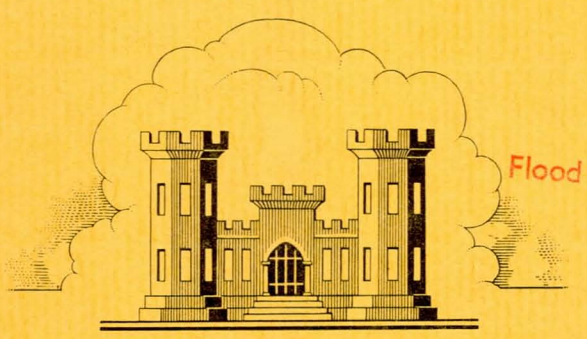
AMPLIFICATION TO THE FINAL ENVIRONMENTAL IMPACT STATEMENT NEW RIVER AND PHOENIX CITY STREAMS FLOOD CONTROL PROJECT MARICOPA COUNTY, ARIZONA

PRESERVATION OF CAVE CREEK DAM



Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
DECEMBER 1977

A371.908

Amplification to the Final Environmental Impact Statement
New River and Phoenix City Streams Flood Control Project
Maricopa County, Arizona

Contents

	Page
Introduction	1
Cave Creek Dam	2
Design Considerations	3
Coordination	3
Environmental Effects	4

Plates

Plate 1	Recommended Plan Flood Control
Plate 2	Cave Buttes Dam General Plan
Plate 3	Existing Cave Creek Dam

Appendixes

Appendix A	Supplemental Report, Cave Creek Dam Bypass Channel
Appendix B	Documentation of a No Adverse Effect Determination Regarding the Periodic Inundation of Cave Creek Dam and the Construction of the Cave Creek Dam Bypass Channel
Appendix C	Environmental Assessment, Cave Creek Dam Bypass Channel

AMPLIFICATION TO THE

FINAL ENVIRONMENTAL IMPACT STATEMENT

NEW RIVER AND PHOENIX CITY STREAMS

FLOOD CONTROL PROJECT, MARICOPA COUNTY, ARIZONA

Introduction

1. This amplification report provides current information regarding the preservation of historic resources within the Cave Buttes Dam project area described in the Final Environmental Impact Statement (FEIS), New River and Phoenix City Streams Flood Control Project, Maricopa County, Arizona. The FEIS was prepared by the U.S. Army Engineer District, Los Angeles, and filed with the Council on Environmental Quality on September 27, 1976.

2. This amplification report addresses a point of concern raised by the Arizona State Historic Preservation Officer regarding the effect of the proposed project on Cave Creek Dam. Cave Creek Dam, a historic concrete arch dam, is within the reservoir area of the authorized Cave Buttes Dam, which is a major component of the New River and Phoenix City Streams Flood Control Project. Plate 1 shows the major features of the flood control project. Plate 2 shows the relationship Cave Creek Dam has to Cave Buttes Dam and Reservoir.

Cave Creek Dam

3. Cave Creek Dam is a reinforced concrete structure with 38 arches and supporting buttresses spaced about 44 feet apart. The top of the dam is at elevation 1642.0. The dam is 1,692 feet long and has a maximum height of 52 feet above the streambed at the downstream toe. Plate 3 shows the dimensions of Cave Creek Dam. The dam was constructed in 1922-1923 through a joint effort of the State of Arizona, Maricopa County, and others.

4. The Arizona State Historic Preservation Officer and the Secretary of the Interior have determined that Cave Creek Dam is a significant historic engineering structure, eligible for inclusion in the National Register of Historic Places. The dam was designed by John E. Eastwood, and is the first reinforced concrete dam built with a curved upstream face. The design proved to be more effective and much less expensive than conventional dams of the time. The design has been copied many times since.

5. As described in the FEIS, the authorized project included the removal of Cave Creek Dam. Since the FEIS was filed with CEQ, the dam has been recognized as a significant historic engineering structure. Consistent with the Nation's policy to preserve such structures of national significance, the Corps has modified the plans for the construction of the project to include the construction of a bypass channel that will allow Cave Creek Dam to be safely preserved within the reservoir area of Cave Buttes Dam.

Design Considerations

6. A Supplemental Report to the project General Design Memorandum No. 3, describing the alternative plans to preserve Cave Creek Dam evaluated by the Corps, the design considerations, and the recommended bypass channel design determined to be the most prudent choice can be found in appendix A. Briefly, the report explains that Cave Creek Dam would be overtopped by a flood having a return period slightly larger than 25 years. If the dam were to be overtopped, floodwaters would wash the foundation materials away from the downstream toe of the dam and from beneath the buttruss foundations and arches, causing the concrete structure to fail.

7. It was determined that modifications to Cave Creek Dam sufficient to make it meet the Corps Dam safety standards would be prohibitively expensive and would alter the physical appearance of the dam. The recommended plan allows the dam to be overtopped, but creates a stilling pool no more than 10 feet lower than the floodwater being impounded by the historic dam. This pool minimizes the physical stresses on the dam, provides stability during floods, and absorbs the erosive energy of floodwater overtopping the dam, thus preventing the dangerous undermining of the dam's foundation.

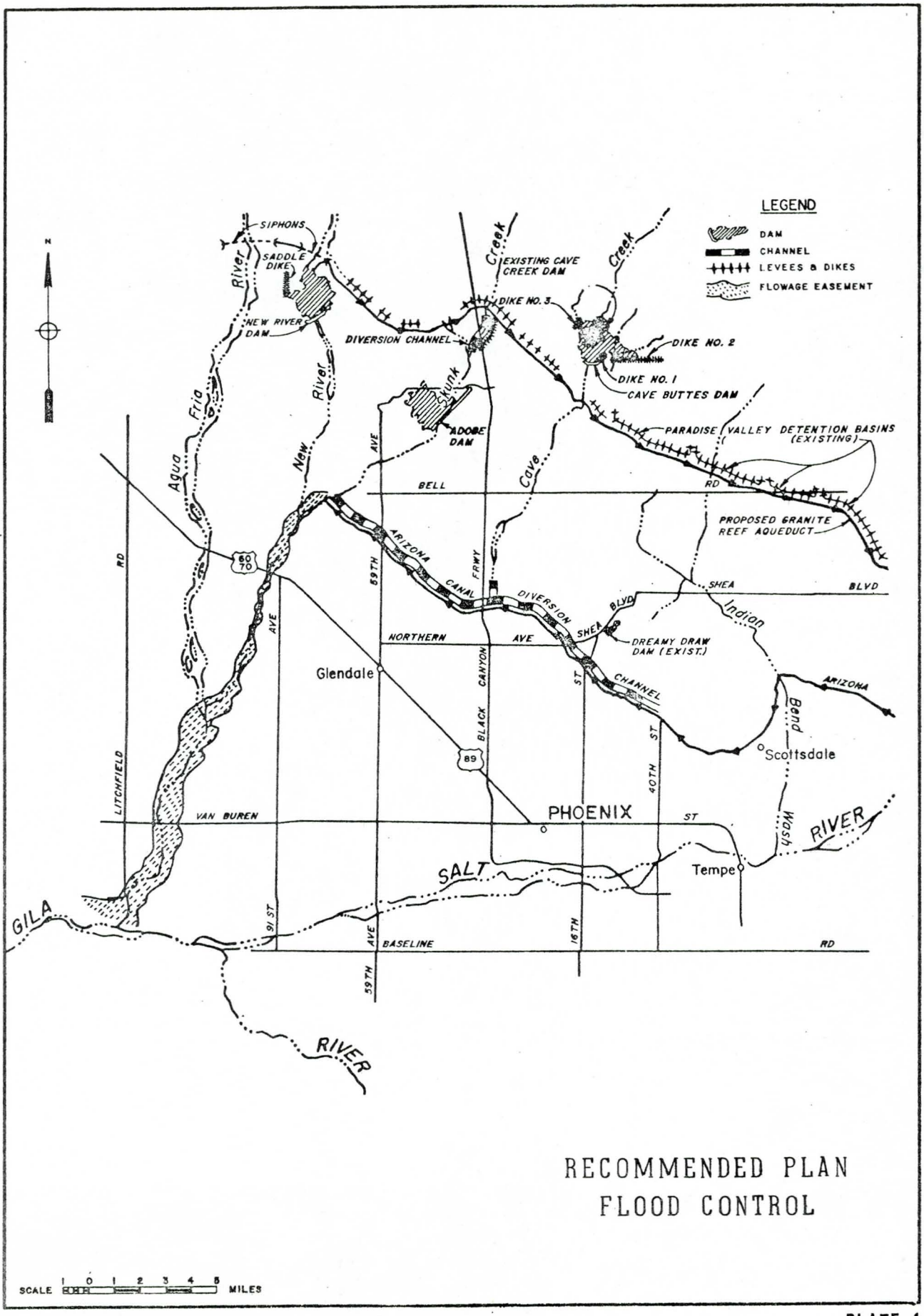
Coordination

8. The concept of adding a bypass channel to preserve Cave Creek Dam was coordinated with the Arizona State Historic Preservation Officer and the staff of the Advisory Council on Historic Preservation. A copy of the Corps report documenting the determination that the construction of the bypass channel and unavoidable periodic inundation would not have an adverse effect on Cave Creek Dam, can be found in appendix B. Copies of the letters of concurrence from the Advisory Council and the State Historic Preservation Officer have also been included in appendix B.

Environmental Effects

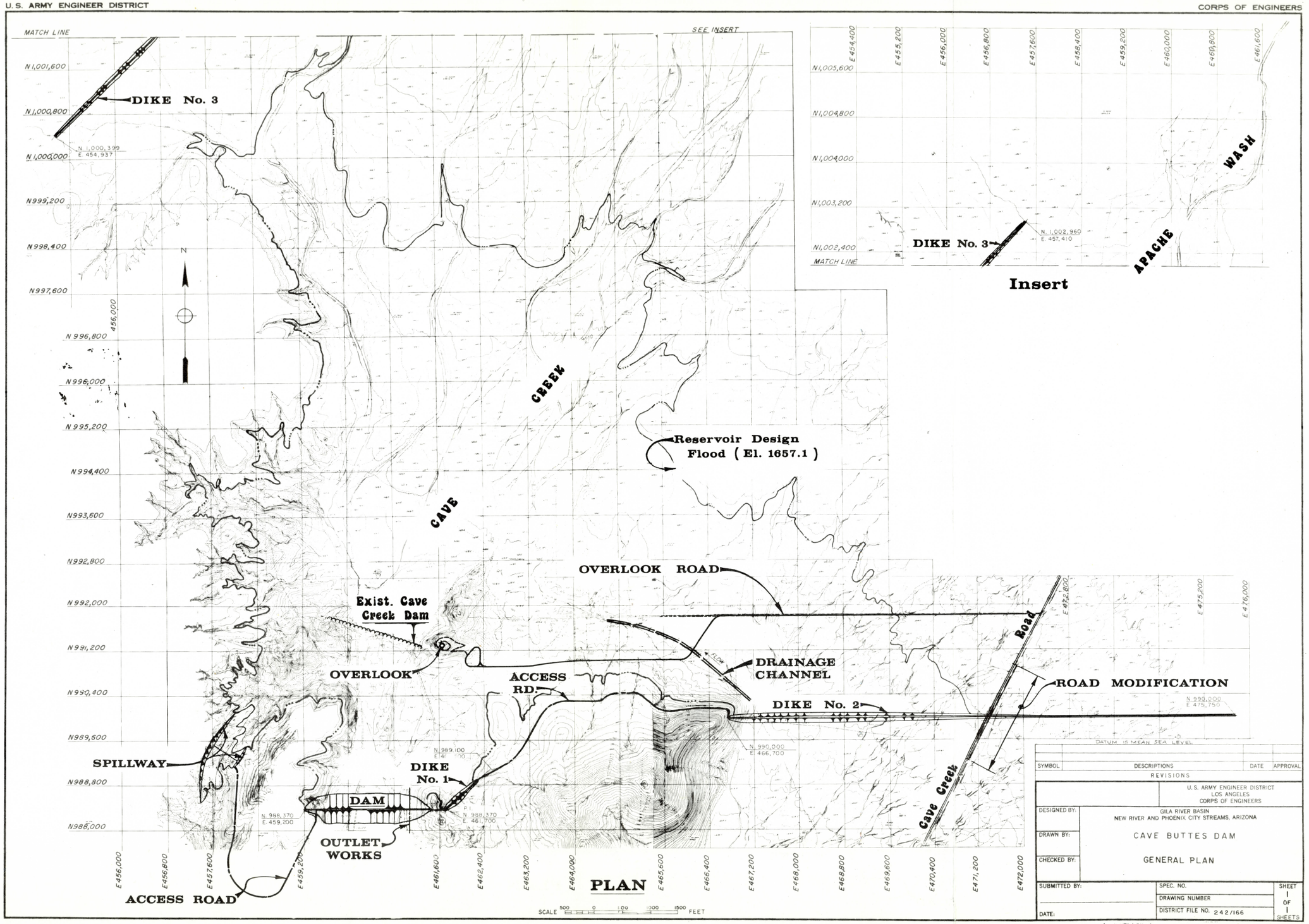
9. The environmental effect of each proposed Corps action is routinely assessed during the planning process. The major environmental effects of the recommended plan are summarized in the supplemental report (Appx. A) and the No Adverse Effect Determination Report (Appx. B). An environmental assessment addressing the effect the proposed bypass channel and preserved dam will have on the environment can be found in appendix C. The environmental assessment documents the District Engineer's determination that an Supplemental Environmental Impact Statement will not be prepared.

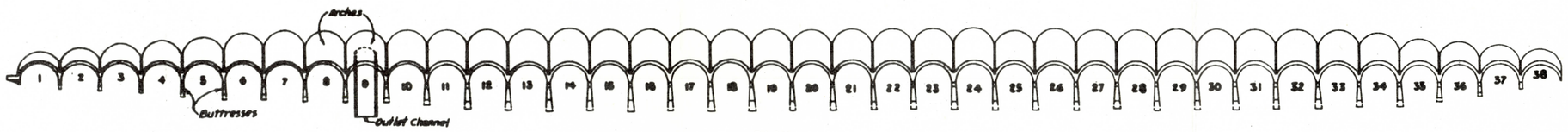
10. In summary, the environmental effects of the proposed action include the preservation of a National Register-eligible structure and the destruction of 15 acres of disturbed upland vegetation. This latter impact is partially mitigated by the fact that soil excavated to form the bypass channel will be deposited in borrow areas previously denuded of vegetation and stripped of topsoil by private gravel mining activities.



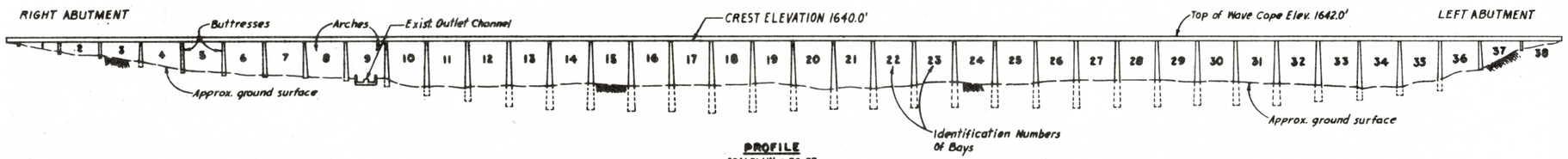
RECOMMENDED PLAN
FLOOD CONTROL

PLATE 1

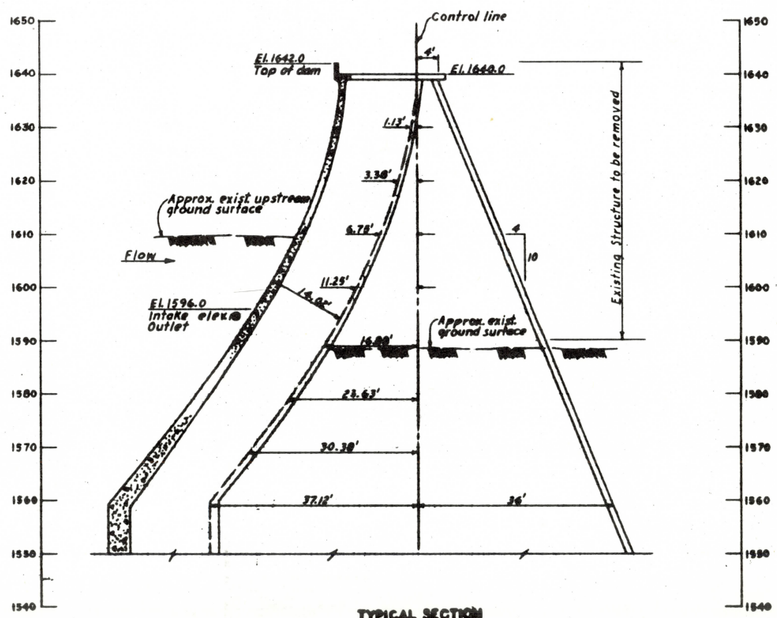

MATCH LINE
SEE INSERT
DIKE No. 3
N 1,000,399
E 454,937
N 1,001,600
N 1,000,800
N 1,000,000
N 999,200
N 998,400
N 997,600
N 996,800
N 996,000
N 995,200
N 994,400
N 993,600
N 992,800
N 992,000
N 991,200
N 990,400
N 989,600
N 988,800
N 988,000
456,000
N
CAVE
CREEK
Reservoir Design
Flood (El. 1657.1)
OVERLOOK ROAD
Exist. Cave
Creek Dam
OVERLOOK
ACCESS
RD.
DRAINAGE
CHANNEL
ROAD MODIFICATION
DIKE No. 2
N 990,000
E 475,750
N 990,000
E 466,700
N 989,100
E 461,700
DIKE
No. 1
N 988,370
E 461,700
N 988,370
E 459,200
DAM
OUTLET
WORKS
SPILLWAY
ACCESS ROAD
Cave Creek Road
E 456,000
E 456,800
E 457,600
E 459,200
E 461,600
E 462,400
E 463,200
E 464,000
E 465,600
E 466,400
E 467,200
E 468,000
E 468,800
E 469,600
E 470,400
E 471,200
E 472,000
E 472,800
E 475,200
E 476,000
SCALE 500 0 500 1000 1500 FEET
PLAN
N 1,005,600
N 1,004,800
N 1,004,000
N 1,003,200
N 1,002,400
MATCH LINE
E 454,400
E 455,200
E 456,000
E 456,800
E 457,600
E 458,400
E 459,200
E 460,000
E 460,800
E 461,600
DIKE No. 3
N 1,002,960
E 457,410
APACHE
WASH
Insert
DATUM IS MEAN SEA LEVEL
SYMBOL
DESCRIPTIONS
DATE
APPROVAL
REVISIONS
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS
DESIGNED BY:
DRAWN BY:
CHECKED BY:
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
GENERAL PLAN
SUBMITTED BY:
DATE:
SPEC. NO.
DRAWING NUMBER
DISTRICT FILE NO. 242/166
SHEET
1
OF
1
SHEETS



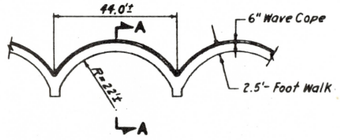
PLAN
SCALE: 1 IN. = 50 FT.



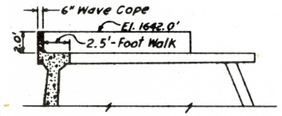
PROFILE
SCALE: 1 IN. = 50 FT.



TYPICAL SECTION
SCALE: 1 IN. = 10 FT.

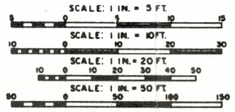


TOP VIEW
SCALE: 1 IN. = 20 FT.



SECTION A-A
SCALE: 1 IN. = 8 FT.

Note:
Reinforcing Steel in the existing concrete structure is not shown.



DATUM IS MEAN SEA LEVEL

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY: J. M. M.
CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZ.

EXISTING CAVE CREEK DAM

SUBMITTED BY:
APPROVAL RECOMMENDED:
APPROVED:
SPEC. NO. DACW09-____ B-____
DISTRICT FILE NO. 242/145
SHEET 1 OF 1 SHEETS

APPENDIX A

TO

AMPLIFICATION TO THE

FINAL ENVIRONMENTAL IMPACT STATEMENT

NEW RIVER AND PHOENIX CITY STREAMS

FLOOD CONTROL PROJECT

MARICOPA COUNTY, ARIZONA

SUPPLEMENTAL REPORT
CAVE CREEK DAM
BYPASS CHANNEL

SUPPLEMENTAL REPORT

TO
DESIGN MEMORANDUM NO. 3,
GENERAL DESIGN MEMORANDUM - PHASE II

FOR
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

PROJECT DESIGN

PART I

CAVE BUTTES DAM (INCLUDING CAVE CREEK
TO PEORIA AVENUE)

CAVE CREEK DAM
BYPASS CHANNEL

SUPPLEMENTAL REPORT

CAVE CREEK DAM
BYPASS CHANNEL

CONTENTS

	Page
Introduction	A-1
Purpose	A-1
Phase I/Phase II Plan	A-1
Cave Buttes Dam	A-1
Cave Creek Dam	A-2
Plan Modification - Cave Creek Dam	A-2
General	A-2
Nomination to the National Register of Historic Places	A-3
Alternatives	A-3
Removal of Cave Creek Dam	A-3
Construction of a Bypass Channel	A-4
Do Nothing	A-5
Selected Alternative	A-5
Design Considerations	A-5
Geotechnical	A-5
Cave Creek Dam	A-5
Bypass Channel	A-6
Hydrological	A-7
Structural	A-8
Hydraulic	A-9
Environmental Assessment	A-10
Economic	A-10
Environmental	A-10
Visitor Safety	A-10
Adverse Effects	A-10
Recommended Plan	A-11
Cost Estimates	A-11
Cost Apportionment	A-13
Plan Implementation	A-13
Local Cooperation	A-13
Recommendations	A-13

TABLES

No.	Title	Page
1	Preliminary Flood Routing - Cave Creek Dam	A-7
2	Cost Estimate, Bypass Channel	A-12

SUPPLEMENTAL REPORT

CONTENTS (Continued)

EXHIBITS

No.	Title
1	Cave Buttes Dam, Bypass Channel, Location Map
2	Cave Buttes Dam, Bypass Channel, Plan Profile & Sections
3	Relationship of pool elevations above and below Cave Creek Dam for routed local SPF

CAVE CREEK DAM
BYPASS CHANNEL

Introduction

1. The Phase II, Part I Design Memorandum, dated July 1976, was submitted to SPD for approval on 30 July 1976 and forwarded to OCE on 19 January 1977. Part of the plan recommended in the Phase II report consists of the construction of Cave Buttes Dam and removal of the existing Cave Creek Dam located about 0.7 mile upstream of the proposed dam. More recent actions suggest that Cave Creek Dam not be removed and that it be preserved as a historical landmark.

Purpose

2. The purpose of this report is to evaluate alternatives to removal of Cave Creek Dam and recommend the action to be taken.

Phase I/Phase II Plan

CAVE BUTTES DAM

3. Cave Buttes Dam, as described in the Phase II, Part I Design Memorandum, would be constructed about 0.7 mile downstream (south) from the existing Cave Creek Dam. The main embankment would be a compacted-earthfill structure with a maximum height of about 109 feet above streambed. The crest of the dam (elevation 1,679.1 feet above mean sea level) would be about 2,260 feet long. The outlet works would consist of an approach channel, an intake structure, a concrete conduit and a stilling basin. The outlet conduit, which would have an intake elevation of 1,560.2 feet, would be 3.75 feet in diameter and capable of releasing about 486 cfs with the water surface at spillway crest.

4. Other structures pertinent to Cave Buttes Dam are 3 earthfill dikes, with lengths of 930 feet, 9,035 feet and 3,245 feet, and an unlined spillway. The spillway, which would be excavated in rock, would have a concrete sill with a length of 510 feet at elevation 1657.1. The spillway, in conjunction with the outlet works, would pass a peak discharge of 100,600 cfs with 5 feet of freeboard.

5. The detention basin would have a capacity of 46,600 acre-feet at the spillway crest of which 5,700 acre-feet would be for the accumulation of sediment over a 100-year period and 40,900 acre-feet would be for flood control.

CAVE CREEK DAM

6. The existing Cave Creek Dam was constructed through a joint effort of the State of Arizona, Maricopa County and others after a major flood in August, 1921. The dam, which was completed in March 1923, is a reinforced concrete structure with 38 arches and supporting buttresses spaced about 44 feet apart. The top of the dam is at elevation 1642.0. The length is 1,692 feet with a maximum height of 52 feet above the existing ground surface at the downstream toe. The present reservoir capacity at elevation 1642.0 is 12,400 acre-feet.

7. The outlet works consists of three 4-by 4-foot openings, two of which have been plugged with concrete. With the water surface elevation at the top of dam, (elevation 1642) the peak discharge through the remaining opening is estimated at 500 cfs. A detached, unlined spillway is located in a natural saddle about 4,800 feet east of the left abutment of the existing dam. The spillway is irregular in cross section with the lowest point at elevation 1637.6.

Plan Modification-Cave Creek Dam

GENERAL

8. During the Phase I and Phase II studies, several investigations relative to the safety of the existing Cave Creek Dam were made. In summary, investigations showed that the dam could fail if the dam were overtopped for a sustained period of time. Studies also indicated that if the dam did fail, its failure would cause minor damage to, but would not endanger, the proposed Cave Buttes Dam about 0.7 mile downstream.

9. It was concluded during the Phase I/Phase II studies that the existing dam would best be utilized only for diversion and control of water during construction of Cave Buttes Dam. After completion of the latter dam, it was proposed that the existing structure then be removed to the existing ground elevation at the downstream toe of the dam.

10. Since completion of these studies, Cave Creek Dam has been nominated to the National Register of Historic Places. Because of this nomination, the recommended plan has been reevaluated.

NOMINATION TO THE NATIONAL REGISTER OF HISTORIC PLACES

11. In October 1976, the Arizona State Historic Preservation Officer (ASHPO) prepared a draft National Register nomination for Cave Creek Dam Archaeological District. This nomination refined the original Cave Creek Archaeological District boundaries and added the Cave Creek Dam, Rio Verde Canal, and a historic ditch to the list of significant cultural resources in the district. In January 1977, an onsite inspection of Cave Creek Dam was conducted with the ASHPO and the Advisory Council on Historic Preservation. Alternatives to the proposed removal of the dam were discussed.

12. In February 1977, in accordance with 36 CFR Part 800.4(a)(2), the Corps requested an opinion from the Secretary of the Interior with respect to the dam's eligibility for inclusion in the National Register. A letter from the Officer of Archeology and Historic Preservation dated 22 March 1977 attested to the eligibility of Cave Creek Dam.

ALTERNATIVES

Removal of Cave Creek Dam

13. The existing dam would be utilized for diversion and control of water during construction of Cave Buttes Dam. After completion of the latter dam, the existing structure would then be removed to elevation 1590, which is the existing ground elevation at the downstream toe of dam. The rubble from the existing structure would be buried in borrow pits adjacent to it. The cost of removing the dam would be about $282,000, including design costs.

14. A data recovery program to satisfactorily mitigate the destruction of the dam might include the following elements: a) photography, mapping, and accurate documentation of the physical measurements of the dam in a manner consistent with the standards for recording historic buildings published by the Historic American Building Survey; b) historic documentary research of the events leading up to the design and construction of the dam, including interviews with local informants and searches of pertinent literature, land title information, and newspaper records; c) a description of the techniques and materials used in the dam's construction; d) a comparison of the dam's construction drawings with its actual as built dimensions; e) the construction of a scale model of the dam, and f) a photographic documentary of the dam's razing.

15. A data recovery program containing these elements would preserve the significant architectural and engineering qualities which make the dam eligible for inclusion in the National Register. The photographic documentation and scale model would partially mitigate for the esthetic properties of the dam which would otherwise soon be forgotten. Such a program would

cost an estimated $50,000 and could be implemented concurrent with the construction of Cave Buttes Dam. However, coordination with the Arizona State Historic Preservation Officer and the Advisory Council on Historic Preservation, as required by section 106 of the National Historic Preservation Act of 1966, and the preparation of a memorandum of agreement would require 3 months.

Construction of Bypass Channel

16. Construction of a detached spillway or bypass channel would limit the impoundment of water behind the dam to a safe elevation and reduce the hydrostatic pressure on the dam. The existing spillway, through an unlined natural saddle about 4,800 feet east of the east abutment, has a low point elevation of 1637.6. However, the construction of dike No. 2 of the Cave Buttes Dam precludes the use of this spillway as a bypass channel. A second alternative is to construct a bypass channel west of the west abutment. A channel at this location would not prevent floodwater from overtopping the dam, but would divert a sufficient amount of floodwater to create a stilling pool which would reduce the hydrostatic pressure on the dam. A channel in this location would have a minor esthetic impact and cost $240,300.

17. Construction of the bypass channel to preserve Cave Creek Dam is legally justified in that the responsibility to preserve structures that are important to the nations history is evident through legislative actions. Some of these Acts which clearly define the Corps responsibility to preserve the dam are summarized in the following subparagraphs.

a) Title 16 USC Section 461 - It is declared that it is a national policy to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States (August 21, 1935 ch. 593, Sect 1, 49 STAT 666).

b) National Historic Preservation Act of 1966 (PL 89-665) - The preamble of the Act declares that the historic and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people.

c) National Environmental Policy Act of 1969 (PL 91-190) - Section 101 (b)(4) of this Act declares that it is the continuing responsibility of the Federal Government to use all practical means to preserve important historic, cultural and natural aspects of our national heritage.

d) Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 15, 1971 (36 FR 8921) - Section 1 of this Order orders that the Federal Government shall provide leadership in preserving, restoring and maintaining the historic and cultural environment of the Nation.

Do Nothing

18. If no modifications are made to the existing dam, a series of floods overtopping the dam could severely erode the material at the downstream toe of the dam and undermine it. Failure of the dam would cause minor damage to the proposed Cave Buttes Dam but would not endanger it. The floodwaters would not cause catastrophic damage nor threaten lives. The collapsed dam would become a serious hazard, an esthetic nuisance, and an operational difficulty. This alternative would cost the Federal Government nothing; however, the liability for the dam, should it fail and cause damage, must be accepted by local interests.

SELECTED ALTERNATIVE

19. The "do nothing" alternative is not recommended in that it would allow a potentially dangerous structure to remain. Total removal would preclude any future problems and costs associated with the maintenance of the existing dam or construction of the bypass channel; however it would destroy a structure of apparent historical significance.

20. Cave Creek Dam, built by John E. Eastwood before his death in 1924, is one of the first reinforced concrete, multiple-arch dams with a curved upstream face to be built in the United States and the first one of its kind to be built in Arizona. Because of the significance of this structure, the Arizona State Historic Preservation Officer and the Chief, Office of Archeology and Historic Preservation, National Park Service, urge that every consideration be given to its preservation. For this reason, removal of the dam is no longer recommended.

21. The remaining alternative of excavating a bypass channel through the saddle about 500 feet west of the right abutment of the dam is selected. This alternative will divert a sufficient amount of floodwater to create a stilling pool below the dam to preclude possible failure of the dam thereby preserving it in its natural state.

DESIGN CONSIDERATIONS

Geotechnical

22. CAVE CREEK DAM - Subsurface investigations by diamond core drilling were contracted during September-October 1972. Test corings were made at 12 locations across the streambed at an average spacing of about 110 feet. Seven holes were core drilled in the "T" wall slope of the concrete buttresses and into the underlying foundation and five holes were core drilled midway between the buttresses.

23. The foundation materials upon which the buttresses are supported and into which they are embedded range from hard schist and well cemented tuffaceous agglomerate near the abutments, to partially or weakly cemented tuffaceous agglomerate at the middle portion of the dam. In the middle portion of the dam, the arches and buttresses are deeply embedded in the alluvial streambed sands and gravels and other materials.

24. Because of the deep embedment in the streambed material there is a high probability that the dam would not slide on its foundation in the event of a near filling of the reservoir. However, long duration overtopping of the structure could produce a very hazardous condition. The streambed alluvium and the underlying partially or weakly cemented tuffaceous agglomerate in the middle portion of the dam would be eroded and severely reduce the passive resistance to the hydrostatic pressure on the upstream face of the dam. Floodwaters could wash these materials away from the downstream side of the dam and from beneath the buttress foundations and arches of the toe of the dam. Only the firm bedrock, such as the schist at the abutments, would withstand the erosive action. The removal of passive forces by erosion could eventually weaken and undermine the foundation of the dam and cause it to fail.

25. BYPASS CHANNEL SITE - In October, 1976, a shallow refractive seismic survey was run along the alinement of the proposed bypass channel. The purpose of the survey was to ascertain the types of materials which would be excavated and to determine the percentage of rock that would require blasting.

26. Three basic rock types were found in the proposed channel area. They are granite, felsite, and greenstone and quartzite.

27. Granite. The granite is covered by a thin alluvial cover and none was exposed in outcrops. Excavations in granite should be rippable.

28. Felsite (altered granite). The felsite is light colored, with moderate grain size, and is moderately foliated. Excavations deeper than 15 feet and scattered hard lenses may require blasting. It is estimated that 75% of the excavation through this material can be ripped.

29. Greenstone and Quartzite. This material is more closely foliated, finer grained and darker than the felsite. The foliation is in the same direction as in the felsite. Occasionally, cherty lenses are more massive and harder than the majority of rock and seem to parallel the foliation. Excavation through the hard lenses may need some blasting as will excavations over 15 feet deep in the slaty rock. It is estimated that 75% of excavations in this rock type material may be ripped.

Hydrological

30. Cave Creek Dam controls a 175-square-mile drainage area on Cave Creek. In 1973, preliminary flood routings of various return periods floods were routed through the existing dam. The various return period floods, under present conditions, were obtained from discharge-frequency regression equations developed for the Phoenix region. The routings were based on the 1970 gross capacity curve which showed a maximum gross reservoir capacity of 12,400 acre-feet. Storage values above maximum gross reservoir capacity represent gross reservoir capacity plus dynamic storage during spill conditions. Flood routing computations assumed that one 4-by 4-foot outlet would be in operation and that the spillway would consist of the dam (1,648-foot effective crest length) and the saddle east of the dam. No sediment allowance or previous pool storage was considered in this analysis.

3. The following table presents the results of these 1973 flood routings, using the above criteria, to demonstrate the potential and frequency of overtopping.

TABLE 1

Preliminary
Flood Routing*
Cave Creek Dam

Return Period (Years)	Peak Inflow (CFS)	Peak Outflow (CFS)	Max. Water Sur. Elev.** (Ft.)	Maximum Storage*** (Acre-ft)	Period of Dam Overtopping (Hrs)
SPF	86,000	71,000	1645.7	15,740	7.5
100	63,000	41,200	1644.5	14,590	6.0
50	46,500	19,500	1643.2	13,500	4.5
25	31,000	1,300	1640.4	11,100	-0
10	17,000	630	1632.6	5,900	-0

* Runoff volume of SPF, which is based on the August 19, 1954, thunderstorm over Queen Creek drainage area, is 33,200 acre-feet.

** Elevation at top of dam is 1642.

*** Maximum reservoir capacity (April 1970) is 12,400 acre-ft.

32. The flood hydrograph which was used in the more recent hydraulic analysis of the bypass channel described in the section "Hydraulics" is included in the Phase I GDM for subject project.

Structural

33. In 1973, Cave Creek Dam was structurally analyzed to determine the maximum elevation at which the dam could be cut off to preclude sliding and provide an acceptable safety factor for all conditions, including overtopping.

34. The depth of overflow for the probable maximum flood was established at 5.7 feet above the crest of the dam. Stability calculations, based on a monolithic area of arch and buttress unit action, revealed that the resultant forces are outside of the middle third yielding high, but allowable, tensile stresses in the upstream face of the arch crown. Resistance to sliding was acceptable providing no erosion of the downstream toe occurred.

35. Shear calculations for the buttresses revealed that the shear stresses were considerably above the allowable stresses. These calculations assumed that only the buttress area resisted the shear forces. If the shear resistance of the arches were to act with the buttresses, the shear stresses would be considerably reduced.

36. Arch stresses were found to be well within the allowable values; however, the arches are continuous between the buttresses and any slight deformation of the buttresses caused by sliding, overstressing, or settlement could affect the arch stresses significantly.

37. As the water surface is lowered, stability and arch stresses become insignificant. Shear stress in the buttress would remain excessive until the water surface is about 17 feet below the top of the dam. Inasmuch as water has reached a level near the top of dam with no mishap, some shear strength must have been contributed by the arches.

38. In January 1977, additional studies were initiated when it was suggested that Cave Creek Dam be preserved. The purpose of these additional studies was to determine the maximum water surface differential between the water impounded upstream of the proposed Cave Buttes Dam and the water detained upstream of Cave Creek Dam that would not seriously overstress Cave Creek Dam. After investigating several conditions, it was determined that a maximum differential of about 10 feet would be acceptable even though shear stresses between elevation 1600 and 1630 would still be high when compared to present criteria.

Hydraulics

39. Based on the structural analysis of Cave Creek Dam, it was decided to limit the maximum pool differential to 10 feet just as the water surface behind Cave Creek Dam reaches the top of the dam. This section summarizes the assumptions which were made and presents the results of hydraulic studies to determine the elevation and cross section of a bypass channel that would satisfy the 10-foot pool differential criteria.

40. The following assumptions were made:

a. The 100-year sediment allowance of 5,730 acre-feet has been depleted. Ninety percent (5160 acre-feet) was assumed to be deposited behind Cave Creek Dam and ten percent (570 acre-feet) between the existing dam and the proposed Cave Buttes Dam. It was further assumed that the 570 acre-feet would offset the material removed between the two dams for construction of Cave Buttes Dam.

b. The sediment behind Cave Creek Dam was assumed to be distributed between elevations 1596 (the elevation of the streambed just upstream of the existing dam), and 1660 (2.9 feet above the spillway crest for Cave Buttes Dam), as a percent of the surface area between these two elevations. The 1970 area capacity curve was used as the base curve.

c. One 4-by 4-foot outlet opening, invert elevation 1596, was assumed to be open.

41. The Modified Puls routing method was used in this study. A flood hydrograph was first routed through the Cave Creek reservoir. The outflow from this routing was used as the inflow hydrograph into the reservoir between Cave Creek and Cave Buttes Dams and was routed through the area between the two dams. The resultant water surface elevations for the two pools were compared to determine the head differential.

42. Two floods were used in this study. They were the local standard project flood, based on the Queen Creek thunderstorm of August 1954, and the general standard project flood based on the Trilby Wash storm of August 1951. The local thunderstorm was found to be the most critical flood for computation of maximum pool differential.

43. After several trial runs a bypass channel with a bottom width of 400 feet and 1 on 1 side slopes cut to elevation 1628, which would be 14 feet below the crest of the existing dam, was determined to meet the stated objective of limiting the maximum water surface differential elevation to 10 feet.

44. The water surface elevations for the two pools are shown on exhibit 1. For an upstream pool elevation of 1641 the downstream pool elevation is about 1630.5 or a differential 10.5 feet; when the upstream pool elevation reaches the top of dam at elevation 1642 the downstream pool is at elevation 1637.5 or a 4.5-foot differential.

45. Inasmuch as the structural criteria and hydraulic calculations are based on nonfinite assumptions because of many unknowns, further refinement of the hydraulic studies were considered inappropriate. Likewise, hydraulic studies were not revised when completed geological studies revealed that steeper sideslopes (2V on 1H) would be recommended.

Environmental Assessment

46. The final environmental statement for the New River and Phoenix City Streams flood control project reported the impacts of removing Cave Creek Dam. The impacts described in the following paragraphs would result from the construction of the bypass channel to preserve Cave Creek Dam.

47. ECONOMIC. Construction of the channel would cost $240,300, and be a Federal cost. The operation and maintenance of the dam, including all liability associated with it, would be the responsibility of the Flood Control District of Maricopa County.

48. ENVIRONMENTAL. The construction of the channel would remove 15 acres of desert vegetation and create a scar on the hillside. However, the dam would continue to entrap sediment, keeping it away from the proposed Cave Buttes Dam.

49. VISITOR SAFETY. The walk on top of the dam, which is readily accessible from either abutment, is 2-1/2 feet wide and has a 2-foot-high parapet wall along its upstream side. The walk is not wide enough to easily or safely pass another person. A slightly larger "landing" is formed at the junction of adjacent bays. These landings break the narrow walk into more negotiable 70-foot sections. The landings, curvature of the walk, and closeness of the ground surface near the abutments tend to lure visitors out toward the center. The ground surface quickly falls away on both sides and the once easily negotiated 70-foot sections of walk become terrifyingly long. This walk cannot be made safe for the average visitor.

50. ADVERSE EFFECT. It has been determined that the construction of this channel and the construction of the Cave Buttes Dam 3,000 feet to the south will cause occasional temporary inundation but will have no adverse physical or esthetic effect on Cave Creek Dam.

Recommended Plan

51. The recommended plan consists of preserving Cave Creek Dam as is and excavating a bypass channel through the saddle about 500 feet west of the right abutment of the dam. The channel would be unlined and have a 400-foot base width, 2V on 1H sideslopes and a crest elevation of 1628. A concrete sill and downstream energy dissipator are not required in that any erosion caused by channel floods would not endanger any other structures and erosion of the channel is acceptable.

Cost Estimates

52. The estimated first cost was developed using October 1975 price levels to be consistent with the costs presented in the Phase II, Part I Design Memorandum. Based on geological investigations about 18% of the materials to be excavated may require blasting while the remaining material can be ripped. The estimated first costs (October 1975 price levels) are given in the following table.

TABLE 2

COST ESTIMATE

Cave Creek Dam Bypass Channel
(October 1975 price levels)

Cost Acct. No.	Description	Quantity	Unit	Unit Cost	Total
	CONSTRUCTION				
18	Cultural resource preservation				
	Excavation, bypass channel				
	Rock (blasting)	31,000	CY	$10.00	$310,000
	Ripable material	135,000	CY	0.75	101,250
	Contingencies				38,750
	Total Cultural resources preservation				$450,000
30	Engineering and design				10,000
31	Supervision and administration				10,000
	Total, construction				$470,000
	LANDS AND RELOCATIONS				
	Lands and damages				$ 0
	Relocations				0
	Total lands and relocations				$ 0
	Total, Cave Creek Dam bypass channel				$470,000*

* On 30 August 1977, bids were opened for the construction of Cave Buttes Dam, which includes excavation of the bypass channel as a separate line item. The low bidder's bid was $240,300 for the excavation of the bypass channel.

Cost Apportionment

53. In accordance with Section 7a of the Archeological and Historical Preservation Act (PL 93-291), costs required to carry out the purposes of this act are considered nonreimbursable project costs. Inasmuch as Cave Creek Dam has been determined eligible for inclusion in the National Register of Historic Places, all costs associated with the preservation of Cave Creek Dam, which includes the bypass channel, will be a Federal cost.

Plan Implementation

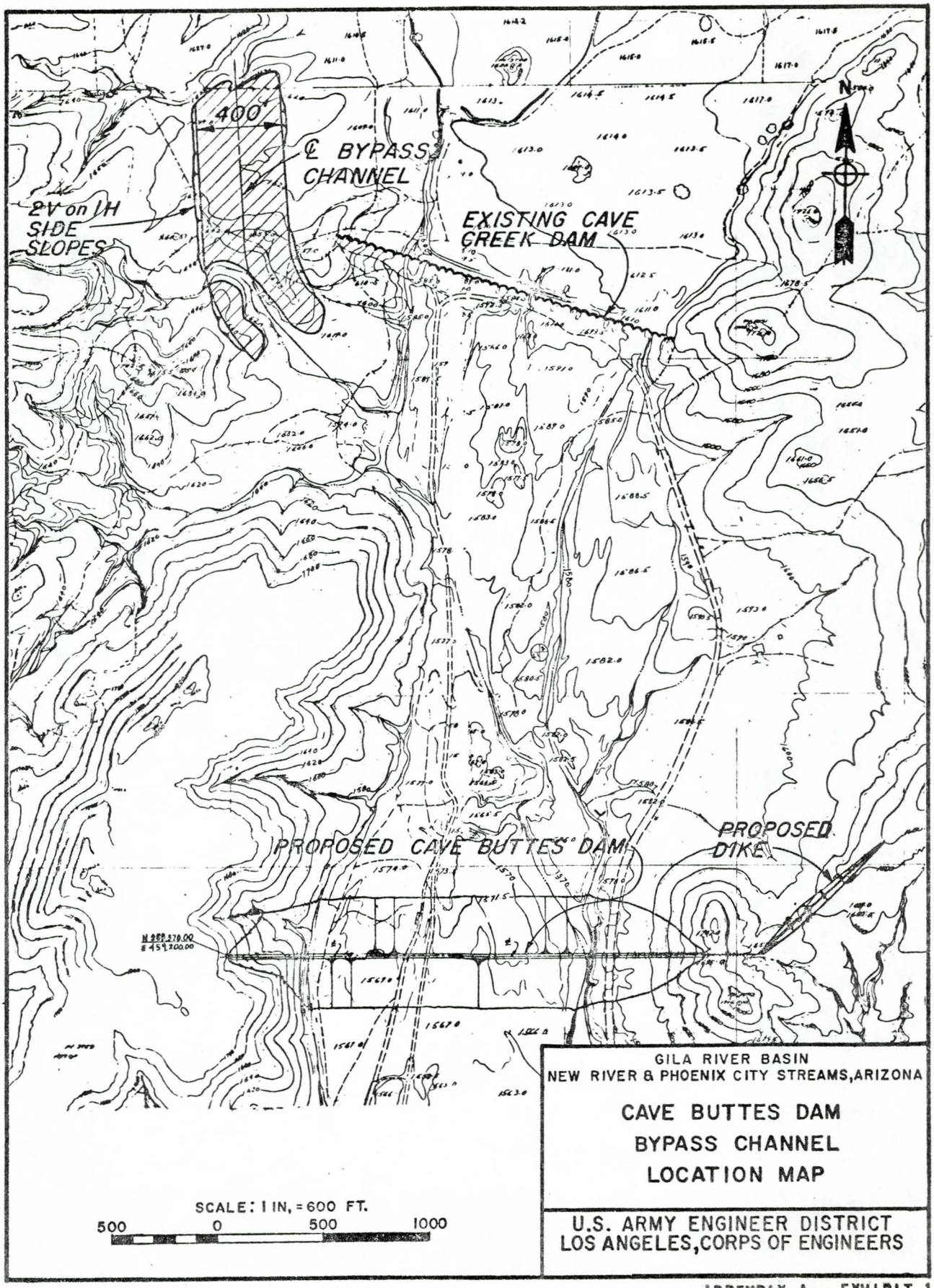
54. The recommended bypass channel would be included as a part of the Cave Buttes Dam construction contract.

Local Cooperation

55. The requirements of local cooperation for the flood control features of the recommended plan are considered adequate to require local interests to maintain the dam and to hold and save the United States free from damages.

Recommendation

56. It is recommended that the Cave Creek Dam bypass channel plan described as the recommended plan herein and shown on exhibit 2 of this report be approved for construction as a part of the Cave Buttes Dam construction contract. It is further recommended that this report become a part of Design Memorandum No. 3, General Design Memorandum - Phase II, Project Design, Part 1, Cave Buttes Dam (including Cave Creek to Peoria Avenue), dated July 1976.

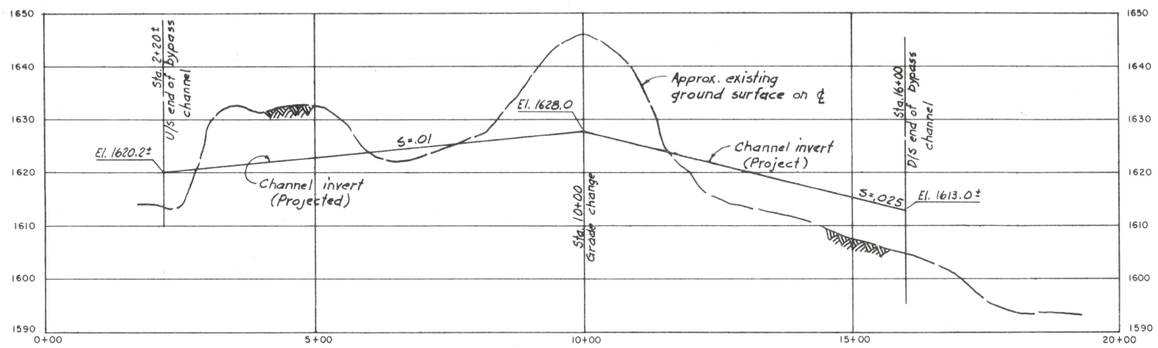


GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
BYPASS CHANNEL
LOCATION MAP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

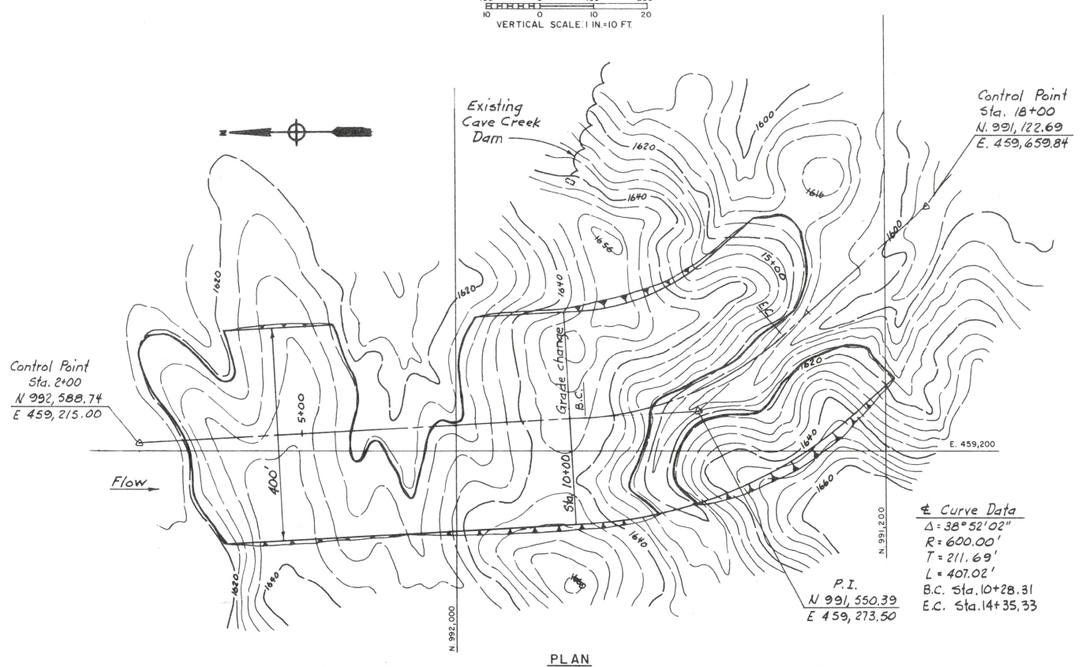
APPENDIX A EXHIBIT 1



℄ PROFILE

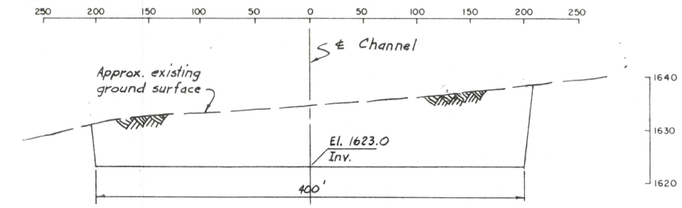
HORIZONAL SCALE: 1 IN.=100 FT.

VERTICAL SCALE: 1 IN.=10 FT.

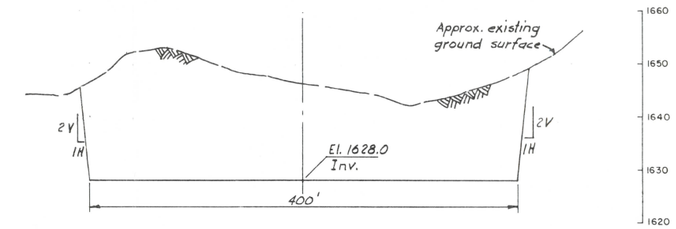


PLAN

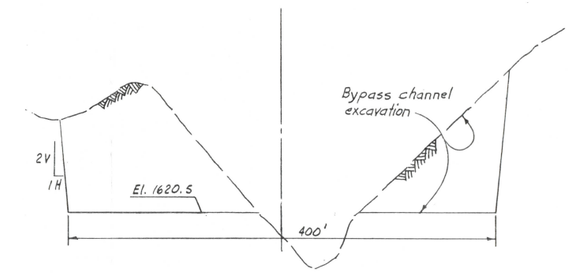
SCALE: 1 IN. = 100 FT.



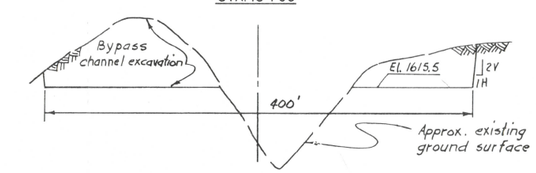
STA. 5+00



STA. 10+00



STA. 13+00



STA. 15+00

HORIZONAL SCALE: 1 IN. = 50 FT.

VERTICAL SCALE: 1 IN. = 10 FT.

Note: Cross Sections are drawn looking downstream

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

DESIGNED BY:

DRAWN BY: J.W.S.

CHECKED BY:

CAVE BUTTES DAM

BYPASS CHANNEL

PLAN, PROFILE AND SECTIONS

SUBMITTED BY: CHIEF, BRANCH

APPROVED: COLONEL, C.E. DISTRICT ENGINEER

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

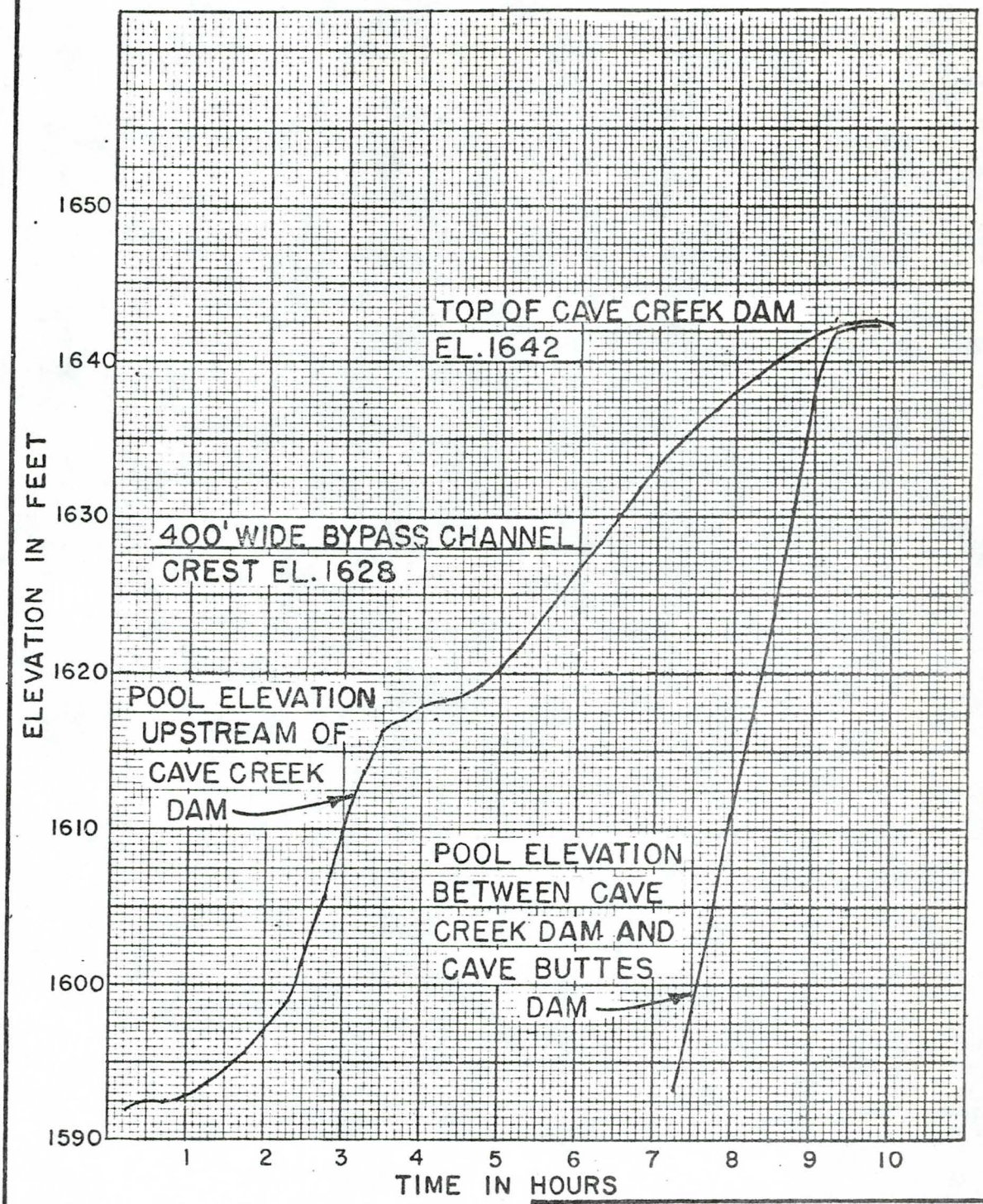
SPEC. NO. DACW 09- ____ B- ____

DISTRICT FILE NO.

DATE:

SHEET 1 OF 1 SHEETS

APPENDIX A EXHIBIT 2



GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

RELATIONSHIP OF POOL ELEVATIONS ABOVE AND BELOW CAVE CREEK DAM FOR ROUTED LOCAL SPF

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

APPENDIX B

TO

AMPLIFICATION TO THE

FINAL ENVIRONMENTAL IMPACT STATEMENT

NEW RIVER AND PHOENIX CITY STREAMS

FLOOD CONTROL PROJECT

MARICOPA COUNTY, ARIZONA

Documentation of a
No Adverse Effect Determination
Regarding the Periodic Inundation of
Cave Creek Dam and the Construction of
the Cave Creek Dam Bypass Channel

Documentation of a No Adverse Effect Determination Regarding the Periodic Inundation of Cave Creek Dam and the Construction of the Cave Creek Dam Bypass Channel

Gila River Basin
New River and Phoenix City Streams, Arizona

Prepared in accordance with 36 CFR Part 800.4(d)

U.S. Army Corps of Engineers
Los Angeles District
August 1977

Documentation of a
No Adverse Effect Determination
Regarding the Periodic Inundation of
Cave Creek Dam and the Construction of the
Cave Creek Dam Bypass Channel

Contents

	Page
LOCATION	B-1
CULTURAL RESOURCE COORDINATION EFFORTS	B-1
CAVE CREEK DAM SAFETY STUDIES	B-3
ALTERNATIVE DAM SAFETY PLANS	B-4
Do nothing	B-5
Partial removal of the dam	B-5
Construction of a bypass channel	B-6
Total removal of the dam	B-6
Title 16 USC Section 461	B-7
National Historic Preservation Act of 1966 (PL 89-665)	B-7
National Environmental Policy Act of 1969 (PL 91-190)	B-8
Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 15, 1971 (36 FR 8921)	B-8
ENVIRONMENTAL ASSESSMENT OF PRESERVING CAVE CREEK DAM	B-8
Economic	B-8
Environmental	B-9
Visitor safety	B-9
RELATIONSHIP OF CAVE CREEK DAM TO CAVE BUTTES DAM	B-10
DETERMINATION OF NO ADVERSE EFFECT	B-10

EXHIBITS

No.	Title
1	Cave Buttes Dam Location Map
2	Determination of National Register eligibility
3	Cave Buttes Dam Bypass Channel Location Map
4	Cave Buttes Dam Bypass Channel, Plan, Profile, and Sections
5	Relationship of Pool Elevations Above and Below Cave Creek Dam for Routed Local SPF

LETTERS OF CONCURRENCE

Advisory Council on Historic Preservation
National and Cultural Resource Conservation Section, Arizona State Parks

Documentation of a

No Adverse Effect Determination

Regarding the Periodic Inundation of

Cave Creek Dam and the Construction of the

Cave Creek Dam Bypass Channel

LOCATION. Cave Creek Dam, a reinforced-concrete structure, is located about 19 miles north of downtown Phoenix in Maricopa County, Arizona. Built across the confluence of Apache Wash and Cave Creek, it is within the reservoir of the proposed Cave Buttes Dam, a feature of the New River and Phoenix City Streams, Arizona, flood control project. A map showing the dam's location is included as Exhibit 1.

CULTURAL RESOURCE COORDINATION EFFORTS. Cultural resource studies of the immediate area were undertaken by the Arizona State University Department of Anthropology for the Corps of Engineers. These studies identified several prehistoric sites. In January 1975, the Arizona State Historic Preservation Officer (ASHPO) delineated the Cave Creek Archeological District around these widely scattered sites to assure that they would be considered collectively in any Federal plans. At that time, Cave Creek Dam was not considered a significant cultural resource; no attempt was made to determine its eligibility for inclusion in the National Register.

In October 1975, an onsite inspection of the archeological district was conducted in accordance with the consultation process of the Advisory Council on Historic Preservation, 36 CFR Part 800.5(b). While standing on the dam, the inspection party discussed the dam's National Register qualities. It was agreed by all that the dam was not a significant historical resource.

In August 1976, a memorandum of agreement for the construction of the New River and Phoenix City Streams, Arizona, flood control project affecting the Cave Creek Archeological District was approved by the Advisory Council. Cave Creek Dam was not mentioned in the memorandum of agreement. Removal of Cave Creek Dam had been discussed during the consultation process. Details of the dam's removal and burial were presented in the Phase 1 General Design Memorandum. The impacts of the dam's removal were presented in the Environmental Statement. No comments were received regarding Cave Creek Dam.

In October 1976, the Arizona State Historic Preservation Officer prepared a draft National Register nomination for Cave Creek Dam Archeological District. This nomination refined the original Cave Creek Archeological District boundaries and added the Cave Creek Dam, Rio Verde Canal, and a historic ditch to the list of significant cultural resources in the district. In January 1977, an onsite inspection of Cave Creek Dam was conducted with the ASHPO and the Advisory Council. Alternatives to the proposed removal of the dam were discussed.

In February 1977, in accordance with 36 CFR Part 800.4(a)(2), the Corps requested an opinion from the Secretary of the Interior with respect to the dam's eligibility for inclusion in the National Register. A letter from the Office of Archeology and Historic Preservation dated 22 March 1977 attesting to the eligibility of Cave Creek Dam is included as Exhibit 2.

In light of the Secretary of the Interior's determination that Cave Creek Dam is eligible for inclusion in the National Register, the Corps of Engineers has reconsidered its proposal to remove Cave Creek Dam. The

following report describes the alternatives to the removal of Cave Creek Dam studied by the Corps and describes the modifications required to preserve the dam.

CAVE CREEK DAM SAFETY STUDIES. The earlier decision to remove the dam was made as a result of investigations relative to its safety. In April 1969, an independent structural evaluation of the existing dam was made by John Carollo Engineers of Phoenix, Arizona. Their calculations indicated that the safety factor against sliding was as low as 1.03 for a water surface elevation of 1,642.0 (top of dam). A safety factor of at least 4.0 is recommended in accordance with the Standards of Safety Inspection of Dams. Additional investigations by the Corps confirm these findings.

Subsurface explorations by diamond core drilling contracted by the Corps in 1972 revealed that the bedrock underlying the existing Cave Creek Dam was both soft and hard tuffaceous agglomerate and schist. Foundation material underlying the buttresses and arches in the middle portion of the dam (arches 10 to 31) consists of a partially cemented gravel and weakly cemented tuffaceous agglomerate, both of which are very erodible. These materials are overlain by streambed alluvium consisting of sand, gravel, cobbles, and boulders. These explorations also revealed that the concrete foundation of the dam extended an average of 25 feet below the streambed rather than 60 feet as indicated on the dam's construction drawings.

Studies indicate that overtopping of the dam could occur during floods bearing occurrence frequencies exceeding approximately 25 years. This overtopping would start the erosion process provided there is no

stilling pool between the dam and the proposed Cave Buttes Dam. The best judgement is that a sustained overpour or accumulative periods of overpour could seriously weaken the foundation of the dam. Further, structural analysis indicates that the structure would be overstressed if the water surface should reach dam crest. Under such a loading condition, the upper part of the dam could be severely damaged. Therefore, it is probable that some mode of failure of the Cave Creek Dam could occur during the life of the proposed Cave Buttes Dam. These findings were presented to the Arizona Water Commission who agreed that the existing Cave Creek Dam could not continue to be safely operated without extensive alterations to the existing structure.

ALTERNATIVE DAM SAFETY PLANS. Alternative plans ranging from preserving the existing structures for flood control use to complete removal were analyzed. Five alternative plans were evaluated and presented in the Phase I Design Memorandum. The plans were: (a) the existing structure would remain as it is; (b) the existing structure would remain, but additional protection would be provided at the downstream toe of the structure; (c) the existing structure would be modified by the removal of nine bays, to provide a spillway that would prevent floodwaters from overtopping the dam; (d) the existing structure would remain, but a bypass channel would be provided to prevent overtopping of the dam; and (e) the existing structure would be removed. The impacts and cost estimates for each of these alternatives follow:

a. Do nothing. If no modifications are made to the existing dam, a series of floods overtopping the dam could undermine the downstream toe of the dam and destroy it. The dam failure would cause some damage to the proposed Cave Buttes Dam but would not cause it to fail; the floodwaters would not cause catastrophic damage or threaten lives. The collapsed dam would become an esthetic nuisance, a legal attractive nuisance, and quite possibly an operation nuisance. This alternative would cost the Federal Government nothing; however, the liability for the dam, should it fail and cause damage, would belong to the Flood Control District of Maricopa County.

b. Protection of the dam's foundation to preclude dam failure due to undermining. This modification was investigated during the Phase I Design Memorandum studies and found to be too costly. The upper part of the dam could still fail from structural overstress associated with overtopping. Protection of the dam's foundation would have a significant esthetic impact on the dam and would cost about $1,000,000.

c. Partial removal of the dam. To preclude overtopping, 9 of the 38 bays would be removed and a lined channel constructed through the breach. This would have serious esthetic impacts on the dam. The partial destruction of the dam would destroy the integrity of the dam, which is part of its National Register quality. The estimated cost of the partial removal and lined channel is $1,300,000.

d. Construction of a bypass channel. Construction of a bypass channel would limit the impoundment of water behind the dam to a safe elevation and would reduce the hydrostatic pressure on the dam. The existing unlined spillway through a natural saddle, about 4,800 feet east of the east abutment, has a crest elevation of 1,640. However, the construction of dike No. 2 of the Cave Buttes Dam precludes the use of this spillway. To preclude floodwater from overtopping the dam, a 2,000-foot-wide spillway around the east abutment of the dam was considered, but this alternative was estimated to cost $4,000,000. A second variation of this alternative would be to construct a bypass channel west of the west abutment. (See exhibits 3 and 4.) A bypass channel at this location would not prevent floodwater from overtopping the dam, but would divert a sufficient amount of floodwater to create a stilling pool, which would reduce the hydrostatic pressure on the dam. Exhibit 5 shows that Cave Creek Dam will be overtopped by floodwater at the same time it is totally inundated by the Cave Buttes Dam floodpool.

e. Total removal of the dam. The existing dam would be utilized for diversion and control of water during construction of Cave Buttes Dam. After completion of the latter dam, the existing structure would then be removed to elevation 1590, which is the existing ground elevation at the downstream toe of the dam. Suitable rubble from the existing structure would be used for upstream toe protection. The remainder of the rubble would be buried in borrow pits adjacent to the structure. The cost of removing the dam would be $235,000.

Alternatives b and c, proposing the protection of the dam's foundation and the partial removal of the dam were not considered further because of their excessive cost. The do nothing alternative, alternative a, was not considered further because it would allow a potentially dangerous structure to remain.

The feasible and prudent dam safety plans evaluated by the Corps were (d) construction of a bypass channel to divert sufficient floodwater to preserve the dam, and (e) total removal of the dam, mitigating for its destruction by recording its method of construction and physical dimensions in a well-documented report.

Construction of the bypass channel to preserve Cave Creek Dam is legally justified in that the responsibility to preserve structures that are important to the Nation's history is evident through legislative actions. Some of these Acts, which clearly define the Corps responsibility to preserve the dam, are summarized in the following subparagraphs.

a. Title 16 USC Section 461 - It is declared that it is a national policy to preserve for public use historic sites, buildings, and objects of national significance for the inspiration and benefit of the people of the United States (August 21, 1935 ch. 593, Sect 1, 49 STAT 666).

b. National Historic Preservation Act of 1966 (PL 89-665) - The preamble of the Act declares that the historic and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people.

c. National Environmental Policy Act of 1969 (PL 91-190) - Section 101 (b) (4) of this Act declares that it is the continuing responsibility of the Federal Government to use all practical means to preserve important historic, cultural, and natural aspects of our national heritage.

d. Executive Order 11593, Protection and Enhancement of the Cultural Environment, May 15, 1971 (36 FR 8921) - Section 1 of this Order requires the Federal Government to provide leadership in preserving, restoring, and maintaining the historic and cultural environment of the Nation.

Because it is the Nation's policy to preserve objects of national significance and because an economic and engineeringly feasible solution exists, the alternative of constructing a bypass channel that would preserve the dam has been selected.

ENVIRONMENTAL ASSESSMENT OF PRESERVING CAVE CREEK DAM. The final environmental statement for the New River and Phoenix City Streams flood control project reported the impacts of removing Cave Creek Dam. The following impacts would result from the construction of a bypass channel to preserve Cave Creek Dam.

a. Economic. Construction of a bypass channel would cost $240,300, and be a Federal cost. The operation and maintenance of the bypass channel and the dam, including all liability associated with them, will be the responsibility of the Flood Control District of Maricopa County.

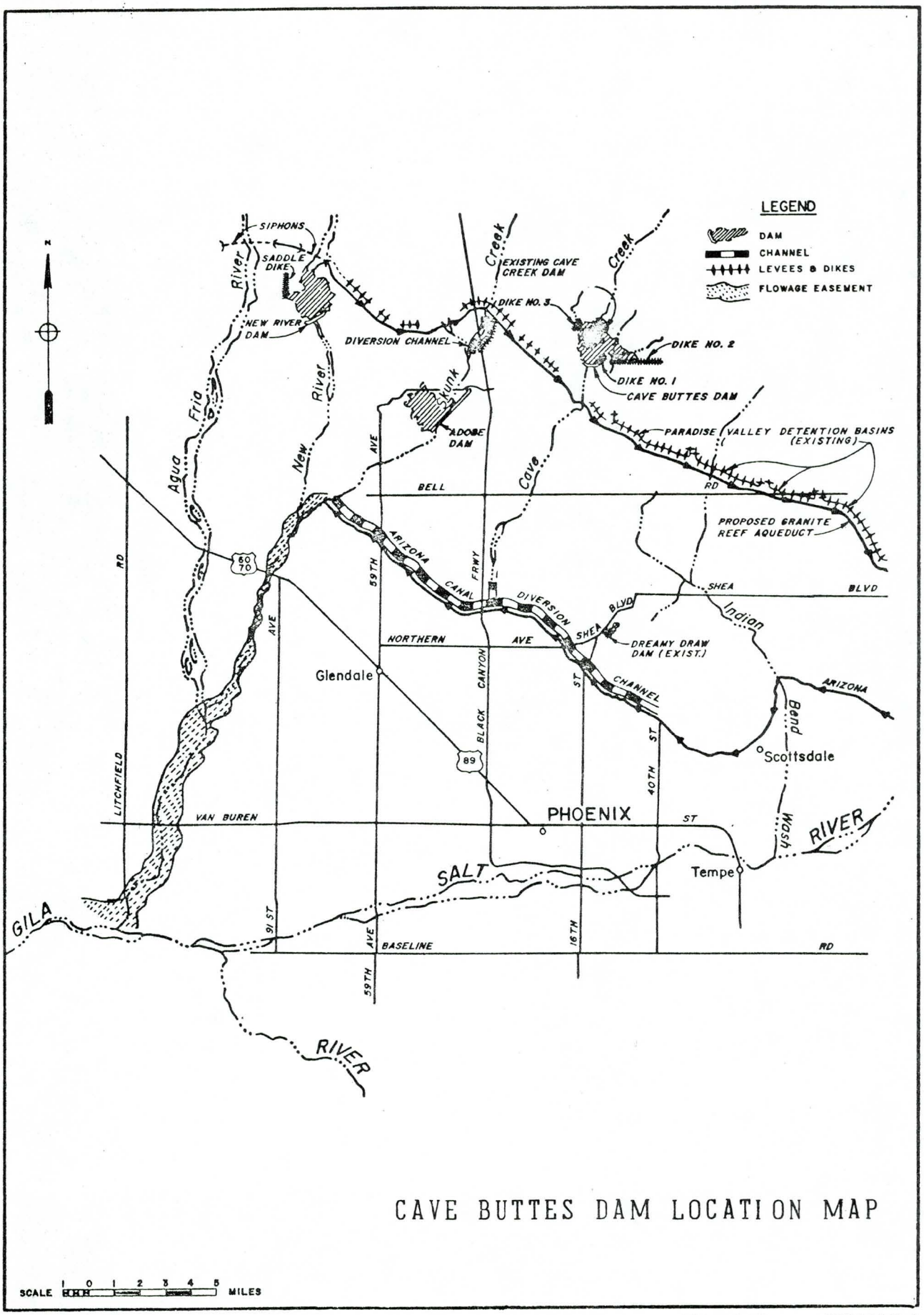
b. Environmental. The construction of the bypass channel would remove 15 acres of desert vegetation and create an unnatural scar on the hillside. The dam would continue to entrap sediment, keeping it away from the proposed Cave Buttes Dam.

c. Visitor safety. The dam attracts visitors. Nearly everyone who visits the dam comes away with a feeling that it is a "neat old dam." The walk on top of the dam is readily accessible from either abutment. The walk is 2-1/2 feet wide and has a 2-foot-high parapet wall along its upstream side that acts as a guardrail. No guardrail exists on the downstream side. The walk is not sufficiently wide enough to easily or safely pass by another person. A slightly larger "landing" is formed at the conjunction of adjacent bays. These landings break up the narrow walk into more negotiable 70-foot sections. The landings, curvature of the walk, and closeness of the ground surface near the abutments tend to lure the visitor out toward the center. The ground surface quickly falls away on both sides. When the visitor realizes his situation, he frequently freezes. The once easily negotiated 70-foot sections of walk become terrifyingly long. This walk cannot be made safe for the average visitor.

The Flood Control District of Maricopa County can install a barbed-wire fence and gate to each end of the walk at a place which is sufficiently high that it will not be easily bypassed. Signs warning visitors to stay off the dam can also be posted. The Flood Control District of Maricopa County is liable for any personal or property damages caused by the dam.

RELATIONSHIP OF CAVE CREEK DAM TO CAVE BUTTES DAM. Cave Creek Dam is located within the reservoir of the proposed Cave Buttes Dam. Floodwater normally impounded by Cave Creek Dam would be diverted through the bypass channel into the reservoir of Cave Buttes Dam. Cave Creek Dam has a 5-percent chance each year of being inundated and a 1-percent chance each year of being completely covered by floodwater impounded by Cave Buttes Dam. Repeated inundation will not structurally harm the dam, nor will significant amounts of debris and sediment esthetically impair its appearance. It will be possible to view Cave Creek Dam from upstream or downstream without seeing the larger Cave Buttes Dam; from most locations, however, the two dams will be seen together.

DETERMINATION OF NO ADVERSE EFFECT. Therefore, the Los Angeles District, Corps of Engineers, recognizing that Cave Creek Dam has been identified by the Secretary of the Interior as a significant historic resource that is eligible for inclusion in the National Register, will construct a bypass channel to divert floodwater around the dam to render the dam safe and thus preserve it for future generations. Further, the Corps of Engineers has determined that the construction of this bypass channel and the construction of the Cave Buttes Dam 3,000 feet to the south which will cause occasional temporary inundation, will have no adverse physical or esthetic effect on Cave Creek Dam.



CAVE BUTTES DAM LOCATION MAP

APPENDIX B EXHIBIT 1

United States Department of the Interior

NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:
H34-880

MAR 22 1977

Mr. Taichi L. Nishihara
Acting Chief, Engineering Division
Department of the Army
Corps of Engineers
P. O. Box 2711
Los Angeles, California 90053

Dear Mr. Nishihara:

Thank you for your letter requesting a determination of eligibility for inclusion in the National Register pursuant to Executive Order 11593. Our determination appears on the enclosed material.

As you understand, your request for our professional judgment constitutes a part of the Federal planning process. We urge that this information be integrated into the National Environmental Policy Act analysis in order to bring about the best possible program decisions. This determination does not serve in any manner as a veto to uses of property, with or without Federal participation or assistance. Any decision on the property in question and the responsibility for program planning concerning such properties lie with the agency or block grant recipient after the Advisory Council on Historic Preservation has had an opportunity to comment.

We are pleased to be of assistance in the implementation of Executive Order 11593.

Sincerely yours,

Jerry L. Rogers
Chief, Office of Archeology
and Historic Preservation

Enclosure (s)

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

APPENDIX B EXHIBIT 2a

E.O.11593

DETERMINATION OF ELIGIBILITY NOTIFICATION

NATIONAL REGISTER OF HISTORIC PLACES

OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

NATIONAL PARK SERVICE

Request submitted by: Taichi Nishihara, Corps of Engineers

Date request received: 18 February 1977

Name of property: Cave Creek Dam State: Arizona

Location: Glendale vicinity

Opinion of the State Historic Preservation Officer:

(x) Eligible ( ) Not eligible ( ) No response

Comments: Cave Creek Dam was constructed in 1922/1923 and designed by John E. Eastwood as a reinforced concrete structure with a curved upstream face. The design proved to be more effective and much less expensive than conventional dams of the time and has been copied innumerable times since.

The Secretary of the Interior has determined that this property is:

(x) Eligible Applicable criteria: (C)

Comments: Cave Creek Dam is the only structure of its type built by John E. Eastwood before his death in 1924. It is the first reinforced concrete, multiple-arch dam, built with a curved upstream face. Because of the significance of this structure, we urge the Corps to give every consideration to its preservation.

( ) Not eligible

Comments:

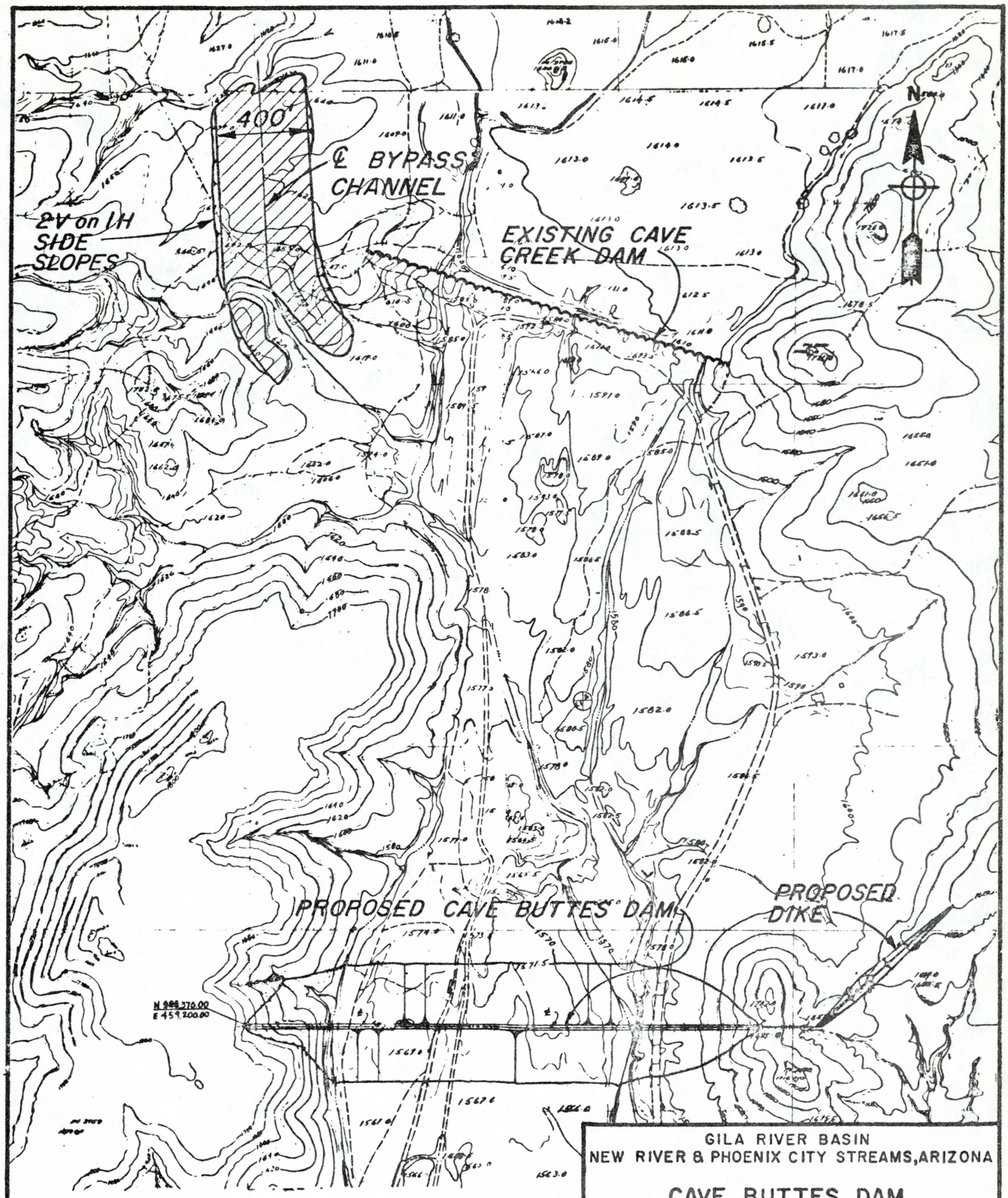
( ) Documentation insufficient (see accompanying sheet explaining additional materials required)

Acting Chief, Office of Archeology and Historic Preservation

Date: 3/22/77

WASO-185
9/75

APPENDIX B EXHIBIT 2b



SCALE: 1 IN. = 600 FT.

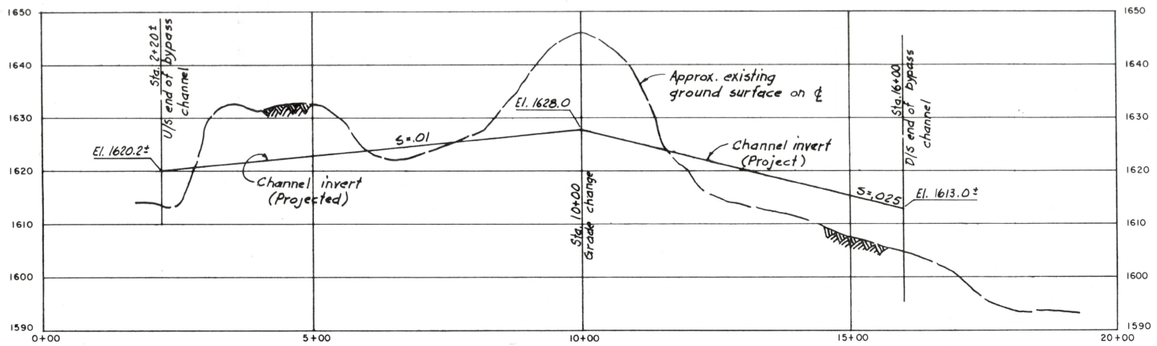
500 0 500 1000

GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
BYPASS CHANNEL
LOCATION MAP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

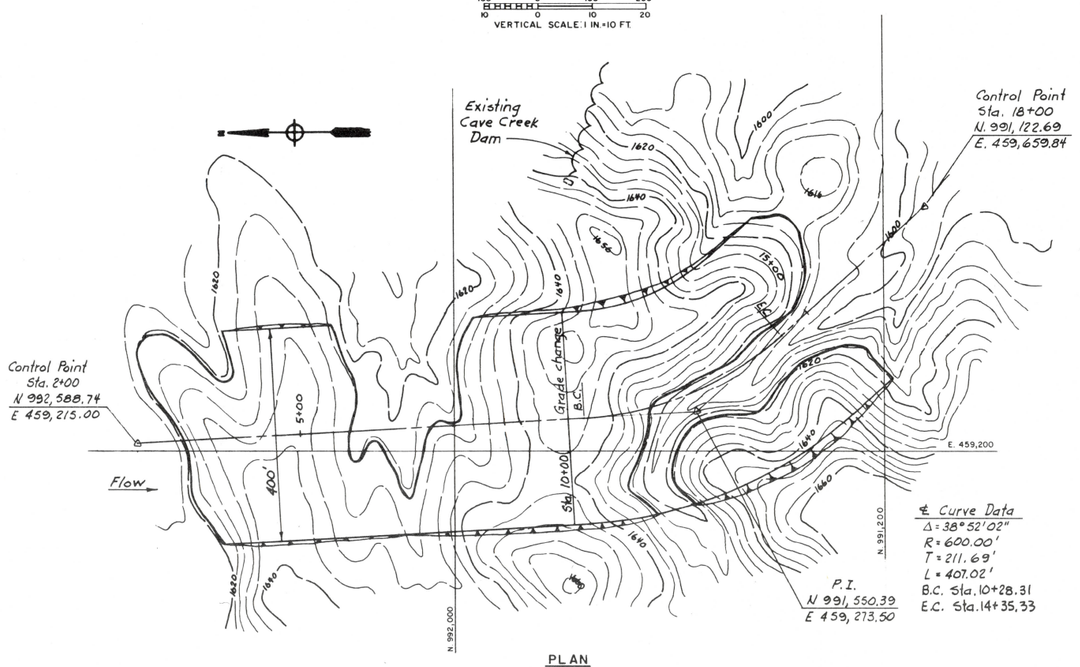
APPENDIX B EXHIBIT 3



℄ PROFILE

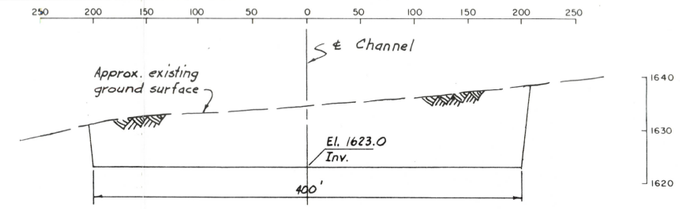
HORIZONAL SCALE: 1 IN.=100 FT.

VERTICAL SCALE: 1 IN.=10 FT.

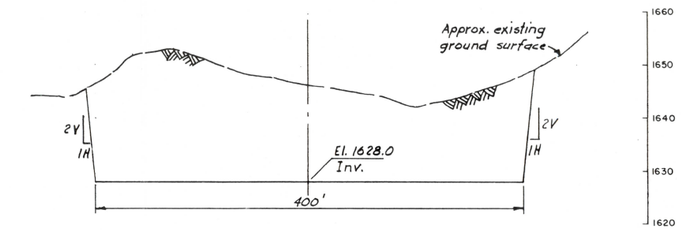


PLAN

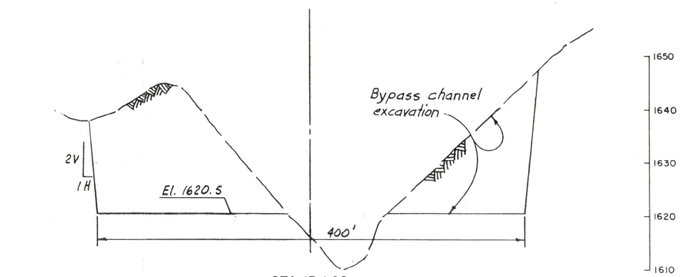
SCALE: 1 IN.=100 FT.



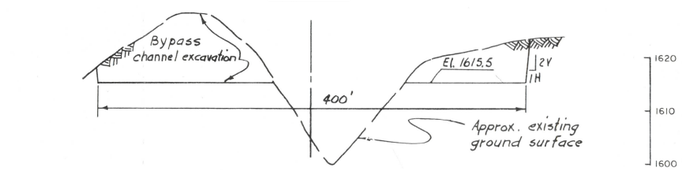
STA. 5+00



STA. 10+00



STA. 13+00



STA. 15+00

250 200 150 100 50 0 50 100 150 200 250

HORIZONAL SCALE: 1 IN.= 50 FT.

VERTICAL SCALE: 1 IN.= 10 FT.

Note: Cross Sections are drawn looking downstream

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: J.W.S.

CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

BYPASS CHANNEL

PLAN, PROFILE AND SECTIONS

SUBMITTED BY: CHIEF, BRANCH

APPROVED: COLONEL, C.E. DISTRICT ENGINEER

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

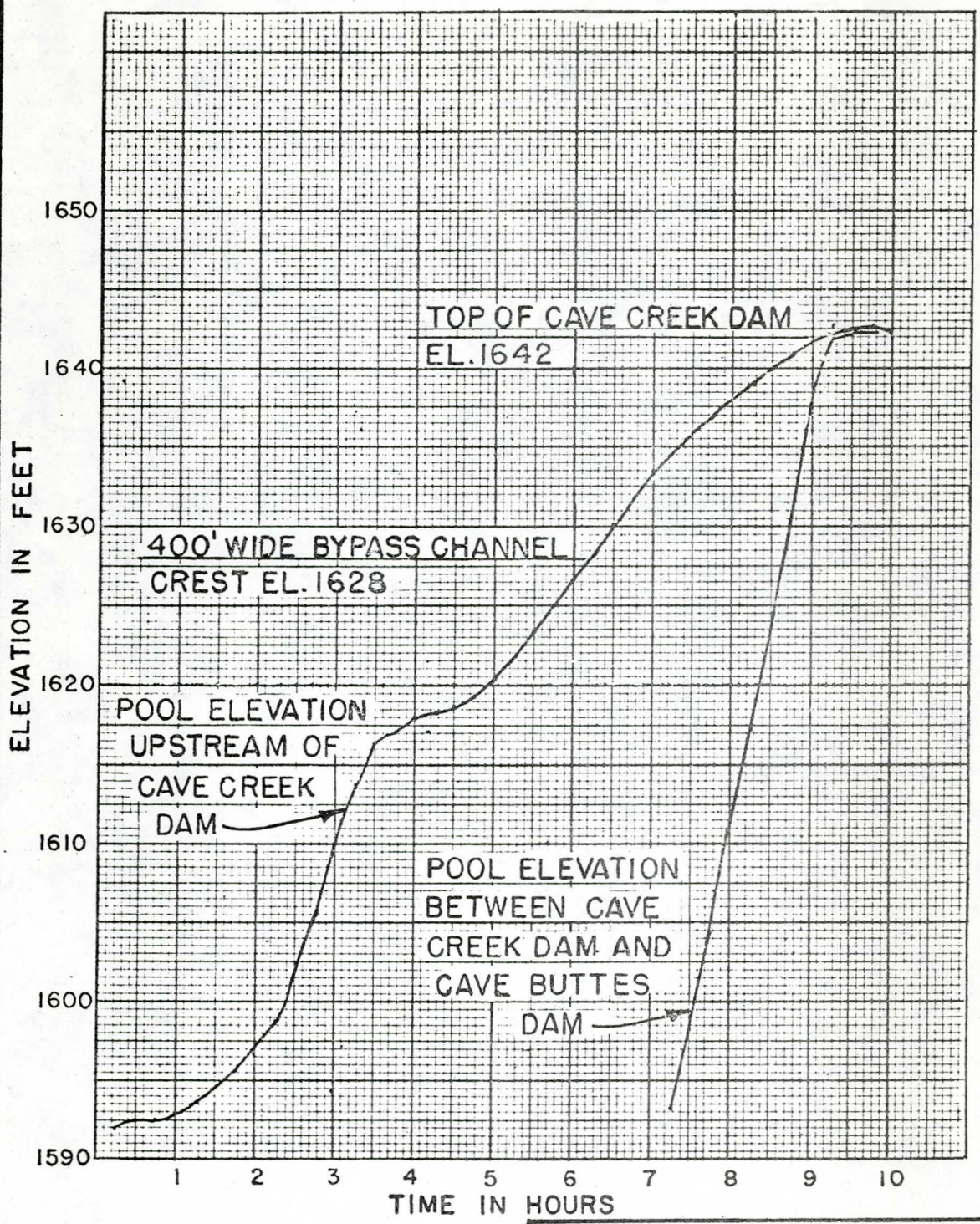
SPEC. NO. DACW 09- ____ B- ____

DISTRICT FILE NO.

DATE:

SHEET 1 OF 1 SHEETS

APPENDIX B EXHIBIT 4



GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

RELATIONSHIP OF POOL ELEVATIONS ABOVE AND BELOW CAVE CREEK DAM FOR ROUTED LOCAL SPF

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS

LETTERS OF CONCURRENCE

Advisory Council on
Historic Preservation
1522 K Street N.W.
Washington, D.C. 20005

Mr. Norman Arno
Chief, Engineering Division
Los Angeles District
Corps of Engineers
P. O. Box 2711
Los Angeles, California 90053

Dear Mr. Arno:

On August 8, 1977, the Council received a determination from the Corps of Engineers that the New River and Phoenix City Streams Flood Control Project, Arizona, would not adversely affect the Cave Creek Dam, a property determined by the Secretary of the Interior to be eligible for inclusion in the National Register of Historic Places. The Executive Director notes no objection to your determination.

A copy of your determination of no adverse effect, along with supporting documentation and this concurrence, should be included in any assessment or statement prepared for this undertaking in compliance with the National Environmental Policy Act and should be kept in your records as evidence of your compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470f, as amended, 90 Stat. 1320).

Your continued cooperation is appreciated.

Sincerely yours,

Robert M. Utley

Robert M. Utley
Deputy Executive Director

The Council is an independent unit of the Executive Branch of the Federal Government charged by the Act of October 15, 1966 to advise the President and Congress in the field of Historic Preservation.

TO: Norman Arno, Chief, Engineering Division, Dept. of the Army, Los Angeles Dist., Corps of Engineers, P.O. Box 2711, Los Angeles, California 90053

FROM: Natural & Cultural Resource Conservation Section
Arizona State Parks
1688 West Adams Street
Phoenix, Arizona 85007
(602) 271-4174

PROJECT: Cave Creek Dam SPLED-EP
New River & Phoenix City Streams Flood Control Project
Construction of bypass channel and periodic inundation
Maricopa County, AZ

I have reviewed this project and offer the following comments:

- ( ) There are Inventory/Register properties in/near the project area as described in the enclosed comments.
- ( ) An opinion of eligibility for inclusion in the National Register of Historic Places is enclosed.

This project will have:

- ( ) An apparent positive effect on cultural resources.
- ( ) No effect on cultural resources.
- (✓) No apparent adverse effect on cultural resources. However,
  - ( ) The State Historic Preservation Officer and/or the State Archaeologist (Arizona State Museum) should be notified if cultural resources are discovered during construction.
  - ( ) An archaeologist should monitor the project during construction.
  - ( ) Existing buildings/structures on the site should be recorded through photographs and/or drawings.
  - ( ) An archaeological clearance survey is requested.
- ( ) A Potential adverse effect on cultural resources. Therefore,
  - ( ) An archaeological clearance survey is requested because of known sites and/or properties in the area.
  - ( ) An archaeologist should monitor the project during construction.
  - ( ) The impact on existing buildings/structures should be evaluated.

On the site. To be vacated if this project is undertaken.

- ( ) An adverse effect on cultural resources included on/or eligible for inclusion on the National Register of Historic Places. Please seek Advisory Council on Historic Preservation comments and prepare a preliminary case report.
- ( ) The effect on cultural resources cannot be determined. Please submit information requested in the enclosed comments.
- (✓) Additional comments are enclosed.

If alternative (d) and recommendations are followed.

Dorothy H Hall
State Historic Preservation Officer

8-30-77
Date

APPENDIX C

TO

AMPLIFICATION TO THE

FINAL ENVIRONMENTAL IMPACT STATEMENT

NEW RIVER AND PHOENIX CITY STREAMS

FLOOD CONTROL PROJECT

MARICOPA COUNTY, ARIZONA

CAVE CREEK DAM
BYPASS CHANNEL
ENVIRONMENTAL ASSESSMENT

DEPARTMENT OF THE ARMY
Los Angeles District, Corps of Engineers

Environmental Assessment

CAVE CREEK DAM
BYPASS CHANNEL

November 1977

Environmental Assessment
CAVE CREEK DAM
BYPASS CHANNEL

Contents

	Page
PROJECT LOCATION	C-1
ENVIRONMENTAL SETTING WITHOUT THE PROJECT FEATURE	C-2
The Project Feature	C-2
Topography	C-2
Geology and Soils	C-2
Surface Hydrology	C-3
Subsurface Hydrology	C-4
Vegetation and Wildlife	C-4
Archeological and Historical Resources	C-5
Social Safety	C-6
Recreation	C-7
Esthetics	C-7
Economic	C-8
PROPOSED ACTION	C-9
ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION	C-10
Topography	C-10
Geology and Soils	C-10
Surface Hydrology	C-10
Subsurface Hydrology	C-10
Vegetation and Wildlife	C-10
Archeological and Historical Resources	C-11
Social Safety	C-11
Recreation	C-11
Esthetics	C-12
Economic	C-12
ALTERNATIVES TO THE PROPOSED ACTION	C-13
COORDINATION	C-15
CONCLUSION AND STATEMENT OF FINDINGS	C-16

Plates

Plate 1	Recommended Plan, Flood Control
Plate 2	Relationship of Pool Elevations Above and Below Cave Creek Dam for Routed Local SPF
Plate 3	Cave Buttes Dam, Bypass Channel, Plan, Profile and Sections

1. PROJECT LOCATION

1.01 This environmental assessment concerns the proposed construction of a bypass channel, determined to be required to safely retain the historically significant Cave Creek Dam within Cave Buttes Reservoir. Cave Creek Dam and Cave Buttes Reservoir are located about 19 miles north of downtown Phoenix, in Maricopa County, Arizona. (Plate 1.) Cave Buttes Dam is a major structural feature of the New River and Phoenix City streams flood control project authorized by the Flood Control Act of 1965, Public Law 89-298.

1.02 A final environmental impact statement (FEIS) concerning the New River and Phoenix City streams flood control project, including the specific effects of the Cave Buttes Dam feature was filed with CEQ on 27 September 1976. Notice of the filing appeared in the Federal Register dated 8 October 1976. As described in the FEIS, the authorized project included removal of Cave Creek Dam. Since the FEIS was filed with CEQ the Secretary of the Interior has determined that Cave Creek Dam is a significant historical resource that is eligible for inclusion in the National Register of Historic Places.

1.03 Consistant with the Nation's policy to preserve such structures of national significance, the Corps of Engineers has modified the plans for the construction of Cave Buttes Dam to include the construction of a bypass channel that will allow the historic dam to be safely preserved within the reservoir area of Cave Buttes Dam. This environmental assessment addresses the effect this action will have on the environment.

2. ENVIRONMENTAL SETTING

WITHOUT THE PROJECT FEATURE

2.01 TOPOGRAPHY. The topography adjacent to Cave Creek Dam is characterized by rugged mountains, a gently sloping terrace, and a flat reservoir area subject to periodic inundation.

2.02 The mountains are a southern extension of the Union Hills which are dissected by intermittent drainages. The highest nearby peak has an elevation of 2,144 feet, about 525 feet above the adjacent valley floor. The Cave Creek drainage flows in this valley. The terrace that forms the valley has an average slope of 30 feet per mile in the study area. The existing Cave Creek Dam, erected in 1923, has altered the topography by impounding sediments and creating a basin. The basin surface has a slope of about 20 feet per mile.

2.03 The terrace area between Cave Creek Dam and the authorized damsite has been extensively altered by sand and gravel mining operations. The valley floor has been pot-marked by excavations 20 to 25 feet deep.

2.04 GEOLOGY AND SOILS. The extension of the Union Hills forming the Cave Creek Dam abutments are composed of three basic rock types; granite, felsite, and greenstone and quartzite. About 75 percent of excavations in these materials can be performed with construction equipment; the remainder may require blasting.

2.05 The foundation materials upon which the Cave Creek Dam buttresses are supported and into which they are embedded range from hard schist and well cemented tuffaceous agglomerate near the abutments to partially or weakly cemented tuffaceous agglomerate at the middle portion of the dam. In the middle portion of the dam, the arches and buttresses are deeply embedded in the alluvial streambed sands and gravels.

2.06 The alluvial soil within Cave Creek Reservoir has been characterized as a limy clay loam subsoil (B4M) by the Soil Conservation Service. They classify the alluvial soil south of the site as a deep sandy loam soil (ALa). Both of these soils are moderately fertile.

2.07 SURFACE HYDROLOGY. The existing Cave Creek Dam, located at the confluence of Apache Wash and Cave Creek, controls a drainage area of about 175 square miles. Based on stream gage records the average annual runoff for the study area is estimated to be 4,700 acre-feet.

2.08 Cave Creek Dam is reinforced concrete structure with 38 arches and supporting buttresses spaced about 44 feet apart. The dam is 1,692 feet long and rises 52 feet above the downstream ground surface. A detached unlined spillway is located in a natural saddle about 4,800 feet east of the left abutment of the dam. No floodwater detained by Cave Creek Dam is believed to have reached spillway elevation and discharged through the spillway in the 55 years since the dam was built. The outlet works consist of three 4- by 4-foot openings, one ungated and two gated. The maximum discharge rate through each of these openings is estimated at about 500 cfs (with water surface at the crest of the dam).

2.09 The dam, as constructed, had a reservoir capacity of 14,000 acre-feet. Capacity has been lost as a result of siltation; the estimated capacity in 1970 was 12,400 acre-feet. According to the latest hydrologic analysis, the reservoir capacity behind the existing Cave Creek Dam could control floods having an occurrence frequency between 25 and 50 years.

2.10 SUBSURFACE HYDROLOGY. Ground water depths in the study area vary tremendously with the local geology. The U.S.G.S. data indicate that the depth to water ranges from a measured depth of 33 feet immediately downstream of the existing Cave Creek Dam (perched on bedrock) to a measured depth of 271 feet 2 miles downstream of the damsite. The ground water contours upstream of the study area range in depth from 300 feet to 800 feet.

2.11 VEGETATION AND WILDLIFE. The Cave Buttes damsite contains about 250 acres of desert wash vegetation and 1,650 acres of desert outwash and upland vegetation within the standard project flood overflow area. The detention basin behind the existing Cave Creek Dam has a dense growth of mostly annual herbaceous vegetation and grasses, including such species as cocklebur, sunflower, dock, mustard, thistle and brome grasses. Because of the heavy sedimentation and inundation effects near Cave Creek Dam, only a few small shrubs occur. Many small mesquite, catclaw acacia and some ironwood occur about 300 yards north of the dam. At least five cottonwoods 30-50 feet tall are growing within the detention basin area. Cave Creek, which meanders through the detention basin, is lined with such species as blue paloverde, mesquite and, near the dam, by a dense growth

of cocklebur 4-6 feet tall. A large amount of vegetation within the detention basin, especially near the dam, is mowed annually. The area upstream from the dam is also used to graze cattle. About 50 acres of dense riparian growth (mesquite, blue paloverde, catclaw acacia and some ironwood) are located about 2,000 feet northwest of the east abutment of Cave Creek Dam. This appears to be the best quality desert wash habitat in the area. Cave Creek habitats support such upland game species as mourning doves, white-winged doves, Gambel's quail and jackrabbits. The large number of spent shotgun shells present suggests the area is important to hunters.

2.12 Gravel mining roads and trails, and the stripping of surface vegetation prior to gravel mining accounts for most of the loss or heavy disturbance of the vegetation downstream of Cave Creek Dam.

2.13 No endangered or threatened wildlife species occupy the study area.

2.14 ARCHEOLOGICAL AND HISTORICAL RESOURCES. Cultural resources studies of the Cave Buttes Dam project area were conducted by the Arizona State University Department of Anthropology in June 1974. The survey identified fourteen archeological sites within the project area. In January 1975 the Arizona State Historic Preservation Officer grouped these fourteen sites together with ten archeological sites located immediately downstream of the project area to form the Cave Creek Archeological District, a property eligible for inclusion in the National Register of Historic Places.

2.15 A memorandum of agreement was prepared pursuant to section 106 of the National Historic Preservation Act. This document describes the actions the Corps will take to avoid or mitigate for adverse effects on National Register sites.

2.16 A cultural resource mitigation program consisting of mapping, collection, and excavation of eleven affected sites was conducted by Arizona State University in the spring of 1976. Additional surveys of the proposed bypass channel right of way and access roads not previously surveyed were also conducted at this time. No additional cultural resources were identified.

2.17 In October 1976 the Arizona State Historic Preservation Officer nominated Cave Creek Dam for inclusion in the National Register of Historic Places. In March 1977 the Chief, Office of Archeology and Historic Preservation determined that Cave Creek Dam was eligible for inclusion in the National Register. His comments were that "Cave Creek Dam was the first reinforced concrete, multiple-arch dam, built with a curved upstream face. Because of the significance of this structure, we urge the Corps to give every consideration to its preservation."

2.18 SOCIAL SAFETY. The existing Cave Creek Dam has been determined to be unsafe by the Corps of Engineers. Based on Corps hydrology, a flood having a frequency between 25 to 50 years would spill over the top of dam. Overtopping of the dam for an extended period of time might undermine the foundation of the dam and cause it to collapse. Should the dam fail in a major storm, it would increase both the flood damages and

probability of loss of life. The flood potential of Cave Creek and the history behind the construction of Cave Creek Dam is discussed in detail in General Design Memorandum No. 3, Gila River Basin, New River and Phoenix City Streams, General Design Memorandum - Phase I, Plan Formulation.

2.19 Cave Creek Dam attracts visitors. The walk on top of the dam is readily accessible from either abutment. The walk is 2-1/2 feet wide and has a 2-foot-high parapet wall along its upstream side that acts as a guardrail. No guardrail exists on the downstream side. The walk is not sufficiently wide enough to easily or safely pass by another person.

2.20 RECREATION. There are no formal recreational facilities within the Cave Buttes Dam area, although the Cave Creek Dam area shows evidence of use for sightseeing and equestrian activities. The study area is also used by hunters and off-road vehicles, although this use often involves trespass.

2.21 ESTHETICS. The distant vistas to the north and east of the existing Cave Creek Dam offer a high degree of visual quality. The valley floor downstream of the dam has been extensively disturbed by sand and gravel mining operations. Several prominently visible access, farm implement and mining roads have been graded across the abutment areas to the east and west of Cave Creek Dam and across the area immediately downstream of the dam. Shallow mine shafts and geological test pits protrude visibly from several of the steeper slopes. Chainlink fences further degrade the esthetic qualities of the area.

2.22 ECONOMIC. Cave Creek Dam was constructed through a joint effort of the State of Arizona, Maricopa County, and others after a major flood in August 1921. All legal rights to the dam have been acquired by the Flood Control District of Maricopa County as a project requirement prior to the initiation of construction of Cave Buttes Dam.

3. PROPOSED ACTION

3.01 The recommended plan consists of preserving Cave Creek Dam as is and excavating a bypass channel through the saddle about 500 feet west of the right abutment of the dam. The channel would be unlined and have a 400-foot base width, 2 vertical on 1 horizontal sideslopes and a crest elevation of 1,628.

3.02 Construcion of a bypass channel would limit the impoundment of water behind the dam to a safe elevation and would reduce the hydrostatic pressure on the dam. The bypass channel would not prevent floodwater from overtopping the dam, but would divert a sufficient amount of floodwater to create a stilling pool, which would reduce the hydrostatic pressure on the dam. Plate 2 shows that Cave Creek Dam will be overtopped by floodwater at the same time it is totally inundated by the Cave Buttes Dam floodpool. Plate 3 shows the design of the bypass channel.

4. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

4.01 TOPOGRAPHY. The topography of the project area will be altered by the excavation of 166,000 cubic yards of rock and soil removed to form the bypass channel.

4.02 GEOLOGY AND SOILS. The material excavated to form the bypass channel will be deposited in borrow areas used for the construction of Cave Buttes Dam. These fill materials will help reshape the borrow areas and supply a growing medium to areas previously denuded by gravel mining operations.

4.03 SURFACE HYDROLOGY. The construction of the bypass channel will not have a significant effect on the surface hydrology of the area. Its presence will allow Cave Creek Dam to remain in place. Water diverted by the channel will be impounded by Cave Buttes Dam.

4.04 SUBSURFACE HYDROLOGY. The proposed action will not affect subsurface hydrology.

4.05 VEGETATION AND WILDLIFE. The construction of the bypass channel will remove 15 acres of disturbed upland vegetation. Cave Creek Dam will continue to entrap sediment which will expedite the reestablishment of the vegetative community upstream of the dam. The bypass channel will not affect endangered or threatened wildlife species.

4.06 ARCHEOLOGICAL AND HISTORICAL RESOURCES. The construction of the bypass channel will not directly affect any archeological or historical resources. The bypass channel will preserve Cave Creek Dam, a National Register-eligible property.

4.07 The proposed action has been reviewed by the Advisory Council on Historic Preservation. The Council concurred with the Corps determination that the proposed action would have no adverse effect on Cave Creek Dam.

4.08 SOCIAL SAFETY. The construction of the bypass channel will assure that floodwater will not erode and undermine the foundations or overstress the buttresses of Cave Creek Dam.

4.09 The recreational development, access roads, and parking lots will attract visitors to Cave Buttes Reservoir. Cave Creek Dam will be a recreational attraction. The walk on top of the dam, which is readily accessible from either abutment is not wide enough for two people to safely pass one another. A spike fence at each end of the walk placed sufficiently high that it cannot be easily bypassed, and signs warning visitors to stay off the dam, will minimize this existing hazard.

4.10 RECREATION. The proposed action will preserve Cave Creek Dam for future generations. The historic dam will continue to be a minor sightseeing attraction.

4.11 ESTHETICS. The construction of the bypass channel will create an unnatural scar on the hillside. The use of the bypass channel as a trail connecting the two reservoir areas will eliminate the need to construct a similar trail to allow equestrians and recreationists to safely and easily traverse the project area.

4.12 Soil excavated from the bypass channel will be deposited in borrow areas. This action will help the reestablishment of vegetative communities and reduce the visual impact of these scarred areas.

4.13 ECONOMIC. Construction of the bypass channel will cost $240,300, and be a Federal cost. The operation and maintenance of the dam, including all liability associated with it, will be the responsibility of the Flood Control District of Maricopa County.

5. ALTERNATIVES TO THE PROPOSED ACTION

5.01 Three alternative plans were evaluated. The plans were: (a) the existing structure would remain as it is; (b) the existing structure would remain, but additional protection would be provided at the downstream toe of the structure; and (c) the existing structure would be modified by the removal of nine bays, to provide a spillway that would prevent floodwaters from overtopping the dam. The impacts and cost estimated for each alternative follows:

a. Do nothing. If no modifications are made to the existing dam, a series of floods overtopping the dam could undermine the downstream toe of the dam and destroy it. The dam failure would cause some damage to the proposed Cave Buttes Dam but would not cause it to fail; the floodwaters would not cause catastrophic damage or threaten lives. The collapsed dam would become an esthetic nuisance, a legal attractive nuisance, and quite possibly an operational nuisance. This alternative would cost the Federal Government nothing; however, the liability for the dam, should it fail and cause damage, would belong to the Flood Control District of Maricopa County.

b. Protection of the dam's foundation to preclude dam failure due to undermining. This modification was investigated during the Phase I Design Memorandum studies and found to be too costly. The upper part of the dam could still fail from structural overstress associated with overtopping. Protection of the dam's foundation would have a significant esthetic impact on the dam and would cost about $1,000,000.

c. Partial removal of the dam. To preclude overtopping, 9 of the 38 bays would be removed and a lined channel constructed through the breach. This would have serious esthetic impacts on the dam. The partial destruction of the dam would destroy the integrity of the dam, which is part of its National Register quality. The estimated cost of the partial removal and lined channel is $1,300,000.

5.02 Alternatives b and c, proposing the protection of the dam's foundation and the partial removal of the dam were not considered further because of their excessive cost. The do nothing alternative, alternative a, was not considered further because it would allow a potentially dangerous condition to remain.

6. COORDINATION

6.01 The proposed action differs little from the action discussed in the FEIS, which was fully coordinated with interested Federal, State, local agencies and individuals. A report addressing the effects of the proposed bypass channel on the dam and the environment was coordinated with the Arizona State Historic Preservation Officer, the Bureau of Land Management, the Advisory Council on Historic Preservation, and the Flood Control District of Maricopa County. The proposed action was informally coordinated with the Historic American Engineering Record, NPS; Interagency Archeological Services, NPS, and the Department of Anthropology, Arizona State University. No adverse comments were received.

7. CONCLUSION AND STATEMENT OF FINDINGS

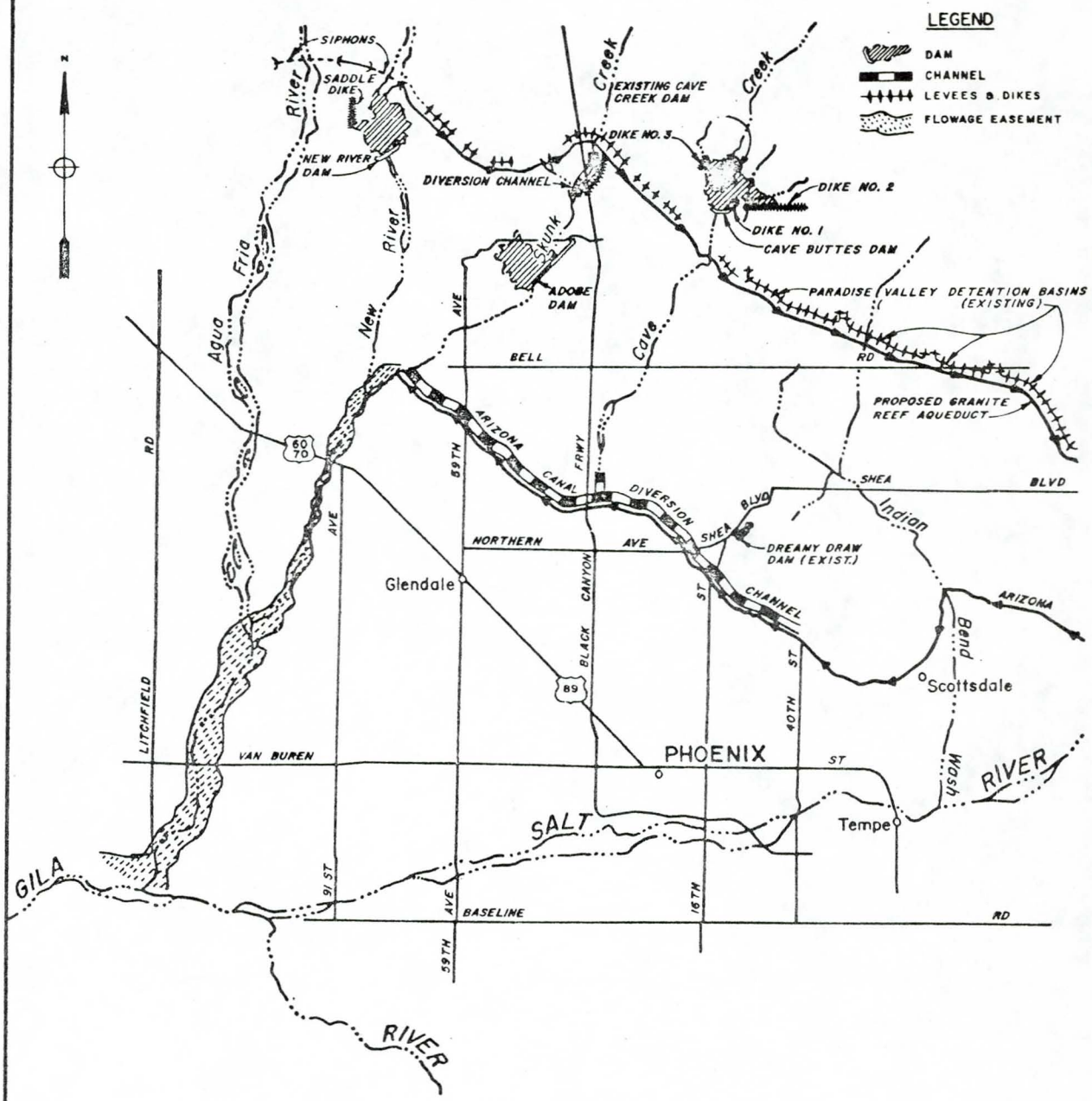
7.01 This action will not have a significant adverse effect on the environment.

7.02 This action will have a beneficial effect on the environment.

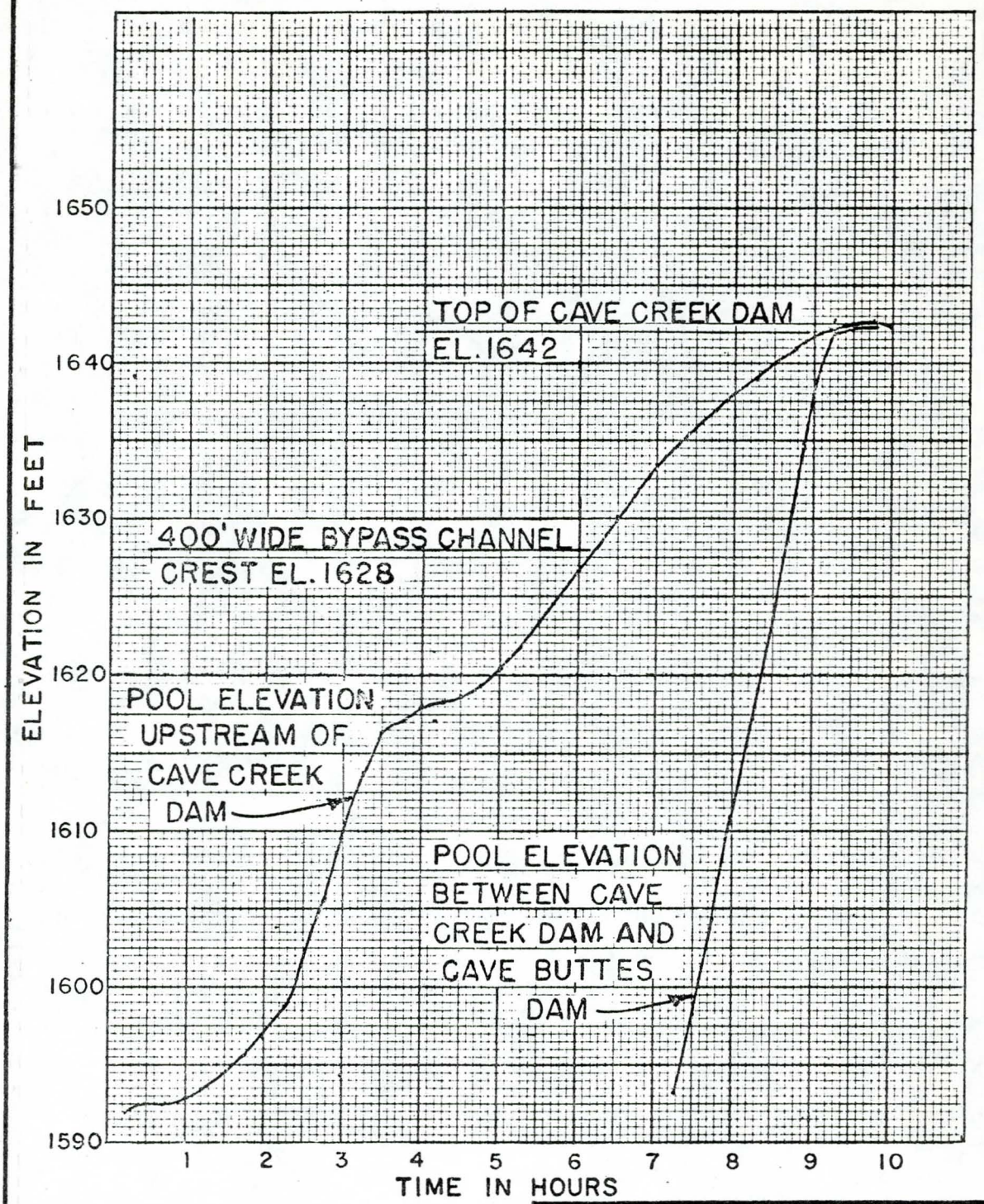
7.03 The effect of this action will not be environmentally controversial.

7.04 A Supplemental Environmental Impact Statement will not be prepared.

HUGH G. ROBINSON
COL, CE
District Engineer



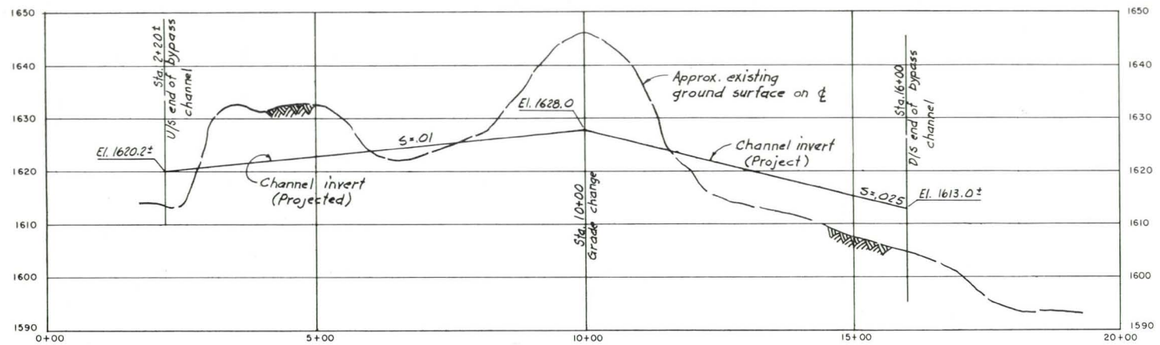
RECOMMENDED PLAN
FLOOD CONTROL



GILA RIVER BASIN
NEW RIVER & PHOENIX CITY STREAMS, ARIZONA

RELATIONSHIP OF POOL ELEVATIONS ABOVE AND BELOW CAVE CREEK DAM FOR ROUTED LOCAL SPF

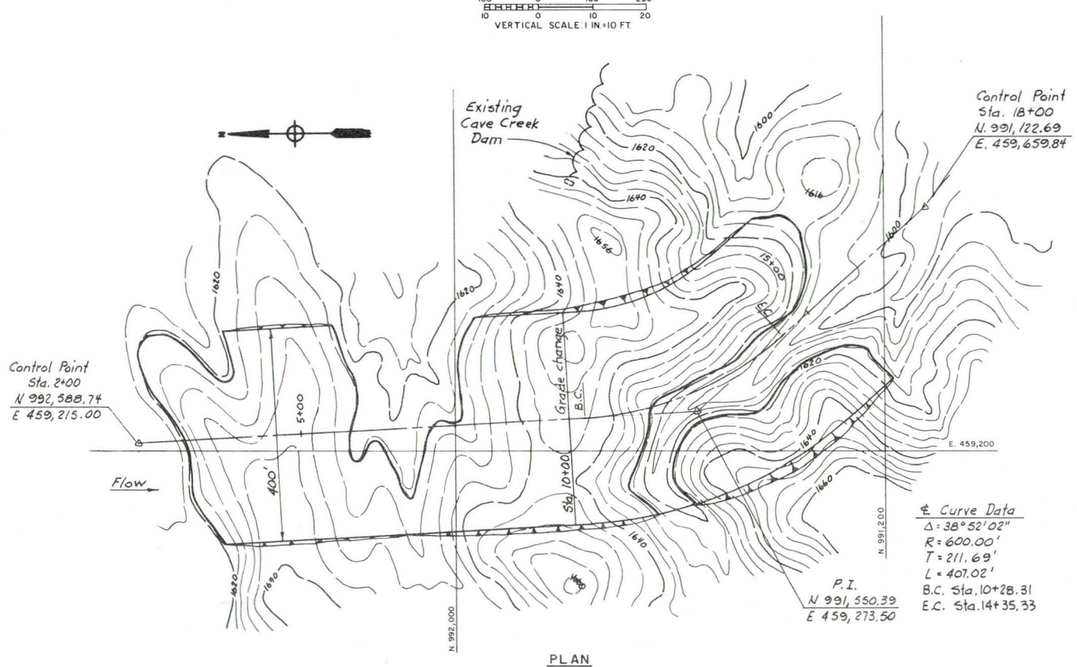
U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS



℄ PROFILE

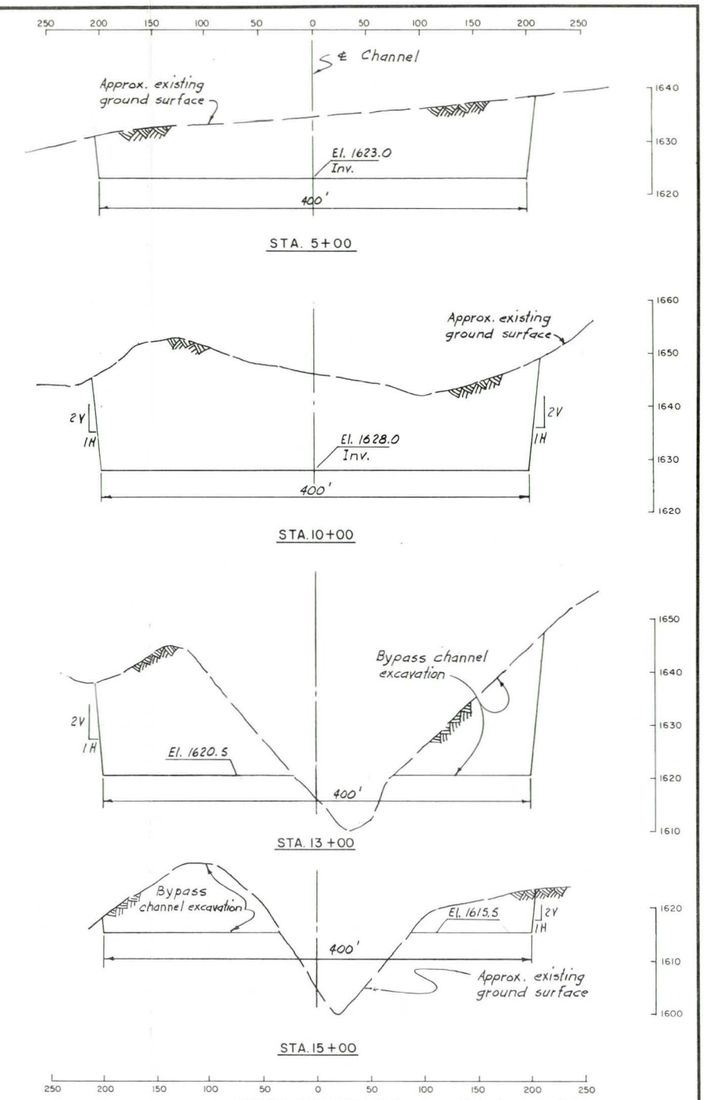
HORIZONAL SCALE: 1 IN.=100 FT.

VERTICAL SCALE: 1 IN.=10 FT.



PLAN

SCALE: 1 IN.=100 FT.



HORIZONAL SCALE: 1 IN = 50 FT.

VERTICAL SCALE: 1 IN = 10 FT.

Note: Cross Sections are drawn looking downstream

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:

DRAWN BY: J.W.S.

CHECKED BY:

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM

BYPASS CHANNEL

PLAN, PROFILE AND SECTIONS

SUBMITTED BY: CHIEF, _____ BRANCH

APPROVED: COLONEL, C.E. DISTRICT ENGINEER

APPROVAL RECOMMENDED: CHIEF, ENGINEERING DIVISION

SPEC. NO. DACW09-_____-B-_____
DISTRICT FILE NO.
DATE:

SHEET 1 OF 1 SHEETS