found Plan 6 to be an acceptable alternative. The majority of speakers at three public meetings held in September 1981 favored Plans 6, 7, and 8. Comments received from response forms in a CAWCS publication indicated that nearly half of the respondents favored Plan 6 among the alternatives.

On October 2, 1981 the CAWCS Governor's Advisory Committee, composed of government, business, agriculture, and environmental representatives, reviewed the alternatives and voted 20 to 1 to recommend Plan 6 to the Governor of Arizona as their preferred plan. The Governor subsequently recommended Plan 6 to the Secretary of the Interior. The Central Arizona Water Conservation District, the state agency responsible for CAP repayment, also endorsed Plan 6.

In October 1981, the CAWCS planning team participated in a "tradeoff" meeting to review all available information on the alternatives and to formulate recommendations. Alternatives were evaluated based on performance, cost, economic benefits, public acceptability, engineering feasibility, environmental impacts, social impacts, and implementability. As a result of these analyses, the Arizona Projects Office of the Bureau of Reclamation recommended that Plans 1, 3, and 6 were appropriate for consideration as the proposed action. Plan 2 was not recommended because it does not provide any regulatory storage capability and offers less flood protection than other action plans. Plan 7 is an environmentally-oriented variation of Plan 6, and many of the benefits of Plan 7 could be obtained with mitigation measures included as part of Plan 6. Therefore, although Plan 7 was not recommended for further consideration, features of this plan could still be obtained. Plan 8 was not recommended because the plan does not meet project objectives.

After reviewing the three recommended plans, the Secretary of the Interior selected Plan 6 as the agency proposed action on November 1981, citing the plan's high performance, public support, and avoidance of impacts to the Fort McDowell Indian Community.

At the time the Secretary decided on the Proposed Action, it contained two options for Roosevelt Dam. Since that time all aspects of the two options have been evaluated. After technical analysis and review and public input, it has been decided to pursue modified Roosevelt Dam as part of Plan 6, the Proposed Action. Because both options were displayed at the time of the decision, this EIS continues to display both options.