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DETAILED PROJECT REPORT

ON

KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

FEBRUARY 1974



DEPARTMENT OF THE ARMY

SACRAMENTO DISTRICT, CORPS OF ENGINEERS

SACRAMENTO, CALIFORNIA

20081029149



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511-101
18 Jul 74

Kern River - Calif. Aqueduct Interdike

Total Project First Cost	\$ 1,675,000
Preauthorization Studies	<u>83,000</u>
Total Project Cost (Fed & non-Fed)	1,758,000
Less Non-Fed First Costs (Reloc.)	(-) <u>25,000</u>
Total Federal Project Cost	1,733,000
Less preauthorization studies	(-) <u>83,000</u>
Less funding for P&S	(-) <u>150,000</u>
Total Required for Construction	\$ 1,500,000

97th Congress } HOUSE OF REPRESENTATIVES } REPORT
2d Session } No. 93-796

WATER RESOURCES DEVELOPMENT ACT OF 1974

FEBRUARY 13, 1974.—Ordered to be printed

Mr. ROBERTS, from the committee of conference,
submitted the following

CONFERENCE REPORT

[To accompany H.R. 10203]

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 10203) authorizing the construction, repair, and preservation of certain public work on rivers and harbors for navigation, flood control, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate amendment insert the following:

TITLE I—WATER RESOURCES DEVELOPMENT

Sec. 1. (a) The Secretary of the Army, acting through the Chief of Engineers, is hereby authorized to undertake the phase I design memorandum stage of advanced engineering and design of the following multi-purpose water resources development projects, substantially in accordance with, and subject to the conditions recommended by the Chief of Engineers in, the reports hereinafter designated.

MIDDLE ATLANTIC COASTAL AREA

The project for hurricane-flood protection at Virginia Beach, Virginia: House Document Numbered 92-365, at an estimated cost of \$954,000.

JAMES RIVER BASIN

The project for flood protection for the city of Buena Vista on the Maury River, Virginia: House Document Numbered 93-56, at an estimated cost of \$665,000.

Sec. 58. (a) The project for navigation in the Atchafalaya River and Bayou Chem, Boeas, and Black, Louisiana, authorized by the River and Harbor Act of 1968 (82 Stat. 731) is hereby modified to provide that the non-Federal interests shall contribute 25 per centum of the costs of areas required for initial and subsequent disposal of spoil, and of necessary retaining dikes, bulkheads, and embankments therefor.

(b) The requirements for appropriate non-Federal interest or interests to furnish an agreement to contribute 25 per centum of the construction costs as set forth in subsection (a) shall be waived by the Secretary of the Army upon a finding by the Administrator of the Environmental Protection Agency that for the area to which such construction applies, the State or States involved, interstate agency, municipality, and other appropriate political subdivisions of the State and industrial concerns are participating in and in compliance with an approved plan for the general geographical area of the dredging activity for construction, modification, expansion, or rehabilitation of waste treatment facilities and the Administrator has found that applicable water quality standards are not being violated.

Sec. 59. Notwithstanding any other provision of law, the States of Illinois and Iowa, which are connected at Keokuk, Iowa, by the bridge constructed by the Keokuk and Hamilton Bridge Company pursuant to Public Law 342 of the Sixty-third Congress and at Burlington, Iowa, by the bridge constructed by the Citizens' Bridge Company, pursuant to Public Law 1 of the Sixty-fourth Congress are authorized to contract individually or jointly with either or both of the cities of Keokuk, Iowa, and Burlington, Iowa, on or before June 1, 1974, to assume responsibility for the operation, maintenance, and repair of the bridges at Keokuk and Burlington and the approaches thereto and for lawful expenses incurred in connection therewith. When either or both States have entered into such an agreement any outstanding principal and interest indebtedness on account of a bridge shall be paid from reserve funds accumulated for that purpose and the balance of such funds, if any, shall be used to defray costs of operating and maintaining the bridge. After such an agreement is entered into with respect to a bridge that bridge shall thereafter be free of tolls.

Sec. 60. The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to perform channel cleanout operations and snagging and clearing for selected streams where chronic and persistent flood conditions exist in the lower Guyandot River Basin, West Virginia, for the purpose of improving channel capacities, visual environment, and human well-being all in the interest of flood control. Such operations shall be performed as an interim measure pending completion of the R.D. Bailey Lake project at a total cost not to exceed \$2,000,000. Appropriate non-Federal interests as determined by the Secretary of the Army, acting through the Chief of Engineers, shall, prior to initiation of remedial operations, agree in accordance with the provisions of section 221 of the Flood Control Act of 1970 that they will furnish the necessary lands, disposal areas, easements, and rights-of-way, and hold and save the United States free from damages due to the cleanout operations.

Sec. 61. Section 205 of the Flood Control Act of 1948 (33 U.S.C. 701s) is amended—

(1) by striking out "\$25,000,000" and inserting in lieu thereof "\$30,000,000".

(2) by striking out "advisable;" and all that follows down through and including the period at the end of such section and insert in lieu thereof the following: "advisable. The amount allotted for a project shall be sufficient to complete Federal participation in the project. Not more than \$1,000,000 shall be allotted under this section for a project at any single locality, except that not more than \$2,000,000 shall be allotted under this section for a project at a single locality if such project protects an area which has been declared to be a major disaster area pursuant to the Disaster Relief Act of 1960 or the Disaster Relief Act of 1970 in the five-year period immediately preceding the date the Chief of Engineers deems such work advisable. The provisions of local cooperation specified in section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply. The work shall be complete in itself and not commit the United States to any additional improvement to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports."

Sec. 62. (a) The Secretary of the Army, acting through the Chief of Engineers, is authorized to perform such work as may be necessary to provide for the repair and conversion to a fixed-type structure of dam numbered 3 on the Big Sandy River, Kentucky and West Virginia.

(b) The work authorized by this section shall have no effect on the condition that local interests shall own, operate, and maintain the structure and related properties as required by the Act of August 6, 1956 (70 Stat. 1062).

(c) There is authorized to be appropriated not to exceed \$330,000 to carry out this section.

Sec. 63. The project for hurricane-flood control at Texas City and vicinity, Texas, authorized by the Flood Control Act approved August 13, 1968, is hereby modified to provide that the non-Federal interests shall have until July 1, 1974, to provide the assurances of local cooperation required in accordance with the recommendations of the Chief of Engineers in House Document Numbered 187, Ninetieth Congress.

Sec. 64. Subsection (b) of section 206 of the Flood Control Act of 1960, as amended (33 U.S.C. 709a), is further amended by striking out "\$11,000,000" and inserting in lieu thereof "\$15,000,000".

Sec. 65. In the case of any reservoir project authorized for construction by the Corps of Engineers, Bureau of Reclamation, or other Federal agency when the Administrator of the Environmental Protection Agency determines pursuant to section 102(b) of the Federal Water Pollution Control Act that any storage in such project for regulation of streamflow for water quality is not needed, or is needed in a different amount, such project may be modified accordingly by the head of the appropriate agency, and any storage no longer required for water quality may be utilized for other authorized purposes of the project when, in the opinion of the head of such agency, such use is justified. Any such modification of a project where the benefits attributable to water quality are 15 per centum or more but not greater

HISTORY OF SPECIAL CONTINUING AUTHORITIES LEGISLATION

<u>LEGISLATION</u>	<u>DATE ENACTED</u>	<u>PUBLIC LAW</u>	<u>LIMITATIONS PROJECT/APPROPRIATION</u>
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Small Flood Control Projects not Spec Auth by Congress

Sec 205 of 1948 FCA	30 Jun 48	PL 858/80	\$ 100,000/\$ 2,000,000
Sec 212 of 1950 FCA	17 May 50	PL 516/81	150,000/ 3,000,000
PL 685/84th Cong/2 Sess	11 Jul 56		400,000/ 10,000,000
Sec 205 of 1962 FCA	23 Oct 62	PL 874/87	1,000,000/ 25,000,000
Sec 61 of WRDA of 1974	7 Mar 74	PL 93/251	1,000,000/ 30,000,000 2,000,000*

* Project cost may go to \$2,000,000 if project is located in a disaster area

Small Navigation Projects not Spec Auth by Congress

Sec 107 of 1960 R&H Act	14 Jul 60	PL 645/86	\$ 200,000/\$ 2,000,000
Sec 310 of 1965 R&H Act	27 Oct 65	PL 298/89	500,000/ 10,000,000
Sec 112 of 1970 R&H Act	31 Dec 70	PL 91/611	1,000,000/ 25,000,000

Small Beach Erosion Control Projects not Spec Auth by Congress

Sec 103 of 1962 R&H Act	23 Oct 62	PL 874/87	\$ 400,000/\$ 3,000,000
Sec 310 of 1965 R&H Act	27 Oct 65	PL 298/89	500,000/ 10,000,000
Sec 112 of 1970 R&H Act	31 Dec 70	PL 91/611	1,000,000/ 25,000,000

Snagging and Clearing for Flood Control

Sec 2 of 1937 FCA	28 Aug 37	PL 406/75	\$ 25,000/\$ 300,000
Sec 13 of 1946 FCA	24 Jul 46	PL 526/79	50,000/ 1,000,000
Sec 208 of 1954 FCA	3 Sep 54	PL 780/83	100,000/ 2,000,000
Sec 26 of WRDA of 1974	7 Mar 74	PL 93/251	250,000/ 5,000,000

Kern River
Intertie

DAEN-CWP-W (21 Feb 74) 2nd Ind

SUBJECT: Kern River - California Aqueduct Intertie; Detailed Project Report

DA, Office of the Chief of Engineers, Washington, D.C. 20314 13 June 1974

TO: Division Engineer, South Pacific

1. The subject DPR is approved.

2. The Final Environmental Statement, with Statement of Findings, was filed with the Council on Environmental Quality on 9 April 1974 and was subsequently printed in the Federal Register of 26 April 1974 (Vol. 39, No. 82, page 14750). CEQ has not commented regarding the environmental impact of this project. Coordination has been accomplished in accordance with Section 102 of the National Environmental Policy Act.

3. Authority is granted to issue simultaneous notification to the concerned members of Congress and the Governor of California informing them of the formal project approval and adoption under Section 205 of the 1948 Flood Control Act, as amended. The notification of formal project approval should describe the project and the conditions of required local cooperation. The application of the Federal cost limitation specified by Section 61 of the Water Resources Development Act of 1974 should be noted. For record purposes, the date of State and Congressional notification is considered to be the date of final project approval and adoption.

4. The following increase in work allowance for the Sacramento District for preparation of plans and specifications for subject project is established pursuant to the special continuing authority provided by Section 205 of the 1948 Flood Control Act, as amended:

<u>Location</u>	<u>Study No.</u>	<u>Code 902-</u>	<u>Amount</u>
Kern River -	03920	516	\$150,000
California Aqueduct Intertie			

5. Allotment of \$150,000 under appropriation 96X3122 Construction, General will be sent the Sacramento District by separate communication.

FOR THE CHIEF OF ENGINEERS:

wd all Incl

J. W. MORRIS
Major General, USA
Director of Civil Works

CF: Sacramento District

draft

FILED
DIS

SPDPD-P (5 Dec 75) 1st Ind

SUBJECT: Kern River - California Aqueduct Intertie, Kern County,
California - Supplement No. 1 to Definite Project Report (DPR)
Dated February 1974

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street, Room 1216
San Francisco, California 94111 *9 Jan 76*

TO: District Engineer, Sacramento

Approved subject to compliance with the inclosed SPD Engineering Division
comments (Inclosure 3).

FOR THE DIVISION ENGINEER:

6 3 Incl
Added 1 Incl
3. as


ROBERT M. RUFVOLD
Colonel, CE
Deputy Division Engineer

CF:
HQDA (DAEN-CWP-W) WASH DC 20314
w/cy B/L & Incl



DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF
SPKED-D

5 December 1975

SUBJECT: Kern River - California Aqueduct Intertie, Kern County,
California - Supplement No. 1 to Definite Project Report (DPR)
Dated February 1974

Division Engineer, South Pacific
ATTN: SPDED

1. Purpose and scope. - The purpose of this supplement is to present a design change that modifies the DPR plan by addition of an emergency bypass channel.
2. Need for emergency bypass channel. - While developing detailed plans with local interests for operation and maintenance of the Intertie facility, it became apparent that the DPR design did not provide a satisfactory means for accommodating Kern River snowmelt flows at the Intertie if it became necessary to instantaneously close the Intertie gates because of unacceptable water quality or temporary outages. Operating conditions for the Intertie are set forth in paragraph 32 of the Definite Project Report and in further detail under Section C, Operational Provisions of the Agreement among the State of California, Kern County Water Agency and Buena Vista Water Storage District for Operation and Maintenance of the Kern River - California Aqueduct Intertie, (Incl 1). The DPR design is predicated on passing snowmelt flows of acceptable quality of up to 3500 cfs into the California Aqueduct on a sustained basis. In this connection, a sedimentation basin has been provided to act as a settling basin for deposition of all particles larger than 0.062 millimeters. All smaller particles remaining in suspension are not considered objectionable to the State. However, the sedimentation basin will not prevent pollutants such as chemicals or oil spills from entering the California Aqueduct during Intertie operation. In this connection, should it be necessary to close the Intertie gates due to an unexpected adverse change in water quality or due to an unexpected outage of the Aqueduct, then an emergency bypass would be required to prevent uncontrolled overtopping of the impounding levees and weirs, an event which, if not prevented, could easily result in washout of these facilities and flooding of adjacent lands. Because of distance involved between the project and Isabella Dam, there is an unavoidable delay in regulating flows at the dam under such conditions which not only makes it impossible to shut off Kern River flows instantaneously, but also complicates getting the Intertie functioning

SPKED-D

5 December 1975

SUBJECT: Kern River - California Aqueduct Intertie, Kern County,
California - Supplement No. 1 to Definite Project Report (DPR)
Dated February 1974

again once the emergency has been corrected. While such events will occur only infrequently, nevertheless the prospect of such occurrences demands a design which will provide sufficient flexibility to facilitate operating under such emergencies.

3. Operation of the emergency bypass channel. - The modified design is depicted on Incl 2. The emergency bypass would be located approximately 800 feet north of the Intertie. Under emergency conditions the bypass channel will provide a positive means for diverting 2200 cfs of Kern River flows into the Buena Vista Canal for subsequent transmittal to Tulare Lake, the natural destination of flows under present conditions. The balance of 1300 cfs would be passed over the existing control weir, which serves as an inlet to Buena Vista Lake and is located at the southerly part of the sedimentation basin. Under emergency operation the following action would be taken as deemed necessary. Isabella Dam would be contacted to shut off flows at the dam, upstream diversions would be activated and flashboards on both the existing control weirs adjacent to the sedimentation basin would be pulled or cut as expeditiously as possible to augment releases through the emergency bypass channel.

4. Design of emergency bypass channel. - The bypass channel would extend from the northwesterly edge of the sedimentation basin to the east bank of the Buena Vista Outlet Canal and would consist of a 220-foot bottom width trapezoidal channel having 1.0V and 2.5H side slopes. The general arrangement and profile are shown on Section G-G of Incl 2. Soil cement or grouted rock bank protection would be provided for the overpour section to minimize erosion where the bypass channel discharges into the Buena Vista Canal. Because of a lack of suitable known rock sources in the area closer than 60 miles (at Tehachapi, California), soil cement was selected over grouted rock for cost estimating purposes; however, the contract plans will permit an alternate of grouted rock to assure the most economical construction. Sacked concrete would be provided on both banks of the emergency bypass channel to provide protection against erosion from drawdown where bypass channel flows exit into the Buena Vista Canal. The soil cement or grouted rock blanket would be placed over an 18" drainage blanket. A line of 6" diameter weepholes at 20" OC located at El. 282 ft., would be used to reduce uplift beneath the protective blanket and provide a stable overpour structure.

5. Cost estimate. - Following is a list of items and estimated costs for the proposed emergency bypass channel construction:

SPKED-D

5 December 1975

SUBJECT: Kern River - California Aqueduct Intertie, Kern County,
California - Supplement No. 1 to Definite Project Report (DPR)
Dated February 1974

DETAILED ESTIMATE OF FIRST COST

(1 Oct 1975 Price Level)

Cost :	:	:	:	Unit :	
Acct.:	Item	: Quantity	: Unit	: Price	: Amount
No. :	:	:	:	: \$	: \$
09.	<u>CHANNELS</u>				
1.	Excavation:				
	Bypass Channel	13,470	C.Y.	2.70	36,369
2.	Slope Protection:				
	Sacked Concrete	90	C.Y.	120.00	10,800
3.	Slope Protection:				
	(Soil Cement)	4,000	C.Y.	10.00	40,000
4.	Drain Material	2,640	Ton	7.00	18,480
5.	Cement	4,000	CWT	3.00	12,000
6.	Weephole Pipes:				
	6" Perforated Header	300	L.F.	6.00	1,800
	6" dia x 10' Long (23)	230	L.F.	6.00	1,380
7.	Stabilized Aggregate:				
	Replace Buena Vista				
	Canal Access Road	196	Ton	7.00	<u>1,372</u>
	SUBTOTAL				122,201
	CONTINGENCIES, 20% +				<u>24,799</u>
	TOTAL - EMERGENCY BYPASS CHANNEL				147,000
30.	ENGINEERING AND DESIGN				20,000
31.	SUPERVISION AND ADMINISTRATION				<u>13,000</u>
	TOTAL - FEDERAL FIRST COST				\$180,000

SPKED-D

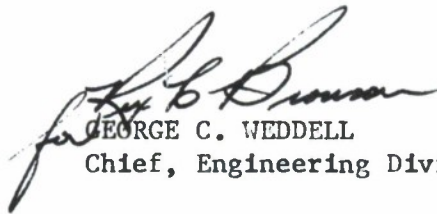
5 December 1975

SUBJECT: Kern River - California Aqueduct Intertie, Kern County,
California - Supplement No. 1 to Definite Project Report (DPR)
Dated February 1974

6. Recommendations. - It is recommended that these changes be approved for inclusion in final contract plans and specifications. Fifteen copies are transmitted herewith.

FOR THE DISTRICT ENGINEER:

2 Incl
as


GEORGE C. WEDDELL
Chief, Engineering Division

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

AGREEMENT AMONG THE STATE OF CALIFORNIA
KERN COUNTY WATER AGENCY,
AND BUENA VISTA WATER STORAGE DISTRICT
FOR OPERATION AND MAINTENANCE OF THE
KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE

THIS AGREEMENT is made this *18th* day of *November*, 1975, between the State of California, pursuant to the provisions of the California Water Resources Development Bond Act, the State Central Valley Project Act, and other applicable laws of the State of California, acting by and through its Department of Water Resources, hereinafter referred to as the "State"; Kern County Water Agency, hereinafter referred to as the "Agency"; and Buena Vista Water Storage District, hereinafter referred to as the "District".

RECITALS:

A. The U. S. Army Corps of Engineers has made findings in its Detailed Project Report dated February 1974 that the Kern River-California Aqueduct Intertie, a gravity connection between the Kern River and the California Aqueduct near State Highway 119, hereinafter referred to as "Intertie", is feasible and will provide flood control benefits and can be constructed as a Small Flood Control Project under Section 205 of the Flood Control Act of 1948, as amended. Announcement of authorization of the Intertie was made on June 20, 1974.

B. Diversion of certain floodwaters into the California Aqueduct, a feature of the State Water Project, is essential to the Corps' finding of feasibility of the Intertie.

Incl 1

C. State as owner and operator of the California Aqueduct is willing to allow such floodwaters to be diverted therein under certain conditions through use of the Intertie in order to provide flood control benefits, provided such use is compatible with the normal operation of the Aqueduct.

D. In order to reduce economic loss to the community resulting from floods, the Agency desires that such floodwaters be diverted into the California Aqueduct through use of the Intertie, and the Buena Vista Water Storage District, North Kern Water Storage District, Tulare Lake Basin Water Storage District, and Hacienda Water District, each such district being duly organized, existing and acting pursuant to the laws of the State of California and hereinafter collectively referred to as the "Kern River Interests", consent to such diversions.

E. The California Aqueduct is designed to be operated within specific water surface fluctuation limits and canal failures may result if it is not so operated.

F. Accepting waters into the California Aqueduct at the Intertie containing suspended solids beyond certain limits may damage the pumps of the Aqueduct facilities which have close tolerances, and may adversely affect the distribution facilities and ground water percolation programs of users receiving water from the Aqueduct.

G. The Agency has indicated to the Corps of Engineers that it intends to sponsor the Intertie and provide assurances of local cooperation for the project, including the assurance that the Agency will operate and maintain the Intertie.

H. The Buena Vista Water Storage District owns and operates certain control works on the Kern River known as the Buena Vista Lake Inlet Weir and the Kern River Outlet Weir.

NOW, THEREFORE, it is mutually agreed as follows:

A. INTRODUCTORY PROVISIONS

1. Definitions

When used in this agreement the following terms shall have the meaning hereinafter set forth:

(a) "Intertie" shall mean the gravity connection between the Kern River and the California Aqueduct near State Highway 119 in Kern County as generally described in the Detailed Project Report on Kern River-California Aqueduct Intertie of the U.S. Corps of Engineers dated February 1974, including:

(1) the Intertie structure comprising the rectangular reinforced concrete channel between the Kern River and the California Aqueduct, including a gated section, gates, trashrack, and water metering facilities.

(2) the sedimentation basin; and

(3) the emergency spillway from the sedimentation basin into the Buena Vista Flood Channel.

(b) "Floodflows" shall mean floodwaters (primarily from snowmelt) released from Lake Isabella to the Kern River according to advance schedules and other waters which enter the Kern River downstream from Lake Isabella at the same time as such floodwaters are released, all of which are in excess of the needs of the Kern River Interests and which they consent to be diverted into the

California Aqueduct in accordance with the "Agreement Among the State of California, Kern County Water Agency, and the Kern River Interests for Diversion of Floodwaters Through the Kern River-California Aqueduct Intertie" dated November 18, 1975.

(c) "Kern River Watermaster" shall mean the Kern River Watermaster appointed and serving as Watermaster pursuant to the Kern River Water Rights and Storage Agreement dated December 31, 1962 among the Kern River Interests.

(d) "State Control Center" shall mean that particular State facility from which responsibility will be exercised for monitoring and controlling the Intertie facilities. Such center at the date of this agreement is the San Joaquin Area Control Center near the Wind Gap Pumping Plant, and the telephone number of said center is (805) 858-2001. State may, from time to time, in the manner provided in Article 14 for giving notices, change the location and/or telephone number of the State Control Center.

(e) "Emergency" shall mean any condition, which in the judgment of the State exists or is about to exist, whereby damage to any portion of California Aqueduct facilities could result unless operation of the Intertie is curtailed or discontinued. Such emergency, for example, could be caused by a power outage at a downstream pumping plant, Aqueduct damage at or downstream from the Intertie, or the existence in the Kern River of waters of quality not meeting the standards set forth in Article 7(b) hereof.

(f) "Normal operation" shall mean all operation of the Intertie except during the period of an emergency.

2. TERM OF AGREEMENT

This agreement shall become effective upon completion of the Intertie and shall remain in effect so long as the Intertie will provide flood control benefits and the State can use such flows in the normal planned operation of the California Aqueduct.

B. RESPONSIBILITY PROVISIONS

3. State

The State shall operate and maintain the Intertie structure to insure the integrity of the California Aqueduct. Such operation and maintenance shall be in accordance with the operation and maintenance manual for the project to be issued by the Corps of Engineers. Subject to the terms and conditions of this agreement, gates shall be opened when floodwaters are released from Lake Isabella and proper notice is received by the State from the Kern River Watermaster, in accordance with the agreement between the State; the Agency and the Kern River Interests for diversion of floodwaters referred to in Article 1(b).

4. Buena Vista Water Storage District

The District shall be responsible for operation of the Buena Vista Lake Inlet and Kern River Outlet Weirs between the Kern River channel and Buena Vista Lake and Buena Vista Flood Channel, respectively.

5. Kern County Water Agency

(a) Except for the Intertie structure which shall be operated and maintained by the State, the Agency shall be responsible for operation and maintenance of the Intertie in

accordance with the operation and maintenance manual for the project to be issued by the Corps of Engineers. The Agency shall reimburse the State for all costs of operation and maintenance of the Intertie structure.

(b) The Agency shall indemnify and hold harmless the State and its officers, agents and employees from any and all claims of third parties by reason of any actual or alleged injuries or damages which they may sustain by reason of the operation and maintenance of the Intertie including, but not limited to, changes in flows of water in channels, watercourses or across lands upstream or downstream from the Intertie.

C. OPERATIONAL PROVISIONS

6. Operational Criteria

Water will be diverted into the California Aqueduct at a rate not in excess of 3,500 cubic feet per second and only when

- (1) snowmelt flood releases from Lake Isabella are scheduled in advance
- (2) the Kern River Watermaster has given timely notice to the State on behalf of the Kern River Interests of the specified time periods and the amounts of floodflows to be diverted through the Intertie by the State,
- (3) water can be used in the State Water Project in accordance with operation plans of the State, (4) the Aqueduct facilities planned for operation are not inoperable because of rare emergencies, and (5) the quality of water meets the standards set forth in Article 7(b) hereof.

If any of the operational criteria are found to be inadequate, they may be revised as appropriate by the parties hereto, with the approval of the Corps of Engineers.

7. Normal Operation

(a) General. Under normal operating conditions,

upon timely notice by the Kern River Watermaster to the State Control Center requesting that floodflows be diverted into the California Aqueduct at a specified time, the State shall initiate changes in operation of the Aqueduct such that the floodflows can be accepted into the Aqueduct at the specified time. Such floodflows shall be made available at a uniform flow rate as nearly as practicable up to the amount of the minimum continuous flow rate (i.e., the minimum flow rate during the on-peak power period) planned for the specified time in the Aqueduct downstream from the Intertie, provided that such flow rate shall be limited to the capacity operationally available in the Aqueduct facilities downstream from the Intertie. The State shall operate the Intertie gates as required to accept the floodflows at such limited flow rate but not to exceed 3,500 cubic feet per second. The District shall set its flashboards at both the Buena Vista Lake Inlet and the Kern River Outlet Weirs at an elevation necessary to maintain the required operating pool level for the Intertie.

(b) Quality. Under normal operating conditions, the floodflows shall be accepted into the California Aqueduct when the quality of water is such that it will not be injurious to Aqueduct pumping facilities or to State Water Project users diverting water from the Aqueduct downstream from the Intertie, as determined by the State. Initial design operating criteria shall be to discharge Kern River water into the Aqueduct with less than 200 parts per million suspended solid concentration, a maximum particle size less than 62 microns in diameter, and with no deleterious

substances such as oil or floating debris.

8. Emergency Operations

(a) General. The Intertie will be operated on an emergency basis when any sudden change in the normal operation is required to react to an emergency. During the period of emergency operation, close coordination between the District, the Kern River Watermaster, the Corps of Engineers and the State will be necessary.

(b) Notice of Emergency. Upon recognition of an emergency or possible emergency, parties to this agreement shall notify the State Control Center.

(c) Emergency Change in Operation of Intertie. Immediately upon recognition of an emergency, which in the judgment of the State would make it necessary that the Intertie be closed or partially closed in advance of the time the District could be notified, the State shall modify the gate openings on the Intertie and shall as nearly simultaneously as possible notify the District and the Sacramento District Corps of Engineers of such modification by telephone or other expedient means. Accordingly, the District shall make every reasonable effort to expeditiously remove flashboards from the Buena Vista Lake Inlet and/or Kern River Outlet Weirs to facilitate passage of flows in the Kern River and augment discharges over the emergency spillway.

(d) Procedure Following Emergency Closing of Intertie. The State shall notify the District when the emergency has been eliminated and normal operation can be resumed, at which time, the flashboards shall be reinstalled to

the required operational elevation. At a mutually acceptable time thereafter, normal operation shall be resumed.

9. Monitoring

The State shall monitor the metering facilities, sample water and determine quantity and quality of flow into the California Aqueduct and the quality of flow in the Aqueduct upstream and downstream of the Intertie. The amount of flow into the Aqueduct shall be reported daily to the Sacramento District Corps of Engineers.

D. OTHER PROVISIONS

10. Modifications

Notwithstanding the operational provisions of this agreement, it is recognized that it has been impossible during the design period of the project to determine with precision the quality of water in the Kern River during snowmelt release periods. The parties hereto therefore agree to observe operation of the project and cooperate to the extent possible in determining the nature of and providing for any necessary modifications to the project and/or the operational provisions to the end that the project purposes will be substantially satisfied and at the same time California Aqueduct facilities will not be adversely affected to any significant degree.

11. Right of Access

(a) State.

The State shall have a right of entry on, over and across and under the Agency's real property in the vicinity of the Intertie structure. Such right of entry is limited to that portion of such property that is reasonably necessary for the purpose of fulfilling the State's responsibility under this

agreement.

(b) Agency and District.

The Agency and the District shall each have a right of entry on the State's service road from State Highway 119 across the concrete channel of the Intertie and over, across, and under the State's real property in the vicinity of the Intertie structure. Such rights of entry are limited to that portion of such property as is reasonably necessary for the purpose of fulfilling the Agency's and the District's respective responsibilities under this agreement and for the purpose of allowing the District access to its facilities in the vicinity of the Buena Vista Flood Channel downstream from the Intertie.

12. Kern River Interests

Notwithstanding the fact that the floodflows accepted into the California Aqueduct through the Intertie are put to use as in the normal operation of the California Aqueduct, the waters are accepted into the California Aqueduct through the Intertie in order to prevent flooding of usable lands. Therefore, nothing in this agreement is intended to or shall affect the responsibilities and liabilities of the Kern River Interests with respect to the control, use, distribution, or disposal of the floodwaters that occur in the Kern River at various times.

13. Opinions and Determinations

Where the terms of this agreement provide for action to be based upon the opinion, judgment, approval, review

or determination of any party hereto, such terms are not intended to be and shall never be construed as permitting such opinion, judgment, approval, review or determination to be arbitrary, capricious or unreasonable.

14. Contracting Officer of State

The contracting officer of the State shall be the Director of Water Resources of the State of California and his successors, or duly authorized representatives. The contracting officer shall be responsible for all discretionary acts, opinions, judgments, approvals, reviews, and determinations required of the State under the terms of this agreement.

15. Successors and Assigns Obligated

This agreement and all its provisions shall apply to and bind the successors and assigns of the parties hereto.

16. Notices

All notices that are required either expressly or by implication to be given by one party to any or all of the other parties under this agreement, except those referred to in Article 7(a), 8, and 9, shall be signed for the State by its contracting officer, and for the Agency and the District by such officer of each as may, from time to time, be authorized in writing to so act. All Notices shall be deemed to have been given if delivered personally or if enclosed in a properly

addressed and stamped envelope and deposited in a United States Post Office for delivery by certified or registered mail. Unless and until notified otherwise, all notices shall be addressed to the parties at their addresses as shown below.

State of California
Department of Water Resources
Post Office Box 388
Sacramento, California 95802

Kern County Water Agency
1415 - 18th Street, Room 418
Bakersfield, California 93301

Buena Vista Water Storage District
Post Office Box 756
Buttonwillow, California 93206

17. Maintenance and Inspection of
Books, Records and Reports

During regular office hours, each of the parties hereto and their duly authorized representatives shall have the right to inspect and make copies of any books, records or reports of the other parties pertaining to this agreement or matters related thereto. Each of the parties hereto shall maintain and make available for such inspection accurate records of all its costs, disbursements and receipts with respect to its activities under this agreement.

IN WITNESS WHEREOF, the parties hereto have executed
this agreement on the date first above written.

Approved as to legal
form and sufficiency:

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

By [Signature] Chief Counsel
Department of Water Resources

By [Signature] Director

Approved as to form:

KERN COUNTY WATER AGENCY

By [Signature] Counsel

By [Signature] President

Attest:

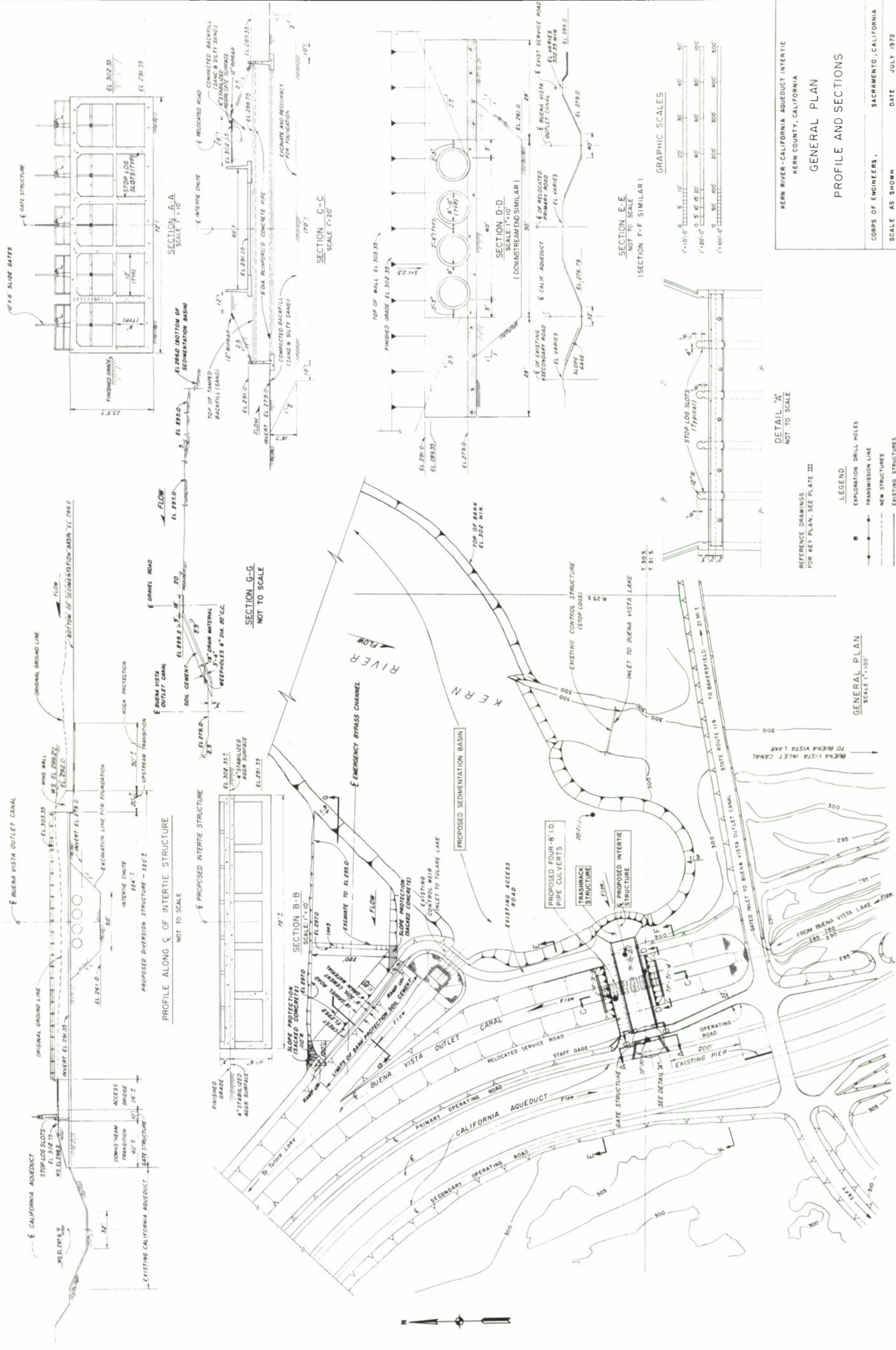
By [Signature]
Secretary
Kern County Water Agency

BUENA VISTA WATER STORAGE DISTRICT

Attest:

By [Signature]
Ass. Secretary
Buena Vista Water Storage District

By [Signature]
President



DETAIL A
NOT TO SCALE

REFERENCE DRAWINGS:
FOR KEY PLAN, SEE PLATE III

LEGEND	
EXPLORATION	●
TRANSMISSION	—●—
NEW STRUCTURE	---
EXISTING STRUCTURE	---

GENERAL PLAN
SCALE 1"=100'

VER-CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

GENERAL PLAN

PROFILE AND SECTIONS

CORPS OF ENGINEERS,
SACRAMENTO, CALIFORNIA

SCALE AS SHOWN DATE

T-2012

5 January 1976

KERN RIVER CALIFORNIA AQUEDUCT INTERTIE

ENGINEERING DIVISION COMMENTS

1. Cost Estimate: Page 3

The cost estimate is satisfactory except for Item 5 (cement) which appears to be low in the quantity specified. Since the district has made no tests, as yet, to determine the actual cement requirements for the soil type, it would be prudent to utilize average figures to estimate cement quantities. In so doing, the cement quantity is increased by approximately 50% (to 6500 $\pm$ CWT), and the estimate revised accordingly. Refer to TM 5-822-4, Paragraph 6b(i)(b).

2. Plate III (Incl. 2):

Provide a small, horizontal apron of soil cement on invert of Buena Vista Outlet Canal (See Section G-G).

Incl 3



DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

REPLY TO
ATTENTION OF

SPKED-P

21 February 1974

SUBJECT: Kern River - California Aqueduct Intertie;
Detailed Project Report

Division Engineer, South Pacific

1. Transmitted for approval are 20 copies of the subject detailed project report (inclosure 1) and 25 copies of the EIS and Statement of Findings (inclosure 2).
2. In view of pending Congressional legislation on small flood control projects, consideration of expediting approval of the report may be advisable. Tulare Lake Basin was declared a disaster area in August 1967, pursuant to the Disaster Relief Act of 1966. The emergency was determined to exist within the period 11 March - 11 June 1969.
3. With reference to SPD comment 2b (1st Indorsement dated 27 February 1973 to SPK basic letter of 18 September 1972, subject: Kern River - California Aqueduct Intertie, Kern County, California; Draft Detailed Project Report) the bar screen was replaced with a log boom to minimize head losses. The log boom is shown on plate III of the DPR.
4. If an interest rate of 6-7/8 percent were to be used for economic analysis, estimated annual benefits and costs would be \$269,000 and \$135,000, respectively. On this basis the intertie project would have a B/C ratio of 2.0 to 1.
5. It is requested that on approval of the DPR, funds in the amount of \$150,000 be provided for preparation of the plans and specifications. It is estimated that the plans and specifications can be prepared for this amount and that they will take about 12 months to complete.

2 Incl
as


F. G. ROCKWELL, JR.
Colonel, CE
District Engineer

DETAILED PROJECT REPORT
ON
KERN RIVER - CALIFORNIA AQUEDUCT INTERTIE

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INCLOSURE 5	Letter, Kern County Water Agency, 13 September 1973
INCLOSURE 6	Letter, Resources Agency of California, 28 January 1974

DETAILED PROJECT REPORT
ON
KERN RIVER - CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

Pertinent Data

1. General

Authorization	Public Law 685-84-2
Stream	Kern River
Type improvement	Diversion structure
Purpose	Flood control

2. Diversion Structure

Length	320 feet
Bottom width	68 feet
Depth	12 feet
Side slope	Vertical
Design capacity	3,500 cubic feet per second
Gates	5 - 12'-0" x 8'-0" slide gates
Sedimentation basin capacity	160 acre-feet

3. Local Cooperation

Lands	50 acres
Relocations	1,100 linear feet of transmission line
Maintenance and operation	\$16,000 per year

4. Costs (1 July 1974 price level)

Total Federal cost	\$1,000,000 a/
Total non-Federal cost	\$ 758,000
Total project cost	\$1,758,000 a/
Federal annual cost	\$ 55,200
Non-Federal annual cost	\$ 61,800
Total annual cost	\$ 117,000

5. Justification

Average annual benefits	\$300,000
Benefit-cost ratio	2.6 to 1

a/ Includes \$83,000 preauthorization study cost.

DETAILED PROJECT REPORT
ON
KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

SECTION I - INTRODUCTION

1. AUTHORITY

This report has been prepared under the provisions of Section 205 of the Flood Control Act of 1948, as amended, pursuant to authorization contained in OCE 1st Indorsement, dated 21 October 1968, to South Pacific Division letter dated 27 June 1968, subject: "Proposed Small Flood Control Project, Kern River-California Aqueduct Intertie." Section 205 of the Flood Control Act approved 30 June 1948, as amended by Section 205 of the Flood Control Act approved 23 October 1962, states as follows:

The Secretary of the Army is hereby authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed \$25,000,000 for any one fiscal year, for the construction of small projects for flood control and related purposes not specifically authorized by Congress, which come within the provisions of Section 1 of the Flood Control Act of June 22, 1936, when in the opinion of the Chief of Engineers such work is advisable: Provided, that not more than \$1,000,000 shall be allotted under this section for a project at any single locality and the amount allocated shall be sufficient to complete federal participation in the project; Provided further, that the provisions of local cooperation specified in Section 3 of the Flood Control Act of June 22, 1936, as amended, shall apply; And provided further, that the work shall be complete in itself and not commit the United States to any additional improvements to insure its successful operation, except as may result from the normal procedure applying to projects authorized after submission of preliminary examination and survey reports.

2. PURPOSE AND SCOPE

The purposes of this report are to present the results of a study of the flood problems on the lower portion of Kern River; to present the economic analysis of plans for alleviation of these problems; to formulate a definite plan of improvement and present its basis for design; to furnish supporting data to permit arriving at independent conclusions on the soundness of economic analysis, engineering design, and adequacy of cost

estimates; and to serve as a basis for the preparation of contract plans and specifications, should the project be authorized for construction. This report is of general design scope and has been prepared in accordance with instructions contained in ER 1165-2-101 and ER 1165-2-12.

3. ENVIRONMENTAL SETTING

a. The Kern River Basin comprises about 2,100 square miles of watershed area above Isabella Dam, about 300 square miles of foothill area below Isabella, and about 600 square miles of alluvial fan area below the mouth of Kern River Canyon. Buena Vista and Tulare Lakebeds are also located in the basin. The area under consideration lies in the valley portion of the Kern River Basin west of the city of Bakersfield, as shown on plate I. Agriculture is the primary industry of the basin and a substantial portion of the work forces of Kings, Tulare and Kern Counties is employed in farm work, processing agricultural products, and agricultural services. The lower Kern River Basin is traversed by State Highway 99, Interstate Highway 5 and numerous other State highways. Local interests have constructed a complex system of conveyance channels and related facilities in the basin for utilization of Kern River water for irrigation purposes. The Bureau of Reclamation's Friant-Kern Canal, terminating at Kern River near Bakersfield, imports irrigation water. Also, the California Aqueduct, a major feature of the State Water Project, traverses the basin. The aqueduct imports municipal and industrial and irrigation water to the southern San Joaquin Valley and to Southern California.

b. The channel of Kern River is confined between continuous levees through the urban area of Bakersfield and by low, natural banks or low, discontinuous levees below that area. The channel has a sandy, shifting bottom and is crossed at intervals by permanent diversion weirs which turn water into several large irrigation canals. As a result of these various diversions and regulation by Isabella Lake, the natural river-flow is extensively modified and is entirely depleted before reaching Tulare Lake in all but exceptionally large runoff years. In many years little water flows beyond the "Second Point of Measurement" (see plate I) above Buena Vista Lake. The major portion of Kern River flow originates as snowmelt and the water is of excellent chemical quality, even in the lower stream reaches. The Kern River channel and other channels and canals between Bakersfield and Buena Vista and Tulare Lakes have been maintained in the past; work has included channel clearing and snagging and levee repair. Most of the useable ground water in the Kern River Basin occurs in the valley area. Ground water pumped from the basin, in conjunction with surface water, supplies irrigation, domestic, and municipal and industrial water needs of the basin. As a result of pumping, an overdraft condition exists in much of the basin. Yields of existing wells along the western edge of the Kern River Basin are for the most part low, and the quality of ground water poor.

c. The project site is located between two oilfields (North and South Coles Levee Oilfields), the California Aqueduct and Buena Vista Outlet Canal, and State Highway 119, in Kern County. There are two existing control weirs in the project area: at the head of Kern River Flood Channel and at the head of Buena Vista Inlet Canal. Low-lying levees nearly encompass the site and extend upstream along both sides of the Kern River. Plate II is a vertical aerial photograph of the project site.

d. Tulare Lake is a broad, flat, leveed depression about 400 square miles in area; approximately 95 percent of the lakebed is in Kings County and about 5 percent in Tulare County. Since the soils are highly suited for agricultural use, the lakebed area has been extensively reclaimed by a cellular dike system and has over 250,000 acres under crop during most years. U. S. Soil Conservation Service soil maps indicate soils in the lakebed are primarily the Tulare association (about 55 percent of the area) in the basin and the Hilmar - Mocho association (about 45 percent of the area) on the basin rim. The Tulare association is a moderately alkaline, highly calcareous silty clay with somewhat poor natural drainage, very slow subsoil permeability and high inherent fertility. The Hilmar-Mocho association includes mildly to moderately alkaline loamy sands and sandy loams with somewhat poor natural drainage, moderately rapid to rapid subsoil permeability and low to moderate inherent fertility. The U. S. Soil Conservation Service soil classification for Tulare Lake indicates nearly 100 percent is Group 3 soil. Land in Group 3 is dominated by coarse to fine textured saline-alkali soils with water tables that are generally less than 6 feet below the surface. The soil poses moderate to severe limitations for crop use. The field crops which generally make up the agricultural activities on the soil require careful management since the soil exhibits slow to very slow soil infiltration rates and high soil salinity. Urban and industrial uses on this type soil are severely limited; it displays severe shrink-swell behavior, severe septic tank limitations due to the high water table, severe corrosivity to untreated steel pipe, and moderate soil pressure limitations. Tulare Lake has only minor utility development and is essentially uninhabited. According to the Tulare Lake Basin Water Storage District, which includes nearly 190,000 acres in the Tulare Lake area, there are over 300 property ownerships in the district. These ownerships range from areas of less than 20 acres to over 10,000 acres; 17 major operators farm nearly 98 percent of the area within the district. Farming in the lakebed has traditionally been somewhat of a gamble due to its history of widespread flooding. However, the flood control provided by upstream reservoirs as well as the increased use of water on tributary streams have led to intensive, diversified cropping in this lakebed area; major crops include cotton, barley, hay and safflower. Kings and Tulare Counties' general plans indicate over 90 percent of Tulare Lake is included in agricultural preserves under the California Land Conservation

Act of 1965. The act provides for the execution of contracts between land owners and counties for the purpose of placing land into restricted open space uses or agricultural preserves. The owner agrees to restrict use of his land to agricultural or other open space uses and in return the county agrees to assess the land for taxation purposes on an income basis rather than a market value basis.

e. Vegetation in the general project area is primarily the valley mesquite habitat type. This type is dominated by honey mesquite, with some saltbrush, winter fat and grasses. It is confined to southwestern Kern County, where the climate is arid with near desert conditions. In 1965 the California Department of Fish and Game estimated that about 47,000 acres of this habitat type remained in the area. They estimated that by 1980 the valley mesquite habitat would no longer exist, having been displaced by agricultural development resulting from delivery of water to the area from the California Aqueduct. Riparian habitat, consisting primarily of willow, Fremont cottonwood, honey mesquite, saltbrush and grasses, exists sparsely along the waterways. Flooding such as shown on plate II is a rare occurrence and has not significantly altered vegetative types. In many years little water flows beyond the "Second Point of Measurement." The main Kern River channel bottom is sandy and generally devoid of vegetation.

f. The valley mesquite area supports populations of doves, California quail, jackrabbits, and cottontails. The mesquite and riparian habitat also provide suitable living conditions for other small mammals and birds. Two rare species exist in the area: the San Joaquin kit fox and the blunt nosed leopard lizard. The habitat of both has been invaded by agricultural development on the valley floor, nearly eliminating these species. Recent studies by the U. S. Bureau of Sport Fisheries and Wildlife indicate the nearest active San Joaquin kit fox dens are approximately 3 miles from the intertie site, near Tupman. Southwestern Kern County is also within the regular feeding range of remaining condors in the State. A State Tule Elk Reserve is located at Tupman about 5 miles northwest of the intertie site; approximately 30 to 35 head of Tule Elk are maintained in the reserve. No fishery exists in lower Kern River due to the intermittent flow. A warm water fishery does exist in the California Aqueduct; fishing access is provided at two sites between the intertie site and Tulare Lake and another fishing access to the aqueduct is located southwest of Buena Vista Lake. The lower Kern River area between Buena Vista and Tulare Lakes provides important wildlife habitat for waterfowl; the Kern National Wildlife Refuge is located just south of Tulare Lake and many duck clubs utilize seasonal marsh type lands (flooded agricultural lands) in the lower river area for hunting. Depending upon the amount of water and food available, important waterfowl use occurs during fall and spring movements and winter residence. The California Department of Fish and Game has estimated

hunting season densities of over 100 per 100 acres. However, at any time large areas in the lower basin are subjected to extensive shallow flooding, such as during a large snowmelt flood, severe outbreaks of botulism affecting waterfowl are likely to occur. Ducks are the primary waterfowl killed. Severe outbreaks have occurred many times in the past, the latest being in 1969. The California Department of Fish and Game has estimated waterfowl loss in 1969 at over 140,000 birds.

g. The Kern County Parks and Recreation Plan adopted by the Kern County Planning Commission in 1966 designates the area on both sides of Kern River as the "Kern River Parkway." The parkway extends from east of Bakersfield to the California Aqueduct, then north along the flood channel to the State Tule Elk Reserve and south along Buena Vista Inlet Canal to Buena Vista Lake. The general intent of the plan is that land in the river bottom is to be preserved for recreation, agriculture and other compatible uses. The land designated in the parkway west of Bakersfield has not been developed for recreation with the exception of the County's Buena Vista Aquatic Recreation Area, located approximately three miles south of the intertie site and adjacent to the California Aqueduct. The recreation facility, which comprises nearly 1,500 acres of water and land surface area, completed in 1973. Some recreation facilities are also available at a State Park located on the Tule Elk Reserve.

h. Past studies and finds indicate an important archeological region lies at the southern or upper end of the San Joaquin Valley and that Buena Vista Lake is the core of the area. At the beginning of historic times, the Buena Vista Lake area together with the lower Kern River was occupied by several Yokuts Indian tribes, and a number of villages are known to have existed (William J. Wallace, 1971). The Indians first came in contact with Whites in 1772 when a Spanish expedition entered the area. Archeological research in the Buena Vista Lake region began in 1899 and has continued intermittently since that time. The latest field studies were conducted in 1963-1965 by the State of California in connection with plans for construction of the California Aqueduct and in 1969-1970 by William J. Wallace (at the request of the National Park Service) for the Buttonwillow Watershed Management Project. Both investigations involved cursory inspections throughout the intertie project area with detailed investigations of known archeological sites around Buena Vista Lake. No sites have been identified in the intertie project area. As noted previously, the intertie site lies essentially within the Kern River Channel and backwater areas and is nearly encompassed by low-lying levees. The project area has been extensively disturbed by past construction activities involving the levees, Highway 119, the Buttonwillow Project, and the California Aqueduct, as well as sediment deposition, channel maintenance and oilwell field activities. It is probable that evidence of any prehistoric sites have been destroyed by these activities. However, the National Park Service has noted that it is not clear from Mr. Wallace's

survey report whether the intertie project area was surveyed, but that his survey does indicate a high potential for prehistoric resources in the general area. The report also states that great expanses of the Buttonwillow Project area, which includes the intertie project area, contained virtually no archeological remains. Such lands included permanent wet lands, certain stretches of flat land fronting Buena Vista Lake, and the dry, sagebrush country back from the lake. The California Department of Parks and Recreation has indicated that in their review of the intertie project they found no National Register sites which would be affected by the project. Review of the California "Historical Landmarks" identified no historical resources in the project area. The National Park Service has indicated that their archeological survey of the project site will be completed by about April 1974.

If any archeological or historical sites are discovered during construction of the project, the National Park Service and Director of the Kern County Museum will be so advised.

4. FLOOD PROBLEMS

The Isabella Lake project, completed by the Corps of Engineers in 1953, is the most significant water resource development project within the basin. The project, located about 30 miles northeast of Bakersfield, provides flood protection for that city and for about 350,000 acres of agricultural land and oil fields in the Kern River area. Isabella Lake is related to other Corps reservoirs located on the Tule, Kaweah, and Kings River in that they all act to minimize floodwater inflow to Tulare Lake. Although a relatively high degree of flood protection has been provided to the area below Isabella Dam, a flood problem still exists in Tulare Lake, particularly during years of exceptionally large snowmelt runoff when large releases from the dam are necessary. During such years, floodwaters enter the lakebed area and cause extensive damage to crops and agricultural facilities.

5. HISTORICAL FLOOD DAMAGES

Since completion of Isabella Lake, the only floods on Kern River threatening or affecting the Tulare Lake area were the 1967 and 1969 snowmelt floods. The 1967 snowmelt runoff was controlled by storage in Isabella Lake together with large releases for irrigation and spreading within the service area, and no damages resulted in Tulare Lake from Kern River floodwaters. However, considerable flood damage occurred in Tulare Lake during the 1966-67 rain and snowmelt flood season as a result of floodwaters from the Kings, Kaweah, and Tule Rivers. Total flood damage to the lake area in 1966-67 was estimated at about \$2,300,000 of which nearly \$1,600,000 was estimated to be due to snowmelt runoff. A record amount of snow was deposited in the upper Kern River Basin during January and February 1969, setting the stage for the snowmelt flood condition which occurred in the following months. In spite of storage in Isabella Lake and large releases for irrigation and spreading, the 1969 snowmelt runoff could not be completely controlled. By the end of June about

300,000 acre-feet of Kern River floodwaters had entered Tulare Lake. The lake contained a total of nearly 1,000,000 acre-feet of water from Kings, Kaweah, Tule, and Kern Rivers and several smaller streams; and 88,000 acres in the lakebed were flooded, including 73,000 acres flooded during the January-February rain floods. The Kings, Kaweah, and Tule Rivers were the main contributors of rain floodflows. Total flood damage in Tulare Lake in 1969 was estimated at \$27,400,000, of which \$16,300,000 was estimated to be due to snowmelt runoff.

6. RECONNAISSANCE REPORT

A reconnaissance report on a potential flood control project based on gravity diversion of Kern River snowmelt floodflows into the California Aqueduct for safe disposition was completed in May 1968. Approval of the report by the Office, Chief of Engineers in October 1968 authorized the detailed project report studies. The findings contained in the reconnaissance report indicated that the plan for a gravity intertie of Kern River to the California Aqueduct would be economically feasible and would be a desirable plan. Based on that report, investigations for a detailed project report were initiated in January 1969.

SECTION II - HYDROLOGY

7. BASIN DESCRIPTION

The Kern River Basin comprises about 2,100 square miles of watershed area above Isabella Dam, about 300 square miles of foothill area below Isabella, and about 600 square miles in alluvial fan area below the mouth of Kern River Canyon. Buena Vista and Tulare Lakebeds are also located in the basin. The channel of Kern River is confined between continuous levees through the urban area of Bakersfield and by low, natural banks or low, discontinuous levees below that area. The channel has a sandy, shifting bottom and is crossed at intervals by permanent diversion weirs which turn water into several large irrigation canals. As a result of the various diversions and regulation by Isabella Lake, the river flow is extensively modified and is entirely depleted before reaching Tulare Lake in all but exceptionally large snowmelt runoff years. In some years little water flows beyond the "Second Point of Measurement" above Buena Vista Lake. Large rain floods originating downstream of Isabella Dam could occasionally produce flows large enough to reach Tulare Lake; however, the volume of water reaching that area from such events would be relatively small. As shown on chart 1, the capacity of the river system diminishes progressively downstream to only about 2,500 cubic feet per second (long-term capacity) in Kern River Flood Channel near Tulare Lake. Several large spreading basins established on the valley floor dispose of floodwaters by evaporation and percolation. In accordance with an agreement in 1964 between the Buena Vista Water Storage District and the owners of Buena Vista Lake, the water storage district may store Kern River waters in cells 1 and 2 of Buena Vista Lake whenever water is available. Cells 1 and 2 will contain about 30,000 acre-feet with a flooded area of about 6,000 acres of land. During the 1969 snowmelt flood season the Corps of Engineers, in cooperation with local interests, constructed Sand Ridge Detention Basin on Kern River Flood Channel just south of Tulare Lake. The basin, formed essentially by leveeing gaps in a natural alluvial ridge, is capable of storing some 63,000 acre-feet of Kern River floodwaters with a flooded area of 15,000 acres. Tulare Lake is the terminal basin for floodwaters from Kaweah, Tule, and Kern Rivers, Kings River South, and other smaller streams and would store over 2,000,000 acre-feet of water if entirely inundated to an elevation of 196 feet. Floodwaters stored in both Buena Vista and Tulare Lakes are depleted by evaporation and percolation, and the remainder utilized for irrigation on adjacent cells or adjoining lands. Floodwaters stored in Sand Ridge Detention Basin may also be utilized for irrigation purposes.

8. CLIMATE

The climate of Kern River Basin is characterized by hot, dry summers and moderate winters. Temperatures on the valley floor have ranged from

lows of 15° F. to highs of about 120° F. In the mountainous area temperatures are somewhat lower, normally varying inversely with elevation. The normal annual precipitation varies widely in the basin, from a low of about 5 inches on the valley floor to a high of about 50 inches in the headwater area of Kern River. Precipitation is largely orographic in nature and usually results from air masses traveling inland from the west and southwest. The valley floor portion of the basin is in the rain shadow of the Coast Ranges.

9. RUNOFF

Regulated runoff of Kern River at the latitude of Bakersfield normally occurs throughout the year; however, about two-thirds of the runoff usually occurs from snowmelt during the spring and summer months. The average annual runoff of Kern River at Isabella Dam is about 683,000 acre-feet and that from the foothill area between the dam and valley floor is about 43,000 acre-feet. Monthly streamflow records are available for the U. S. Geological Survey gage on Kern River near Bakersfield (First Point of Measurement) since 1904. The drainage area at this gage is about 2,400 square miles. Two types of floods are characteristic of the Kern River Basin, rain and snowmelt. Rain floods are characterized by high peak flows and relatively small volumes. Except in extremely rare events, rainfloods originating above Isabella Lake will be completely controlled by the reservoir. Large rain floods on Kern River originating downstream of Isabella Dam may produce flows reaching Buena Vista Lake and the lower Kern River area, but damaging rates of flow last only a few hours. Snowmelt floods are characterized by moderate peak flows, but large volumes extending over a number of months. During years of very large snowmelt runoff, storage space in Isabella Lake and the downstream irrigation and spreading diversion capacities are inadequate, and considerable water may reach Tulare Lake. Snowmelt floods can be predicted with reasonable accuracy before high runoff rates begin, so reservoir and irrigation and spreading operations can be planned in advance of floodflows.

10. PREPROJECT OPERATION STUDIES

Damaging rain and snowmelt flows may both reach the lower Kern River area, although rain floodflows reaching Tulare Lake are minor and of short duration. Only diversion of snowmelt flows to the California Aqueduct is considered feasible. Excessive turbidity and operational timing problems would probably make rain floodflows incompatible with normal operation of the aqueduct. Therefore, this report deals only with diversion of snowmelt flow to the aqueduct. Anticipated snowmelt flooding in the lakebed areas was studied on a frequency basis. Chart 2 is an annual snowmelt volume frequency curve (total runoff March through September) for Kern River near Bakersfield (First Point) which was developed from streamflow records. The 5, 10, 25, 50, 100 and 300 year snowmelt runoff

volumes at First Point were obtained from the curve and their respective monthly distributions developed. The flows were then routed to the lakebed areas to study snowmelt flooding under anticipated future, preproject (preintertie) conditions. Irrigation and spreading capabilities originally used in the reservoir regulation manual for Isabella Lake were adjusted in light of experience gained from actual operations in flood situations in 1967 and 1969 and to reflect changes which could be reasonably expected under average future conditions. It was assumed storage would first occur in cells 1 and 2 of Buena Vista Lake to a maximum of 30,000 acre-feet. As noted in paragraph 7, Buena Vista Water Storage District may store water in cells 1 and 2, and it was assumed the district will continue to do so when water is available. Storage was then assumed to occur in Sand Ridge Detention Basin to a maximum of 63,000 acre-feet. As mentioned in paragraph 7, the detention basin was constructed during the 1969 snowmelt flood season. The levee forming the basin will remain in place permanently but flowage rights were for 1969 only; arrangements for future storage are the responsibility of local interests. Local interests are required to maintain and operate the detention basin. Storage in Tulare Lake was assumed to occur last. Cells 1 and 2 of Buena Vista Lake were filled with rain floodwaters prior to the snowmelt season in 1967. Based on this event and the water storage agreement noted above, cells 1 and 2 were assumed filled with rain floodwaters for events with an exceedance interval of 25 years or greater. Snowmelt waters were introduced into the lake as evaporation reduced rain flood storage. Results of the volume routings at the indicated frequencies are shown below. All of the routed flows to Tulare Lake are damaging.

Exceedence: interval : (years) :	Flow at First Point a/ : (1,000 acre-feet)	Buena Vista Lake: maximum storage	Sand Ridge : maximum storage	Tulare Lake : Kern River inflow
5	800	19	0	0
10	1,030	30	0	0
25	1,320	30 b/	63	112
50	1,650	30 b/	63	257
100	1,930	30 b/	63	435
300	2,410	30 b/	63	613

a/ Total volume at First Point, March through September.

b/ Assumed previously filled with rain floodwaters.

The estimated average annual snowmelt inflow to the Tulare Lake area from Kern River is 14,900 acre-feet under anticipated future preproject conditions.

11. FLOOD RUNOFF COMPARISON

Floodflows to Tulare Lake computed from the routings, described in the preceding paragraph, compare favorably with the actual flows occurring in 1967 and 1969. During 1967 cells 1 and 2 in Buena Vista Lake were filled to capacity with rain floodwaters, and no Kern River floodwaters reached Tulare Lake. Results of the volume routing most nearly comparable to the 1967 event (based on flow at First Point, 10-year event) show Buena Vista Lake filled to capacity and no Kern River floodwaters reaching Tulare Lake. Although Sand Ridge Detention Basin, constructed during the 1969 snowmelt flood season, was considered in the volume routing being compared to the 1967 flood event, the routing indicated no storage in Sand Ridge, as shown below.

Identification:	Flow at First Point <u>a/</u>	Buena Vista Lake: maximum storage (1,000 acre-feet)	Sand Ridge: maximum storage (1,000 acre-feet)	Tulare Lake: Kern River inflow
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1967				
Historical	1,102	30	0 <u>b/</u>	0
Volume routing (10-year event)	1,030 <u>c/</u>	30	0	0
1969				
Historical	1,930	31 <u>d/</u>	62	300 <u>e/</u>
Volume routing (100-year event)	1,930 <u>c/</u>	30 <u>f/</u>	63	435

a/ Total flow at First Point, March through September.

b/ Sand Ridge Detention Basin constructed during 1969 snowmelt flood season.

c/ Nearest comparable event based on flow at First Point.

d/ Includes 8,000 acre-feet of rain floodwaters.

e/ Does not include 85,000 acre-feet of snowmelt waters pumped into the California Aqueduct under a one-time emergency operation.

f/ Assumed previously filled with rain floodwaters.

During the 1969 flood period, cell 2 in Buena Vista Lake was filled to a capacity of about 8,000 acre-feet with rain floodwaters. Cells 1 and 2 were later filled with Kern River snowmelt floodwaters to a maximum storage of about 31,000 acre-feet (slightly encroaching on levee freeboard).

By the end of June about 450,000 acre-feet of Kern River floodwaters had flowed beyond Wasco Road and some 300,000 acre-feet had entered Tulare Lake. Sand Ridge Detention Basin contained nearly 62,000 acre-feet of Kern River water at maximum storage during 1969, and it is estimated that the detention basin dissipated a total of over 100,000 acre-feet of water including evaporation. Results of the volume routing most nearly comparable to the 1969 event (based on flow at First Point, 100-year event) show Buena Vista Lake filled to capacity with rain floodwaters (a basic assumption noted in paragraph 10) and a considerably greater volume of Kern River snowmelt floodwaters in Tulare Lake. However, in 1969 only about 8,000 acre-feet of rain floodwaters were actually stored in Buena Vista Lake prior to the snowmelt season, and a completed segment of the California Aqueduct a few miles north of the intertie site was utilized under a one-time emergency operation to divert about 85,000 acre-feet (through September) of snowmelt floodwaters from Kern River some 25 to 50 miles farther north to farming areas able to use the water for irrigation. The California Aqueduct was completed in 1971 and is in operation, although delivery of water to Southern California will be limited during early years of operation. Without additional storage or emergency diversion of Kern River snowmelt floodwaters as accomplished in 1969, runoff in the magnitude of that occurring in 1969 can be expected to contribute over 100,000 acre-feet more water to the Tulare Lake area under future conditions, causing correspondingly greater damages.

SECTION III - FLOOD DAMAGES

12. GENERAL

Primary flood damages in the Tulare Lake area result from crop losses and loss of crop production in subsequent years as a result of land remaining flooded. Additional flood damages include damages to roads, levees, other property improvements and operating equipment, and cost of flood fighting. Damages occur when floodwaters from Kern River enter the lakebed area to intermingle and pond with waters from Kings, Kaweah, and Tule Rivers.

13. AVERAGE ANNUAL DAMAGES

Average annual primary damages were determined by applying a unit damage value to the average yearly damaging snowmelt flow to the lakebed area, noted in paragraph 10. All inflow from Kern River to the lakebed area is damaging; however, Kern River rain floodflows reaching Tulare Lake are minor and of short duration, and rainflood damages are considered negligible in this analysis. The unit damage value for floodwaters entering Tulare Lake was developed from the flood damages estimates to have been sustained in 1967 and 1969. These flood damages estimates were documented in flood reports prepared by the Sacramento District in December 1967 and August 1970, respectively. Damages estimated at about \$2,300,000 in Tulare Lake during the 1966-67 rain and snowmelt season were due to nearly 100,000 acre-feet of floodwaters from the Kings, Kaweah, and Tule Rivers. Total flood damages in 1969 were estimated at \$27,400,000 due to over 1,100,000 acre-feet of rain and snowmelt runoff from the Kings, Kaweah, Tule, and Kern Rivers. Dividing these gross damage estimates by the estimated volumes of floodwater entering the lakebed for the respective events and adjusting to 1974 price level yields a unit damage of about \$29 per acre-foot. Since Kern River snowmelt floodwaters ponded in Tulare Lake are routinely used as irrigation supplies, the value of such irrigation water was netted out in evaluating the unit damage values. These floodwaters are generally used on lower quality land on the perimeter of the lakebed area. An office study of crops grown on these lands, with and without irrigation, established the irrigation value of water in the area (net increase in income with irrigation) at about \$10 per acre-foot. Of floodwater ponding in Tulare Lake from all sources, some 50 percent evaporates and the remainder is used for irrigation. Therefore, the irrigation value of floodwater ponded in the lakebed is estimated at \$5 per acre-foot of inflow; and the unit damage value for floodwaters entering Tulare Lake is estimated at \$24 per acre-foot net, with the irrigation value deducted from flood damages. The estimated average annual snowmelt inflow to Tulare Lake from Kern River, 14,900 acre-feet (given in paragraph 10),

was multiplied by \$24 per acre-foot to obtain average annual damages. On this basis average annual primary snowmelt damages in Tulare Lake caused by Kern River are estimated at \$358,000 under current conditions.

14. ADJUSTMENT FOR ANTICIPATED FUTURE DEVELOPMENT

Flood damage studies indicate that future changes in average annual damage may be expected in direct proportion to the change in economic development in the flood plain. Since Tulare Lake is subject to flooding even with the proposed intertie project, the area is expected to remain essentially uninhabited and agricultural development is the basis for developing the factor used in projecting future economic growth in Tulare Lake. Farming in the lakebed has traditionally been somewhat of a gamble due to its history of widespread flooding. However, the flood control afforded by the upstream reservoirs as well as the increased use of water on tributary streams have led to intensive, diversified cropping in the lakebed area. Most of the cropland has been developed for irrigated agriculture. The annual increase in economic growth over the period of analysis (1975-2025) was based on the 1970 Series D prediction of agricultural development in Tulare Basin used in the "Comprehensive Framework Study - California Region." The development essentially comprises increased crop yields and more efficient production with improved crop varieties; very little increase in cropland acreage was forecast. The agricultural development factors for Tulare Basin developed in the framework studies are shown below; base year is 1965.

Year	:	Factor
1965		1.00
1980		1.46
2000		1.96
2020		2.46

Development factors with base year 1975 and extended to 2025 developed from the above values are as follows.

Year	:	Factor
1975		1.00
1985		1.20
1995		1.39
2005		1.58
2015		1.77
2025		1.95

The adjustment factor representing equivalent increase over the period of analysis (1975-2025), discounting deferred damage at 5-5/8 percent rate of interest, is 1.30. The \$24 per acre-foot unit damage value (given in the previous paragraph) was multiplied by 1.30 to obtain the future unit damage value for floodwaters entering Tulare Lake. The future unit damage value is \$31.20 per acre-foot.

15. FUTURE AVERAGE ANNUAL DAMAGES

The estimated average annual snowmelt inflow to Tulare Lake from Kern River, 14,900 acre-feet (given in paragraph 10), was multiplied by \$31.20, the future unit damage value (given in the previous paragraph), to obtain the future average annual primary damages. Future average annual primary snowmelt flood damages in Tulare Lake are \$465,000.

SECTION IV - PLANS OF IMPROVEMENT CONSIDERED

16. PLANS CONSIDERED

Several plans for alleviating Kern River flood problems in Tulare Lake were considered, including diversion of floodwaters out of Kern River Basin, additional upstream storage on Kern River, and additional spreading areas and/or injection well fields along Kern River. The alternative of doing nothing was also considered.

a. Diversion of floodwaters out of the basin via an intertie of Kern River to the California Aqueduct was considered and found both practical and economically feasible. The plan description and environmental effects are discussed in paragraphs 19 and 20.

b. Development of additional upstream storage for flood control could be accomplished most economically by enlarging Isabella Lake. The practical limit of such enlargement would be about 100,000 acre-feet. In 1966 the Sacramento District prepared a Draft Review Report on the Kern River Basin which contained a feasible plan for the enlargement of Isabella Dam to increase the recreation pool from 30,000 acre-feet to 110,000 acre-feet and the gross pool from 570,000 acre-feet to 670,000 acre-feet. Of the 100,000 acre-foot total increase in storage, 20,000 acre-feet was an increase in active flood control space. The added flood control storage compensated for loss of useable surcharge storage of the existing project and would result in no change in present average annual flood control accomplishments of Isabella Lake. The environmental effects of such an enlargement for recreation purposes were also considered since Isabella Lake supports one of the most important warmwater fisheries in California and the lake is outstanding in both fish production and angler use. However, local interests failed to provide assurances of local cooperation for this plan, and completion of the report was deferred. In 1972, local interests expressed their intent to provide the required assurances. Studies were initiated to update the plan, although at the present time adequate assurances have not been provided to continue planning on this possible enlargement plan of Isabella Lake. Enlargement of Isabella Lake to 670,000 acre-feet to provide 100,000 acre-feet of additional flood control storage would not provide as high a degree of snow-melt flood protection to Tulare Lake as would the intertie project. Such a project also would not control main floods originating below Isabella Lake. The enlarged lake would provide a slightly increased average pool, tending to enhance the recreation opportunity. Only a few additional acres of land would be required and there would be little increase in overall size of the existing project. However, periodic inundation of existing wildlife lands would occur resulting in adverse effects on wildlife inhabiting project lands, such as raccoons, opossums, bobcats,

cayotes, badgers, gray foxes and a variety of game and nongame birds. Kern River floodwaters would remain in the basin, and some portion could be beneficially used for irrigation and ground water recharge as floodwaters were released from the reservoir. The project would not affect natural vegetation or wildlife in the Kern River Intertie area. Although such a project for flood control might be feasible, it is estimated to cost about 3 times as much as the intertie diversion and as already mentioned would provide a lower degree of flood protection to Tulare Lake.

c. Additional spreading areas and/or injection well fields along Kern River might also be economically feasible on a cost and benefit basis. However, acquiring large agricultural acreage and other lands along the river for spreading areas to protect other agricultural lands in Tulare Lake appears impractical from the regional economic, social welfare, and environmental viewpoints. The lands required for spreading areas would result in disruption of agricultural activities, destruction of important natural vegetation (including valley mesquite habitat) upon which wildlife are dependent for food and shelter, resulting in potential adverse effects. It is possible that land spreading areas could increase the problem of botulism affecting waterfowl in the lower Kern River area. Although injection well fields would require less land than spreading areas, operation and maintenance of the wells would require roads, power lines and pipelines, affecting agricultural activities, natural vegetation and wildlife. Kern River floodwaters would remain in the basin and some portion could be beneficially used for irrigation. The cost of additional spreading areas or injection well fields providing flood protection comparable to an intertie diversion is estimated to be several times as much as for the intertie.

d. If no project is accomplished, flood problems in the area due to Kern River floodwaters would remain. Flood damages in Tulare Lake would increase, as the economic growth from increasing agricultural production would still be expected to occur. There would be no disruption of the natural or human environment associated with construction of a project. The intertie diversion was determined to be the best plan for providing flood protection to the Tulare Lake area. Details of the intertie plan are described in the following paragraphs.

17. INTERTIE PLAN

At the point where Kern River is diverted south to Buena Vista Lake and north toward Tulare Lake, the California Aqueduct is lower in elevation and passes within several hundred feet of Kern River. These facts suggested the possibility of effecting a gravity connection of Kern River to the aqueduct in order to divert floodflows away from productive agricultural lands in the Tulare Lake area. The California Aqueduct is complete and in operation. During years of very large snowmelt runoff,

flows in the aqueduct being transported to the southern San Joaquin Valley and Southern California could be gradually reduced and temporarily replaced by Kern River waters. On such occasions, the flow introduced into the California Aqueduct would be largely utilized in the basin south of the Tehachapi Mountains in lieu of water which would otherwise have been diverted in the same amount from the Sacramento - San Joaquin Delta. Any rain floodflows reaching the intertie site would probably continue to be diverted south to Buena Vista Lake and north toward Tulare Lake, as excessive turbidity of such waters would probably make them incompatible with water quality objectives for aqueduct water. In addition, because of the relative unpredictability of rain floods, waters from such events probably could not be introduced into the aqueduct because of operational timing problems. Reconnaissance studies indicated that a gravity intertie of 3,000 cubic feet per second capacity would be functionally and economically feasible, and an acceptable plan of improvement. The connection studied consisted essentially of a concrete lined intake channel crossing the Buena Vista Outlet Canal, a gated inlet to the California Aqueduct and a sedimentation basin immediately upstream of the entrance to the intertie to settle out bed load material.

18. SCOPE OF PROJECT

Reconnaissance studies considered only a gated chute and one design capacity (3,000 cubic feet per second) for the intertie project. Subsequently, studies were made of alternative intertie plans, including a broad-crested weir and pumping plants; various capacities were studied to identify the optimum project plan. These studies are summarized in Section VIII, Project Formulation and Justification. The most economical and desirable plan was determined to be a gated chute of 3,500 cubic feet per second capacity.

19. PROJECT PLAN

The location and major features of the project are shown on plates I, II and III. The proposed gated gravity connection would be about 320 feet long; originating on the east side of the Buena Vista Outlet Canal, it would cross the canal on fill and join the California Aqueduct about 300 feet north of State Route 119. The rectangular reinforced concrete intake channel would be sized to carry a maximum flow of 3,500 cubic feet per second. Wing walls would transition into the structure from a sediment basin just upstream. The intake channel invert would be at elevation 291.35 feet. The intake channel would be 68 feet wide with 12 foot high walls. The gated section would have a net width of 60 feet; outlet works would consist of 5 manually operated slide gates measuring 12 feet wide by 8 feet high. Gate operation would normally be facilitated by a portable engine drive. Stop log slots would be provided on the downstream side (aqueduct side) of the slide gates for

maintenance purposes. The exist channel would be 100 feet wide, the invert remaining level at 291.35 feet. No special energy dissipator would be required at the exit (entrance to the California Aqueduct). A log boom would be provided at the upstream ends of the chute to prevent floating debris from entering the chute and the aqueduct. In order to settle out bed load material prior to introduction of Kern River water into the California Aqueduct, a sedimentation basin would be provided immediately upstream of the entrance to the intertie. The sedimentation basin would be about 1,900 feet long and average about 700 feet in width, providing about 160 acre-feet of space below the intertie chute invert for sediment storage and settling. Periodic removal of sediments from the basin would be required. During dry periods the basin is accessible to land based equipment from State Route 119. Access to the intertie gate section would be provided by the California Aqueduct's primary operating road, which crosses Route 119 and which would bridge the intertie chute. Access to the existing control weir on the Kern River Flood Channel would be provided by a road on fill, adjacent to the intertie chute. Existing levees in the project area are sufficient to provide adequate head for operation of the intertie at design capacity; there would be no additional levee construction. Channel capacity in Kern River upstream from the diversion site is adequate to deliver sufficient water to the intertie for its intended operation. Operation of the intertie would not affect the operation of Isabella Lake for flood control. No channel enlargement or improvement is included in the proposed plan. However, to insure adequate channel capacity to deliver water to the intertie in the future for its intended operation and to insure adequate channel capacities downstream of the intertie in case of need during rainfloods and for periods when the intertie cannot be operated for some reason, maintenance of existing channel capacities from Bakersfield to Buena Vista and Tulare Lakes would be required. Construction of the intertie would require rights-of-way for the diversion structure, sediment basin, spoil areas, and other related works. Flows in Buena Vista Outlet Canal would be carried beneath the intertie chute in four 8-foot diameter reinforced concrete pipes having a combined capacity of 800 cubic feet per second.

20. ENVIRONMENTAL ASPECTS OF PROJECT

The proposed project would result in the following changes or conversions of environmental resources:

a. The proposed project would provide additional flood protection to the Tulare Lake area from Kern River snowmelt floodwaters. Because of an agreement between the owners of Buena Vista Lake and the Buena Vista Water Storage District regarding storage in the lake, it is considered that the project would not benefit Buena Vista Lake. Of floodwater ponding in Tulare Lake from all sources, some 50 percent evaporates and the remainder is used for irrigation. Operation of the intertie would preclude the use of such ponded Kern River snowmelt floodwater for irrigation purposes. Lands irrigated with this water are usually

lower quality lands on the perimeter of the lakebed area which under normal conditions would not be irrigated, and the net income from crops on these lands is generally considerably lower than from other lands in the lakebed area.

b. Under anticipated future conditions, it is expected the intertie would divert an average annual equivalent amount of about 15,000 acre-feet of Kern River snowmelt floodwaters into the California Aqueduct. This water would be delivered to the southern San Joaquin Valley and Southern California and represents about 2 percent of the average annual runoff (about 725,000 acre-feet) of Kern River.

c. Approximately 50 acres of flood plain lands in Kern River channel would be required for construction of project works and waste areas.

The beneficial and detrimental aspects of these changes are discussed below.

(1) Provision of additional flood protection to Tulare Lake from Kern River snowmelt floodflows would result in annual benefits currently estimated to average about \$300,000. The benefits consist solely of flood damage reduction and were evaluated as the difference in flood damages with and without the intertie project. Flood damages alleviated would include crop losses and loss of crop production as a result of land remaining flooded. Additional flood damages which would be reduced include damages to roads, levees, other property improvements and operating equipment, and cost of flood fighting. No land enhancement is anticipated due to no change to higher land use as a result of the proposed project. The project is not considered to provide any flood protection to Buena Vista Lake.

(2) Benefits that might accrue from using ponded snowmelt floodwaters (which are to be diverted) would be foregone. However, the irrigation value of any water to be diverted through the intertie was netted out in the economic evaluation of providing flood control to Tulare Lake. Furthermore, local interests asserting they hold all of the water rights to waters of Kern River flowing to Tulare Lake state that they and other local interests desire protection from such snowmelt floodwaters.

(3) The intertie structure would extend little above existing canal embankments in the project area and would have minor visual impact as seen from highway 119. No channel enlargement or improvement is included in the proposed project. However, maintenance of existing channel capacities of Kern River to Buena Vista and Tulare Lakes would be required. Clearing in the project area required for construction would consist primarily of debris removal from the river channel. Approximately 460,000 cubic yards of material would be excavated from the channel in constructing the sedimentation basin. Sediments would be spoiled along existing levees and in backwater areas in the project area. Sediments removed

from the basin during maintenance operations would also be spoiled in these areas. The spoil areas will be shaped to conform with the surrounding terrain. Seeding of the spoil areas and revegetation of disturbed areas will encompass a planting program designed to include planting of native vegetation and other plant species advantageous to existing wildlife as well as functioning to minimize erosion.

(4) Diversion of Kern River snowmelt floodflows into the California Aqueduct will have little effect on ground water recharge in the lower Kern River area. Channel losses in the Kern River Flood Channel are low and for the most part ponded waters evaporate, are used for irrigation, or are absorbed or perched by upper soil layers.

(5) Although diversion of snowmelt floodwaters into the California Aqueduct might reduce pumping costs for delivery of water to the southern San Joaquin Valley and Southern California, any such savings would be offset by additional aqueduct operation and maintenance costs associated with operation of the intertie. Considerable coordination would be necessary between the Corps of Engineers, the State of California, and local interests to effect the transfer of floodwaters.

(6) Removal of snowmelt floodwaters from the Kern River system will have the effect of reducing in high snowmelt years some acreage of water fowl habitat that has historically been created by such floodflows. However, this loss will tend to be offset by the resultant reduction of waterfowl botulism, since shallow flooding is conducive to this condition. Diversion of Kern River snowmelt floodwaters out of the basin once in 10 to 20 years, on the average, is expected to have little effect on other animal and plant life in the area. The project will not significantly affect rare or endangered species in the general project area.

(7) The project would not affect the remaining valley mesquite habitat. Valley mesquite is adapted to the arid climate with near desert conditions in southwestern Kern County and is not dependent on infrequent snowmelt flooding for sustenance. Agricultural development displacing this habitat would occur with or without the intertie project, being primarily dependent on the availability of irrigation water.

(8) The project would have no affect on historical or archeological resources. The region is rich in aboriginal remains; however, there are no known significant archeological or historical resources in the project area.

(9) The project would have a relatively small affect on the social and socio-economic characteristics of the area. However, the reduction in flooding in Tulare Lake would tend to benefit the economic base of the community by increasing to some degree employment opportunities in connection with the crops grown and by increasing the net income to the area. The well-being of the farm workers and service industries would be increased by the stabilizing influence of more uniform crop production.

SECTION V - BASIS FOR DESIGN

21. SURVEYS AND EXPLORATIONS

The general intertie area is covered by the U. S. Geological Survey's Tupman quadrangle, dated 1954, having a scale of 1 to 24,000 and 20 foot contour intervals. More detailed topography is available from the State Department of Water Resources on "California Aqueduct, South San Joaquin Division - Topography," dated January 1961, having a scale of 1 inch equals 200 feet and 5 foot contour intervals. Topography of the intertie site, including the California Aqueduct, is available from the State Department of Water Resources on "California Aqueduct, South San Joaquin Division, General Plan," dated 20 April 1967, as revised 27 July 1967, having a scale of 1 inch equals 100 feet and 5 foot contour intervals. Additionally, topographic surveys were conducted in January 1970 by the Sacramento District for the intertie site; the map prepared from these surveys has a scale of 1 inch equals 100 feet and 2 foot contour intervals.

22. SOILS

Soil logs and soil surveys near the intertie site are available from the State Department of Water Resources and the State Division of Highways. Additional subsurface explorations for this project were accomplished by the Sacramento District in August 1971, including four undisturbed tube-type sampler borings and one continuous-flight auger boring. Location of the borings is shown on plate V and logs of borings are shown on plates VI and VII. Disturbed and undisturbed samples of the materials encountered were subjected to laboratory classification tests conducted in accordance with the "Unified Soil Classification System," TM 3-357, Appendix A, April 1960, reprinted May 1967. Materials encountered in the intertie chute area were sandy clay, clayey sand, silty sand, sand, and clay, to a depth of about 25 feet, in order of their predominance. Below the 25 foot depth the materials were silty sand, sand, clay, silt, silty gravelly sand, and sandy gravel, in order of their predominance, to a depth of about 60 feet. Sandy silts and silty sands were non-plastic to low plasticity and sandy clays were low plasticity. The clays were predominantly low plasticity except a layer of high plasticity clay between 8 and 18 feet deep. Borrow materials were silty sand, sandy clay, and sand, in order of their predominance, to a depth of 16 feet.

23. SOILS DESIGN

Because of the layers of weak foundation materials within the upper 18 feet of intertie chute foundation area, noted above, special treatment is required. Driven or drilled cast-in-place concrete piles have been considered; however, this type of foundation was excluded because of excessive cost. In order to alleviate the effect of the weak materials in the

upper zones of the foundation area, these weak materials are to be removed and replaced with silty sands and sands from the borrow area. The weak materials would be spoiled along existing levees and in backwater areas in the project area. The existing materials beneath the intertie chute and the culverts for the Buena Vista Outlet Canal are to be excavated 18 feet below existing ground surface and wasted. After excavation the sandy borrow materials are to be placed in the excavated area and compacted. Using the above foundation treatment, adequate support will be provided for the proposed structure with minimum settlements, both differential and total. Allowable safe bearing capacities of 2,000 pounds per square foot dead load only and 3,000 pounds per square foot dead plus live load will be realized using the above foundation treatment.

24. CONSTRUCTION MATERIALS

Embankment material for the fill across the Buena Vista Outlet Canal would be obtained from excavation of the sedimentation basin. Concrete, steel reinforcement, lumber, commercial material suitable for patrol road surfacing, stone for bank protection and other miscellaneous construction materials are available in Bakersfield, located about 20 miles northeast of the project area.

25. HYDRAULIC DESIGN

The width of the intertie chute was determined by the functional requirements of 3,500 cubic feet per second flow, a 320-foot length, a limiting water surface elevation of 299.2 in the upstream sedimentation basin, and a limiting static water surface elevation of 298.2 at the control gates. Use of a roughness factor of $K = 0.0013$ results in a maximum static water surface elevation of 299.1 feet. Use of $K = 0.007$ was also investigated and increases the static water surface elevation by 0.1 feet. Final design will consider the implications of using both of these factors. Losses in terms of velocity head (HV) lost in addition to friction included the following:

Contraction from the sedimentation basin	= 0.2 HV
Roadway and gate piers	= 0.5 HV
Expansion downstream of gates	= 0.2 HV
Velocity head of flow into aqueduct	= 1.0 HV

The resulting chute would be 68-feet wide with an invert elevation of 291.35. The top of the walls at elevation 303.35 would provide 4.15 feet of freeboard above the static water level in the chute. Flow would be controlled by five 12'-0" by 8'-0" slide gates mounted on 2-foot wide piers. Downstream of the gates, the chute would be flared to 100-foot width at the junction with the aqueduct. Flow of 800 cubic feet per second in the Buena Vista Canal would be passed under the intertie chute through four

8-foot diameter culverts, 170-feet long. An "n" value of .0225 was used in Mannings equation to determine the water surface downstream of the culverts. Losses through the culverts in addition to friction (using an "n" value of .016 in Mannings equation) included the velocity head for an exit loss and 0.5 of the velocity head for an entrance loss.

26. CARE AND DIVERSION OF WATER DURING CONSTRUCTION

During construction of the culverts, the flow in the Buena Vista Outlet Canal can be excluded by closing the gated culverts passing under Highway 119 and constructing a low downstream cofferdam. Construction of the intertie chute would be in the dry except at the junction with the aqueduct where a cofferdam would be required.

27. STRUCTURAL DESIGN

The major structures included in the plan are the intertie chute, pipe-culverts beneath the chute, a sedimentation basin at the entrance to the chute, an access bridge at the downstream end of the chute and a gate structure adjacent to the access bridge. The structural design of the intertie, pipe-culverts, access bridge and gate structure would be in accordance with applicable portions of EM 1110-2-2101 (Working Stresses for Structural Design), EM 1110-2-2502 (Retaining Walls) and EM 1110-2-2902 (Conduits, Culverts and Pipes). The access bridge would be designed for HS-20 highway loading conditions and would be consistent with standards of the State Division of Highways. Soil values and reinforced concrete design stresses are assumed to be as follows:

SOIL UNIT WEIGHTS (Pounds per cubic foot)

<u>Dry</u>	<u>Moist</u>	<u>Saturated</u>	<u>Submerged</u>	<u>Shear Value</u>
100	120	125	63	$\phi=30^\circ$

Backfill on batter wall, $K_A=0.33$

Coefficient of friction between concrete and drainage fill, $S=0.40$

REINFORCED CONCRETE DESIGN STRESSES (Pounds per square inch)

$$f_c' = 4,000$$

$$f_c = 0.35f_c' = 1,400$$

$$f_s = 20,000$$

28. INTERTIE STRUCTURE

The reinforced concrete intertie structure is shown on plates III and IV, and would be 320 feet long, supported on compacted fill. It would consist of an upstream transition, a chute, an access bridge, a gate structure and a downstream transition. The upstream transition, 20 feet long at the centerline and 128 feet wide at the entrance, would be trapezoidal in plan, and would converge to a 68-foot wide chute. The chute would be 224 feet long and 68 feet wide, constructed with a 52-foot wide center slab, and an "L" shaped retaining wall on both sides, 12 feet high and having a slab 8-foot wide. The access bridge would consist of a 26-foot wide reinforced concrete deck at the downstream end of the chute; it would provide access from State Highway 119 to the primary operating road along the California Aqueduct and to the service road leading to the existing control weir on the Buena Vista Outlet Canal. Flows through the chute would be controlled by five 12'-0" x 8'-0" manually operated slide gates. The gate section would be 10 feet long. The downstream transition, 40 feet long, would be trapezoidal in plan and would diverge from 68 feet wide at the end of the gate section to 100 feet wide at the exit to the California Aqueduct. The structural design of the intertie would be based upon the following loading conditions:

CASE I - CONSTRUCTION CONDITION: channel empty, no backfill, wind on completed structure during construction with an assumed wind load of 30 pounds per square foot on exposed surface, 33-1/3 percent overstress permitted, resultant within the middle half of base, 75 percent of base in compression.

CASE Ia - CONSTRUCTION CONDITION: channel empty, backfill (moist) in place, D-4 tractor loading on backfill, wall loading computed by Boussinesq equation, 50 percent overstress permitted, no uplift pressure, resultant within middle half of base.

CASE II - CONSTRUCTION CONDITION WITH EARTHQUAKE: channel empty, backfill (moist) in place, earthquake on completed structure with seismic acceleration of mass (0.10g) and dynamic earth pressure (0.20 of active earth pressure), no uplift pressure, resultant within middle half of base, 33-1/3 percent overstress permitted.

CASE III - OPERATING CONDITION : water in channel to elevation 299.2, submerged backfill to water elevation and saturated above, 100 percent uplift, normal working stresses, resultant within middle third of base.

29. GATE STRUCTURE

The gate structure is shown on plate III and would consist of five 12'-0" x 8'-0" openings or a net width of 60 feet; with 2-foot thick

internal piers, the gross width would be 68 feet. Five 12'-0" x 8'-0" (standard size) manually operated slide gates would be provided, which in full open position would allow discharge of the design flow through the intertie structure to the California Aqueduct. Gate operation would be facilitated with a portable engine drive.

30. ACCESS BRIDGE

The access bridge is shown on plate III and would consist of a reinforced concrete deck slab supported at the abutments by the walls of the gate structure and by the four interior piers of the gate structure extended upstream the width of the bridge deck. The bridge deck would be 72 feet long, with the top of the slab constructed to elevation 300.35+ feet and would have a total width of 26 feet including a parapet wall 3 feet high along the upstream edge of the bridge. The abutment walls and four piers would be approximately 2 feet thick and 8.0 feet high, and would be supported by the reinforced concrete chute slab 2.5 feet thick. The bridge deck was designed for HS-20 live loading. The basis of design to determine the size of the supporting members (abutment walls and piers) was coordinated with hydraulic design considerations for the gate structure.

31. PIPE-CULVERTS

The culverts are shown on plates II and III and would consist of four 8-foot inside diameter concrete pipes laid beneath the intertie to pass flows in the Buena Vista Outlet Canal. The culverts would be 170 feet long with invert at elevation 279.0. Two headwalls, located upstream and downstream of the pipe-culverts, 12-foot high and top at elevation 291.0, would contain backfill providing support for the intertie chute placed to elevation 300.35. An access road to the existing control weir on Buena Vista Outlet Canal would be provided on the downstream or northern portion of this embankment. From elevation 300.35 to elevation 289.35, this embankment would slope down, 1.0 on 2.5 on both sides, thus providing a freeboard of 1.6 feet to the headwalls. The headwalls would be designed as "T" walls, and the loading conditions considered are the same as those considered for the "L" walls of the intertie, described above under paragraph 28. Diagrams of those loading cases for the intertie structure, for the center headwalls and wing walls of the pipe-culverts, and summarizing the results of stability analysis for each of these cases are shown on plate IV. Construction joints at 30 to 40 feet spacing would be provided along the entire length of the intertie. The center headwalls of the pipe culverts would be constructed 50 feet in length. The wing walls on both sides would be approximately 28 feet long.

32. SEDIMENTATION BASIN

The sedimentation basin, as shown on plates II and III, would be located immediately upstream of the intertie entrance. The basin has been designed

to remove and store all sediment particles 0.062 millimeters in size (sand) and larger from the stream flow during the 100-year snowmelt flood. The State of California Department of Water Resources has informally indicated that sand-size particles could not be introduced into the California Aqueduct. Based on recent studies by the U. S. Geological Survey the estimated sediment load (0.062 millimeters and larger) during the 100-year event is about 185,000 cubic yards. Although some finer particles (less than 0.062 millimeters) will be deposited in the sedimentation basin, most will remain in suspension and pass into the aqueduct. This fine, suspended material will probably be deposited in terminal storage reservoirs of the State Water Project. It is possible that this suspended material may constitute a significant part of the total Kern River sediment load. The Department of Water Resources has informally indicated that the quality of water would probably be acceptable. In a letter of 19 June 1972 (inclosure 1) the department stated that the State would be willing to accept Kern River snowmelt flood releases into the aqueduct when, among other things, the quality of water meets standards agreed to in advance by the Corps and the Department of Water Resources. Such standards will be established prior to initiation of construction of the project. The sedimentation basin would be of irregular shape and would have a surface area of some 30 acres. The basin would be about 1,900 feet long and average about 700 feet in width. The basin invert would be excavated to elevation 286.0 feet, providing some 160 acre-feet of space below the chute invert (elevation 291.35 feet) for sediment storage and settling. Approximately 460,000 cubic yards of material would be excavated from the stream channel in constructing the sedimentation basin. Sediments would be spoiled along existing levees and in backwater areas in the project area. Sediments removed from the basin during maintenance operations would also be spoiled in these areas. The spoil areas will be shaped to conform with the surrounding terrain. Seeding of the spoil areas and revegetation of disturbed areas will encompass a planting program designed to include planting of native vegetation and other plant species advantageous to existing wildlife as well as functioning to minimize erosion. Equivalent average annual sediment storage in the basin is estimated at about 4,500 cubic yards. However, in many years no sediment would be deposited, as flows would be entirely depleted near Second Point, located several miles above the intertie site. Removal of accumulated sediments would be accomplished by land based equipment during low flow periods. To prevent erosion and reacquisition of bed-load materials at the lower end of the basin where flow would be accelerating near the entrance to the intertie structure, rock protection on the floor of the basin would be provided at that location. Paving would be placed between the wing-walls at the entrance of the intertie structure.

33. ACCESS ROAD

Access to the intertie structure would be provided by the proposed relocated California Aqueduct primary operating road which would bridge

the intertie structure; the intertie would be located about 300 feet north of State Highway 119. Access to the existing control weir on Buena Vista Outlet Canal would be provided by a service road located on the downstream side of the intertie embankment. As this service road is also part of a road relocation, it would not be necessary to construct access roads as such.

34. RELOCATION OF ROADS AND UTILITIES

The primary operating road would require approximately 300 feet of relocation to continue providing access to the California Aqueduct east levee. This would consist of a 22-foot wide travel surface of 4-inch stabilized aggregate. Also requiring relocation is the existing service road providing access to the control weir on the Buena Vista Outlet Canal. This road would be 200 feet long and 26 feet wide with a 2-foot aggregate shoulder adjacent to the intertie structure. It would also be necessary to relocate 2 wooden power poles and approximately 1,100 linear feet of 3-wire 17KV transmission line passing through the project area.

35. PERMANENT OPERATING EQUIPMENT

Permanent operating equipment would consist of one staff gage to be installed at the upstream end of the access bridge, one slope gage to be installed in the California Aqueduct, and one portable engine drive to facilitate operation of the slide gates.

36. LANDS AND DAMAGES

There are approximately 50 acres required for construction of the project works and spoil areas. The Kern County Land Company has title to about 44 acres. The remainder is owned by the Buena Vista Water Storage District. The subject property consists primarily of the bed of the Kern River and adjacent flood plain. The soil is mostly sandy river wash and little vegetation exists in the channel bottom. Vegetation exists primarily along the edges of the river bed and on adjacent lands. There is an abandoned oil well on the property and the proposed take line crosses over one observation well. Along the north and northeast sides of the property there are three wells which are currently being pumped for oil. Only light clearing and grubbing would be necessary to prepare the project site for construction, and this would consist primarily of debris removal from the Kern River channel. An estimated fair market value of \$170 per acre in the area, based on fee simple title and excluding all mineral rights, was determined after an analysis of property sales in the area.

37. ENVIRONMENTAL CONSIDERATIONS

Natural vegetation in the general project area is primarily the valley mesquite habitat type. This habitat type is the last significant acreage

of mesquite wildlife habitat in the San Joaquin Valley and supports populations of doves, quail, jackrabbits and cottontails. Vegetation in the project area consists primarily of mesquite, saltbrush, willows and scattered cottonwoods. The Kern River channel bottom is nearly devoid of vegetation and construction of the project would disturb little natural vegetation. The sedimentation basin would lie within the existing Kern River channel. Spoil areas would be located along existing levees and in backwater areas in the project area, and would be shaped and seeded. Two highway bridges, two control weirs, the California Aqueduct and Buena Vista Inlet and Outlet Canals are in the project area. The intertie itself would be a low lying structure extending little above existing canal embankments. No special beautification measures would be necessary in the project area. No fishery exists in lower Kern River due to the intermittent flow. Operation of the intertie might possibly benefit waterfowl in the lower Kern River area between Buena Vista and Tulare Lakes, but no other wildlife resources or natural vegetation would be significantly affected. No fish and wildlife mitigation measures would be necessitated by the project. There is not any property included within the project boundaries which would fall within the provisions of Executive Order 11593, "Protection and Enhancement of the Cultural Environment."

38. KERN RIVER CHANNEL AND LEVEES

Existing levees within the project area are adequate to provide the head necessary for operation of the 3,500 cubic foot per second gravity diversion; no levee construction would be required. Channel capacity in Kern River upstream from the intertie is adequate to assure delivery of water to the site for its intended operation without affecting operation of Isabella Lake for flood control. No channel enlargement or improvement is included in the proposed plan. Kern River channel capacities from First Point of Measurement to Buena Vista and Tulare Lakes are shown on chart 1; the channel capacities are basically those shown in "Appendix II - Reservoir Regulation Manual for Isabella Project - of Master Manual of Reservoir Regulation, Tulare Lake Basin, California," dated 11 May 1953, revised 27 September 1954, Sacramento District, Corps of Engineers, with some exceptions. These channel capacities have been recently verified by observations during periods of high flow in 1967 and 1969. During the 1969 flood season flows shown on chart 1 occurred over a period of several months and were safely contained within existing stream channels. Kern River channel and Buena Vista Inlet and Outlet Canals have been maintained in the past. However, as noted in paragraph 19, to insure adequate channel capacity to deliver water to the intertie in the future for its intended operation and to insure adequate channel capacities downstream of the intertie in case of need during rainfloods and for a period when the intertie cannot be operated for some reason, maintenance of existing channel capacities from Bakersfield to Buena Vista and Tulare Lakes would be required.

SECTION VI - COST ESTIMATES

39. BASIS OF COST ESTIMATES

Estimates of cost shown in this report are based on 1 July 1974 price levels. Adequate allowances for contingencies, engineering and design, and supervision and administration have been included in the first cost. Economic and financial costs are considered to be essentially the same and therefore only economic costs are presented in this report. Interest on the investment was computed at 5-5/8 percent. A 50-year amortization period was used as the economic life of the project. However, with adequate maintenance, the structure would be expected to function effectively over an extended project life. The annual costs include suitable allowances for the estimated costs of maintenance, operation and minor replacements of the project after completion. The estimated cost of additional maintenance on Kern River channels has also been included in the annual costs. It is assumed that with normal maintenance no major replacements will be required during the estimated life of the project.

40. ESTIMATE OF FIRST COST

The total estimated first cost of the intertie project, based on 1 July 1974 price levels, is \$1,675,000; preauthorization study cost is \$83,000. Under the present law local interests are required to pay for lands and damages, relocations, and to repay any Federal first cost, including preauthorization study cost, in excess of \$1,000,000. Details of the estimate are included in table I. The Federal and non-Federal costs are listed by principal items in the following tabulation.

fed & non-fed

2

Item	: Amount (\$)
<u>FEDERAL COST</u>	
Channels (culverts in Buena Vista Outlet Canal)	205,000
Diversion Structure (includes sedimentation basin)	1,165,000
Permanent Operating Equipment	2,000
Engineering and Design	175,000
Supervision and Administration	<u>103,000</u>
Total Federal Cost Items	1,650,000
Preauthorization Study Cost	<u>83,000</u>
Subtotal	1,733,000
Less Cost in Excess of Federal Limitation	<u>733,000</u>
TOTAL FEDERAL COST	1,000,000
Less Preauthorization Study Cost	<u>83,000</u>
TOTAL FEDERAL FIRST COST	917,000
<u>NON-FEDERAL COST</u>	
Lands and Damages	16,000 <u>a/</u>
Relocations	7,000
Engineering and Design	1,000
Supervision and Administration	<u>1,000</u>
Total Non-Federal Cost Items	25,000
Cost in Excess of Federal Limitation	<u>733,000</u>
TOTAL NON-FEDERAL FIRST COST	758,000
TOTAL PROJECT FIRST COST	1,675.000 <u>b/</u>

a/ Includes acquisition costs.

b/ Excludes \$83,000 preauthorization study cost.

41. ESTIMATE OF ANNUAL COST

No charge for interest during construction is included in the estimate since the project would be completed in less than 2 years. The adjustment for loss of productivity of lands to be acquired for the project was considered negligible as such lands would be flood plain lands in Kern River channel. Annual costs are based on 5-5/8 percent interest and an amortization period of 50 years. Details of the estimate are included in table II. Annual economic costs are summarized below.

Item	: Amount (\$)
<u>FEDERAL COST</u>	
Interest and Amortization	55,200
Maintenance and Operation	<u>None</u>
TOTAL FEDERAL ANNUAL COST	55,200
<u>NON-FEDERAL COST</u>	
Interest and Amortization	45,700
Adjustment for Loss of Land Productivity	Negligible
Maintenance and Operation	
(Structure)	5,800
(Sedimentation basin)	4,600
(Kern River channels)	5,700
Replacements	<u>None</u>
TOTAL NON-FEDERAL ANNUAL COST	61,800
TOTAL PROJECT ANNUAL COST	117,000

SECTION VII - ACCOMPLISHMENTS AND BENEFITS

42. PROJECT OPERATION STUDIES

Flood control accomplishments for the intertie were determined from routings of Kern River flows to Tulare Lake. Project routings included the proposed project's capability to divert a maximum of 3,500 cubic feet per second from Kern River to the California Aqueduct. The routings also included irrigation and spreading diversion criteria, storage sequence, and other assumptions identical to those of preproject routings, described in paragraph 10. Average flow rate at Buena Vista Pumping Plant (on the California Aqueduct several miles south of the intertie site) for the months March through September during the period of analysis used to evaluate intertie accomplishments, 1975-2025, is shown below. These rates are based on the demand for water in Southern California and the anticipated capacity of the Buena Vista Pumping Plant.

Period (years)	Average flow rate (cubic feet per second)
1975 - 1977	500
1978 - 1980	1,000
1981 - 1985	1,500
1986 - 1987	2,000
1988 - 1990	2,500
1991 - 2000	3,000
2001 - 2020	3,500
2021 on	4,000

Average annual Kern River snowmelt flooding in Tulare Lake under preproject conditions and under project conditions, assuming floodwater would be diverted into the aqueduct (through a 3,500 cubic foot per second capacity intertie) at the capacity indicated for the entire period of analysis, are tabulated on the following page.

Conditions and aqueduct capacity (cubic feet per second)	:	Average annual inflow to Tulare Lake (acre-feet)
<u>Preproject</u>		14,900
<u>Project</u>		
500		11,200
1,000		8,800
1,500		6,900
2,000		4,900
2,500		3,100
3,000		1,900
3,500		1,200

43. FLOOD CONTROL ACCOMPLISHMENTS

Figures in the preceding tabulation indicate the proposed project of 3,500 c.f.s. capacity would provide considerable protection to Tulare Lake from Kern River snowmelt runoff under the assumed storage sequence described in paragraph 10. Although the Tulare Lake area would not be completely protected from Kern River floodflows during the period of analysis, the lakebed would nevertheless gain a high degree of protection as the flow rate of the California Aqueduct was increased. Examination of the routings indicates the proposed intertie project would provide nearly 100-year protection to Tulare Lake from Kern River snowmelt flooding when the California Aqueduct is operating at ultimate design capacity.

44. FLOOD CONTROL BENEFITS

Primary flood control benefits consist of reduction in flood damages. No land enhancement benefits are anticipated due to change to higher land use as a result of the project. Flood damage reduction benefits were evaluated as the difference in flood damages without and with the diversion project. Average annual primary damages under project conditions were computed by applying the future unit damage figure of \$31.20 per acre-foot (net of irrigation, as explained in paragraphs 13 and 14) to the average annual flood volumes damaging Tulare Lake under conditions discussed in the preceding paragraph. Damages under project conditions (residual damages), assuming floodwater would be diverted into the aqueduct (through a 3,500 cubic foot per second capacity intertie) at the capacity indicated for entire period of analysis, are tabulated on the following page.

Aqueduct capacity (cubic feet per second)	:	Average annual residual damages (dollars)
500		349,000
1,000		275,000
1,500		215,000
2,000		153,000
2,500		97,000
3,000		59,000
3,500		37,000

However, as noted in paragraph 42, the average flow rate at the Buena Vista Pumping Plant, the primary determinant of aqueduct disposal capacity at the intertie site, will be limited during the early years of intertie operation. Therefore, reductions in residual damages deferred by limited aqueduct capacities during the buildup period were discounted at 5-5/8 percent rate of interest. Equivalent average annual residual damages in Tulare Lake for the period of analysis (1975-2025) are \$165,000. In order to determine the primary flood control benefits creditable to the project, future residual damages are subtracted from future preproject damages. As noted in paragraph 15, future average annual flood damages under pre-project conditions amount to \$465,000. Subtracting \$165,000 residual damages for the proposed 3,500 cubic foot per second capacity intertie project from preproject damages leaves \$300,000 primary flood control benefits.

45. OTHER ACCOMPLISHMENTS

Although the reconnaissance report mentioned possible benefits other than flood control, the economic feasibility of the proposed plan is based solely on flood control benefits. Of floodwater ponding in Tulare Lake, some 50 percent evaporates and the remainder is used for irrigation. Operation of the intertie would require irrigation interests to give up any right to such Kern River snowmelt floodwater, thereby forgoing benefits that might accrue from using these ponded floodwaters for irrigation purposes. As noted in paragraph 13, flood control benefits in this report are net of the irrigation value of any snowmelt water diverted through the intertie. Diversion of snowmelt floodwaters into the California Aqueduct would not result in any net benefits to municipal and industrial water supply and irrigation, as any such savings would be offset by additional State costs associated with operation and maintenance of the intertie. The State has confirmed this conclusion in a letter dated 19 June 1972 (Inclosure 1). Considerable coordination would be necessary to effect the transfer of floodwaters. There are indications that diversion of snowmelt floodwaters into the California Aqueduct might benefit wild-

life resources in the lower Kern River area. Specifically, such benefits might accrue to the intertie by reducing the occurrence of botulism affecting waterfowl. However, such benefits have not been evaluated and are not guaranteed to accrue, and are therefore considered incidental and intangible. The project would have a favorable, although minor, effect on social and socio-economic values in the Tulare Lake area.

SECTION VIII - PROJECT FORMULATION AND JUSTIFICATION

46. PROJECT FORMULATION

During detailed project investigation, studies were made of alternative intertie plans, including a broad-crested weir and a pumping plant. Additional studies indicated a gated chute was still the best design for an intertie. The broad-crested weir alternative was determined to be incompatible with aqueduct operation and unacceptable to the State of California. The pumping station plan was determined to cost some 3 to 4 times as much as the proposed plan. As mentioned in paragraph 18, reconnaissance studies considered only a gated chute of 3,000 cubic feet per second capacity. Studies were made of various capacity gated chutes to determine the proper degree of development. Chute capacities studied were approximately those which would control the 25, 50, 100 and 300-year snowmelt flood events presented in paragraph 10 (assuming adequate pumping capacity exists in the California Aqueduct). As stated in paragraph 32, the sedimentation basin for the recommended plan (3,500 cubic feet per second capacity) was designed to remove all sand particles from the streamflow during the 100-year snowmelt flood. Sedimentation basins for the other gated chute plans were sized to remove all sand from the streamflow during events the respective chutes were designed to control. A tabulation of cost features and total first cost for these plans is shown below.

Intertie capacity (cubic feet per second) :	Channels & diversion : structure :	Sedimentation basin : Cost (\$)	Lands, damages & relocations :	Total project first cost <u>a/</u>
2,000	577,000	216,000	25,000	818,000
3,000	823,000	433,000	25,000	1,281,000
3,500	1,069,000	581,000	25,000	1,675,000
4,000	1,214,000	1,019,000	25,000	2,258,000

a/ Excludes \$83,000 preauthorization study costs.

Economic comparison of the several gated chute plans based on July 1974 price levels, 5-5/8 percent interest and a 50-year period of analysis, 1975 to 2025, is summarized on the following page.

Intertie capacity (cubic feet per second):	:	: Annual	: Excess benefits:	
	: Annual benefits:	costs	: over costs	: Benefit to
		(dollars)		: cost ratio
2,000	173,000	61,000	112,000	2.84
3,000	246,000	90,000	156,000	2.73
3,500	300,000	117,000	183,000	2.56
4,000	309,000	148,000	161,000	2.09

As the tabulation indicates, the project having the greatest excess of benefits over costs is the 3,500 cubic foot per second capacity intertie; therefore, this project represents about the optimum functional economic scale of development. This project provides a high degree of protection to Tulare Lake from Kern River snowmelt floodwaters, and is selected as the most desirable project.

47. PROJECT JUSTIFICATION

The total average annual benefits are \$300,000 all flood control, as discussed in paragraphs 44 and 45. Comparison of the average annual benefits with the total annual project economic cost, \$117,000, indicates a benefit to cost ratio for the Kern River-California Aqueduct Intertie Project of 2.6 to 1.

SECTION IX - COORDINATION AND LOCAL COOPERATION

48. COORDINATION

Views of interested Federal and non-Federal agencies concerning the project were received on initiation of detailed project studies. Further views have been obtained through discussions, meetings, correspondence and coordination of an environmental working paper. A public meeting was held on 4 May 1972 in Bakersfield to present the tentative plan of improvement and its environmental impact. Details of the proposed project were furnished for review to interested Federal agencies, the State of California, and the local sponsor. Formal State comments have been requested. In addition to the coordination of this report indicated below, considerable coordination has been accomplished in connection with the environmental statement prepared for this proposed project.

49. COMMENTS OF OTHER FEDERAL AGENCIES

No Federal agencies responded to the announcement of public meeting nor were any represented at the 4 May 1972 public meeting; past views and comments of field offices of other Federal agencies are summarized below.

The Bureau of Land Management has noted that no public domain lands are within the study area.

The Forest Service has stated they have no resource management interests connected with the project.

The Soil Conservation Service has noted that flood protection for the Tulare Lake area should be beneficial to the permanent improvement of agricultural lands.

The Bureau of Sports Fisheries and Wildlife was concerned with possible adverse project effects on vegetation and wildlife, but also felt there would be a definite project benefit to waterfowl through reduction of botulism-induced waterfowl mortalities. This agency also reviewed the Draft Detailed Project Report. The agency was pleased to note that project plans include the shaping and seeding of spoil areas and emphasized that spoil areas should be chosen which have little woody cover. The agency also noted that valley mesquite habitat on other lands is expected to be lost to agricultural development either with or without the project as irrigation water becomes available (See inclosure 4).

50. COMMENTS OF STATE OF CALIFORNIA

Two State agencies were represented at the 4 May 1972 public meeting; their comments are summarized below:

a. The Department of Fish and Game recognized the benefit to waterfowl but expressed concern over possible adverse project effects on vegetation and other wildlife.

b. The Department of Water Resources stated they would be willing to accept Kern River water into the California Aqueduct under certain conditions and would provide the State portion of project costs of lands, easements and rights-of-way shared with local interests. The State has also indicated such intent by letter of 19 June 1972 (inclosure 1).

Formal State comments on the draft Detailed Project Report were received in January 1974 (inclosure 6). The State reiterated the Department of Water Resources' position of cooperation and support for the project as expressed in their letter of 19 June 1972.

51. COMMENTS OF LOCAL AGENCIES AND GROUPS

Several local agencies and groups made statements at the 4 May 1972 public meeting; comments are summarized below.

The Wheeler Ridge-Maricopa Water Storage District expressed concern with the quality of water which would be diverted through the intertie, but supported the flood control function of the project.

The Kern County Water Agency stated they are a sponsor of the intertie study. The agency has indicated by letter of 8 August 1972 (inclosure 2) their intention to provide assurances of local cooperation, as described in the following paragraph. This agency also reviewed the draft Detailed Project Report and found the report satisfactory (inclosure 5).

The Tulare Lake Basin Water Storage District stated support of the intertie project.

The Project Land Use Task Force, a local citizens' group, expressed concern that the intertie project might be a first step to converting land use in Tulare Lake from agriculture to urban, industrial or residential uses.

52. LOCAL COOPERATION

Consistent with existing policy for small flood control projects and the provisions of Section 205 of the 1948 Flood Control Act, as amended, local interests would be required to:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including spoil disposal areas, and relocations necessary

for construction and maintenance of the project, with adherence to the provisions of Public Law 91-646.

b. Hold and save the United States free from damages due to the construction and operation of the project.

c. Maintain and operate the completed works in accordance with regulations prescribed by the Secretary of the Army.

d. Reimburse the United States for any Federal first cost in connection with planning and construction of the project, including preauthorization study cost, in excess of \$1,000,000.

In addition, local interests would be required to prevent flood plain encroachments of any type that would impair the effectiveness of the Kern River channel from Bakersfield to Buena Vista and Tulare Lakes and to maintain the existing channel capacities. Channel capacities will be documented and coordinated with local interests. Local interests would also be required to obtain assurances satisfactory to the Corps of Engineers that the State of California would accept Kern River snowmelt floodwaters, which would damage Tulare Lake, into the California Aqueduct. As stated in paragraph 32, water quality standards will be established prior to initiation of construction of the project. Water quality standards, as well as channel capacities and acceptable methods of channel maintenance, will be specified in an operation and maintenance manual to be prepared prior to completion of construction. Furthermore, local interests would be responsible for settling any claims for water rights pertaining to diversion of Kern River waters into the California Aqueduct.

The estimated first cost of required local cooperation is \$758,000, for the required lands and relocations and costs in excess of the Federal limitation. The local annual costs are estimated to be \$61,800 which includes \$10,400 for operation, maintenance and replacement of facilities and \$5,700 for Kern River channel maintenance. As noted in paragraph 50, the State Department of Water Resources has indicated a desire to participate in the project and could participate financially to the extent of providing a portion of project costs of lands, easements and rights-of-way (see inclosure 1). A number of local agencies have expressed support for the project including the Kern County Water Agency, Kern County Canal and Water Company, Kern County Board of Supervisors, Buena Vista Water Storage District, Tulare Lake Basin Water Storage District and J. G. Boswell Company. By letter of August 1972 (inclosure 2), the Kern County Water Agency has indicated its intent to provide the necessary assurances of local cooperation.

SECTION X - DISCUSSION

53. FLOOD PROBLEM

Floodwaters from Kern River normally reach the Tulare Lake area only during large floods. Although a relatively high degree of flood protection has been provided to the area below Isabella Dam, a flood problem still exists in Tulare Lake, particularly during years of exceptionally large snowmelt runoff. During such years, floodwaters enter the lakebed area and cause extensive damage to crops and agricultural facilities. Future annual snowmelt flood damages are estimated at \$465,000, on the average.

54. SOLUTION

The proposed plan for solution of the Kern River snowmelt flood threat to Tulare Lake consists of a gravity diversion of 3,500 cubic feet per second capacity from Kern River to the California Aqueduct. The total cost of this project is estimated at \$1,758,000 including \$83,000 preauthorization study cost. The intertie project would provide nearly 100-year protection to Tulare Lake from Kern River snowmelt flooding.

55. COST AND REPAYMENT

The proposed project is single-purpose, functioning solely for flood control. Local interests are required to reimburse the Federal Government for any planning and construction cost, including preauthorization study cost, in excess of \$1,000,000. Local interests are also required to furnish the necessary lands, easements, rights-of-way and relocations necessary for construction of the project, the cost of which is currently estimated at \$25,000. The Federal first cost, including preauthorization study cost, is estimated at \$1,733,000.

56. JUSTIFICATION

Annual primary benefits have been estimated at \$300,000 all are flood damage reduction benefits. The primary benefits, compared with an annual economic cost of \$117,000, give a benefit-cost ratio of 2.6 to 1.

57. ASSURANCES

The Kern County Water Agency has expressed its intent to provide the necessary assurances of local cooperation (see inclosure 2). The State of California has also expressed its willingness to accept Kern River floodflows into the California Aqueduct, subject to certain conditions, to achieve the intended flood control benefits (see inclosure 1).

58. STATEMENT OF FINDINGS

The documents concerning the proposed action, as well as the stated views of other interested agencies and the concerned public, have been reviewed and evaluated relative to the various practicable alternatives to provide flood protection from Kern River to the Tulare Lake area. The possible consequences of these alternatives have been studied according to environmental, social well-being, and economic effects, including regional and national development and engineering feasibility. In evaluation, the following points were considered pertinent:

a. The project will provide a very high degree of protection to agricultural lands in the Tulare Lake area from Kern River snowmelt floodwaters.

b. The project is sized at the optimum economic capacity, is functionally adequate and economically justified.

c. The project would have a favorable, although minor, effect on social and socio-economic values in the Tulare Lake area.

d. The project may incidentally benefit waterfowl in the area by alleviating occurrence of botulism affecting waterfowl. There are no significant adverse project effects on vegetation and other wildlife.

The proposed action, as developed in the following section, Conclusions and Recommendations, is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objective. The recommended action is consonant with national policy, statutes, and administrative directives, and the total public interest should best be served by implementation of the recommendation.

SECTION XI - CONCLUSIONS AND RECOMMENDATIONS

59. CONCLUSIONS

Based upon the data presented herein, the District Engineer concludes that:

a. A considerable flood problem exists in Tulare Lake, particularly during years of large snowmelt runoff. It is estimated that, if protective measures are not taken, future average annual Kern River snowmelt flood damages would be about \$465,000 per year in the lakebed, on the average.

b. The most practical and economical plan for alleviation of the flood problems consists of a 3,500 cubic feet per second capacity diversion structure from Kern River to the California Aqueduct. The project would function solely for flood control purposes. The estimated first cost of this project, including preauthorization study cost, is \$1,758,000. This project is economically justified, with a benefit-cost ratio of 2.6 to 1.

60. RECOMMENDATIONS

Pursuant to the foregoing, it is recommended that the plan of improvement described in this report be authorized for construction at an estimated cost to the United States of \$1,000,000, provided that local interests:

a. Provide without cost to the United States all lands, easements, and rights-of-way, including spoil disposal areas, and relocations necessary for construction and maintenance of the project, with adherence to the provisions of Public Law 91-646.

b. Hold and save the United States free from damages due to the construction and operation of the project.

c. Maintain and operate the completed works in accordance with regulations prescribed by the Secretary of the Army.

d. Reimburse the United States for any Federal first cost in connection with planning and construction of the project, including preauthorization study cost, in excess of \$1,000,000.

e. Prevent flood plain encroachments of any type that would impair the effectiveness of the Kern River channel from Bakersfield to Buena Vista and Tulare Lakes and maintain the existing channel capacities.

f. Obtain assurances satisfactory to the Corps of Engineers that the State of California would accept Kern River snowmelt floodwaters, which would damage Tulare Lake, into the California Aqueduct.

g. Settle any claims for water rights pertaining to diversion of Kern River waters into the California Aqueduct.



F. G. ROCKWELL, JR.
Colonel, CE
District Engineer

Table I

DETAILED ESTIMATE OF FIRST COST

KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE

(July 1974 price level)

Cost :		:	:	Unit :	
Acct. :	Item	:	Quantity	Unit	Price : Amount
No. :		:			(\$) : (\$)

FEDERAL09. CHANNELS

Foundation excavation	11,900	c.y.	2.30	27,370
Foundation backfill	11,430	c.y.	0.35	4,000
Pipe culverts, 96-inch RCP, 9-inches thick, Class III	680	l.f.	140.00	95,200
Compacted backfill	4,460	c.y.	1.00	4,460
Tamped backfill	2,360	c.y.	3.50	8,260
Riprap, 12-inch	260	c.y.	20.00	5,200
Drain pipe, 6-inch	220	l.f.	4.00	880
Concrete: Formed	85	c.y.	125.00	10,625
Unformed	145	c.y.	60.00	8,700
Reinforcement	19,000	lb.	0.25	4,750
Cement	345	bb1.	6.50	2,245
Subtotal				171,690
Contingencies, 20%+				28,310
TOTAL CHANNELS				205,000

15. DIVERSION STRUCTURE

Excavation, sedimentation basin	460,000	c.y.	1.05	483,000
Excavation, intertie structure	9,500	c.y.	3.30	31,350
Backfill, access road	600	c.y.	0.35	210
Backfill, intertie structure	1,330	c.y.	3.50	4,655
Concrete: Formed	490	c.y.	115.00	56,350
Unformed	1,615	c.y.	60.00	96,900
Bridge deck	90	c.y.	190.00	17,100
Gate superstructure	30	c.y.	125.00	3,750
Reinforcement	187,000	lb.	0.25	46,750
Cement	3,300	bb1.	6.50	21,450

DETAILED ESTIMATE OF FIRST COST (Cont'd)

Cost :	:	:	: Unit :	:
Acct. :	Item	: Quantity	:Unit:Price	:Amount
No. :	:	:	: (\$)	: (\$)

FEDERAL (Cont'd)

Handrail, State type	70	1.f.	9.00	630
Double handrail & posts	600	1.f.	9.00	5,400
Drain pipe, 6-inch	520	1.f.	5.00	2,600
Slide gates, 12-foot x 8-foot with manual hoist and frame	5	ea.	37,000	185,000
Miscellaneous metal	5,000	lb.	1.50	7,500
Rock protection, 12-inch	600	c.y.	15.00	<u>9,000</u>

Subtotal	971,645
Contingencies, 20%+	<u>193,355</u>

TOTAL DIVERSION STRUCTURE 1,165,000

20. PERMANENT OPERATING EQUIPMENT

Staff gage and slope gage	1	job	550
Portable, engine drive	1	ea.	1,100
Contingencies, 20%+			<u>350</u>

TOTAL PERMANENT OPERATING EQUIPMENT 2,000

30. ENGINEERING AND DESIGN 175,000

31. SUPERVISION AND ADMINISTRATION 103,000

TOTAL UNADJUSTED FEDERAL FIRST COST 1,650,000
NON FEDERAL CASH CONTRIBUTION -733,000

TOTAL FEDERAL FIRST COST 917,000 a/

NON-FEDERAL

01. LANDS AND DAMAGES

Land acquisition	50	acre	170.00	8,500
Acquisition				4,000
Administration				1,200

Subtotal	13,700
Contingencies	<u>2,300</u>

TOTAL LANDS AND DAMAGES 16,000

a/ Excludes \$83,000 cost of preauthorization studies

DETAILED ESTIMATE OF FIRST COST (Cont'd)

Cost :	:	:	:	Unit :	:
Acct. :	Item	: Quantity	: Unit	: Price	: Amount
No. :	:	:	:	: (\$)	: (\$)

NON-FEDERAL (Cont'd)

02. RELOCATIONS

.1 Roads:	Excavation	110	c.y.	2.30	255
	Compacted embankment	180	c.y.	2.30	415
	Aggregate	77	ton	6.00	460
	Liquid asphalt	5.8	ton	90.00	520

Subtotal	1,650
Contingencies, 20%+	<u>350</u>

TOTAL ROADS RELOCATIONS 2,000

.3 Utilities:	3-wire, 17KV power-				
	line including 2				
	wooden poles	1,100	1.f.	3.80	4,180

Contingencies, 20%+	<u>820</u>
---------------------	------------

TOTAL UTILITIES RELOCATIONS 5,000

TOTAL RELOCATIONS 7,000

30. ENGINEERING AND DESIGN 1,000

31. SUPERVISION AND ADMINISTRATION 1,000

TOTAL UNADJUSTED NON-FEDERAL FIRST COST 25,000

NON-FEDERAL CASH CONTRIBUTION 733,000

TOTAL NON-FEDERAL FIRST COST 758,000

TOTAL PROJECT FIRST COST 1,675,000 a/

a/ Excludes \$83,000 cost of preauthorization studies.

Table II

DETAILED ESTIMATE OF ANNUAL COST

KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE

(July 1974 price level)

INVESTMENT

1. FEDERAL

a. First cost	\$917,000 a/
b. Interest during construction	None
c. Gross (or net) investment	<u>\$917,000</u>

2. NON-FEDERAL

a. First cost	\$758,000
b. Interest during construction	None
c. Gross (or net) investment	<u>\$758,000</u>

ANNUAL COST

3. FEDERAL

a. Interest - 5-5/8 percent (0.05625 x 1c)	\$ 51,700
b. Amortization - 50-year (0.00390 x 1c)	3,500
c. Maintenance and operation	None
d. Total Federal annual cost	<u>\$ 55,200</u>

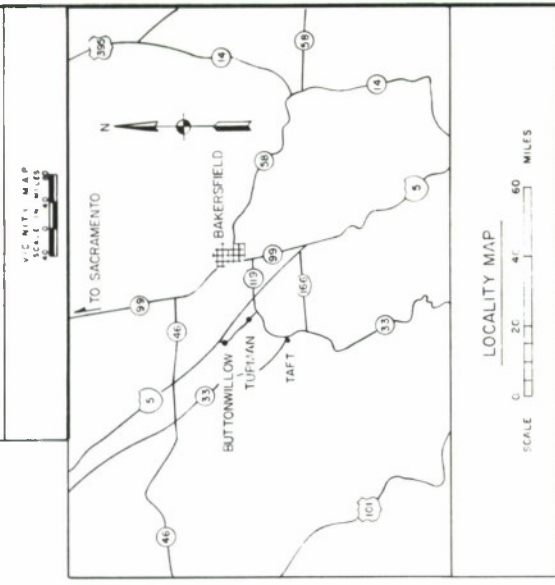
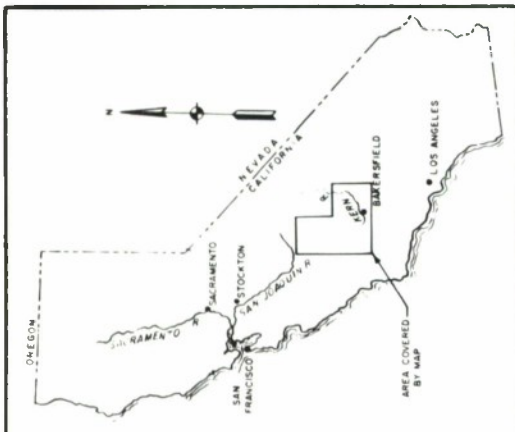
4. NON-FEDERAL

a. Interest - 5-5/8 percent (0.05625 x 2c)	\$ 42,700
b. Amortization - 50-year (0.00390 x 2c)	3,000
c. Adjustment for net loss in land productivity	Negligible
d. Maintenance and operation	
(Structure)	5,800
(Sedimentation basin)	4,600
(Kern River channels)	5,700
e. Major replacements	None
f. Total non-Federal annual cost	<u>\$ 61,800</u>

5. TOTAL PROJECT ANNUAL COST

\$117,000

a/ Excludes \$83,000 cost of preauthorization studies.

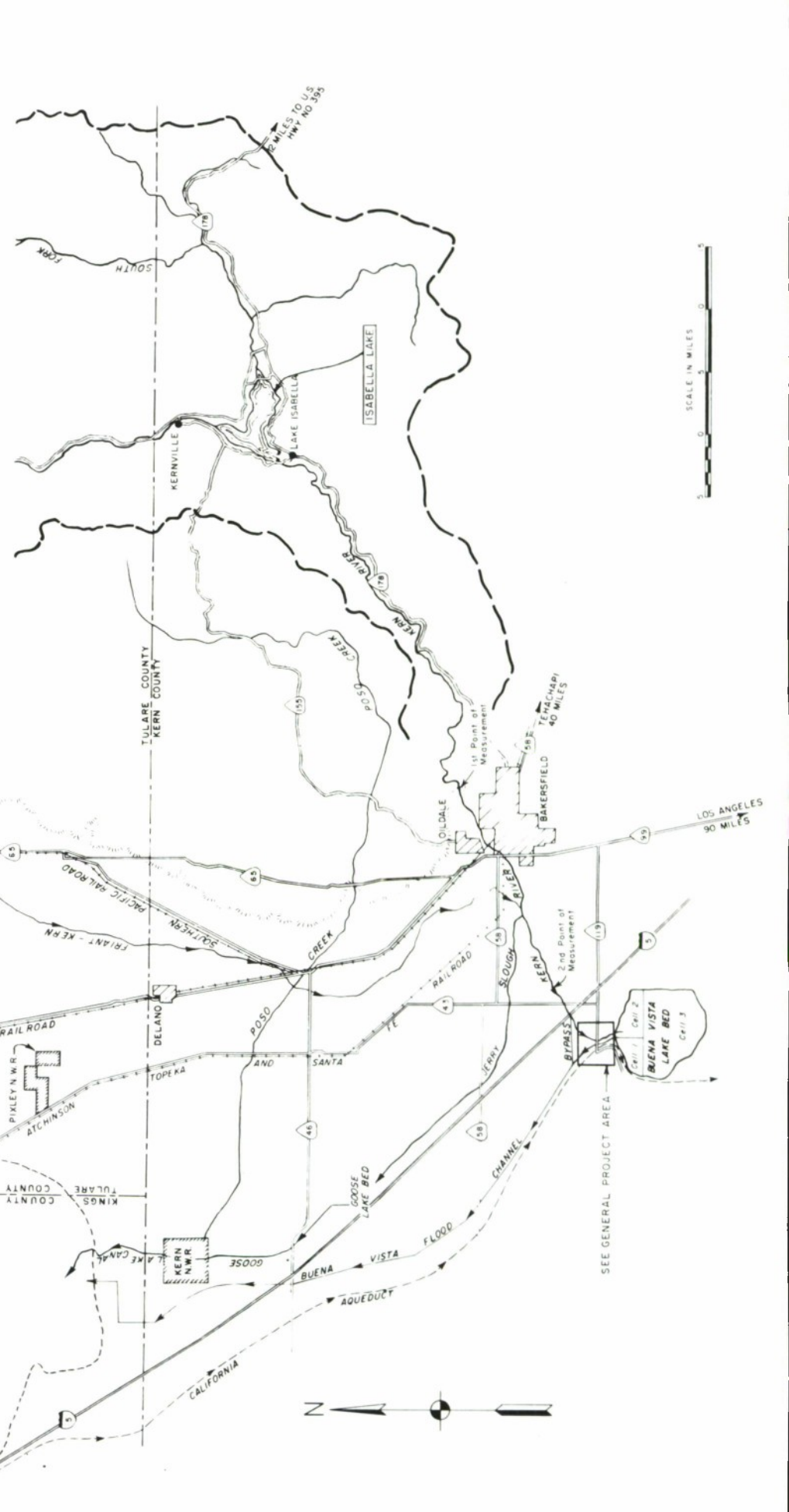
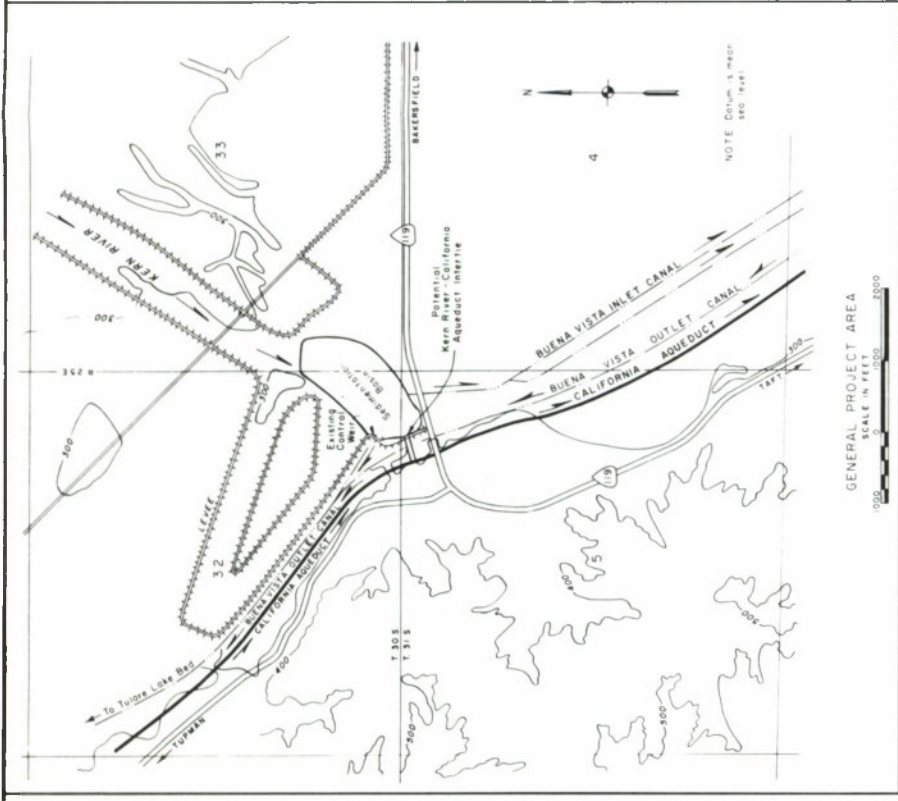


LEGEND

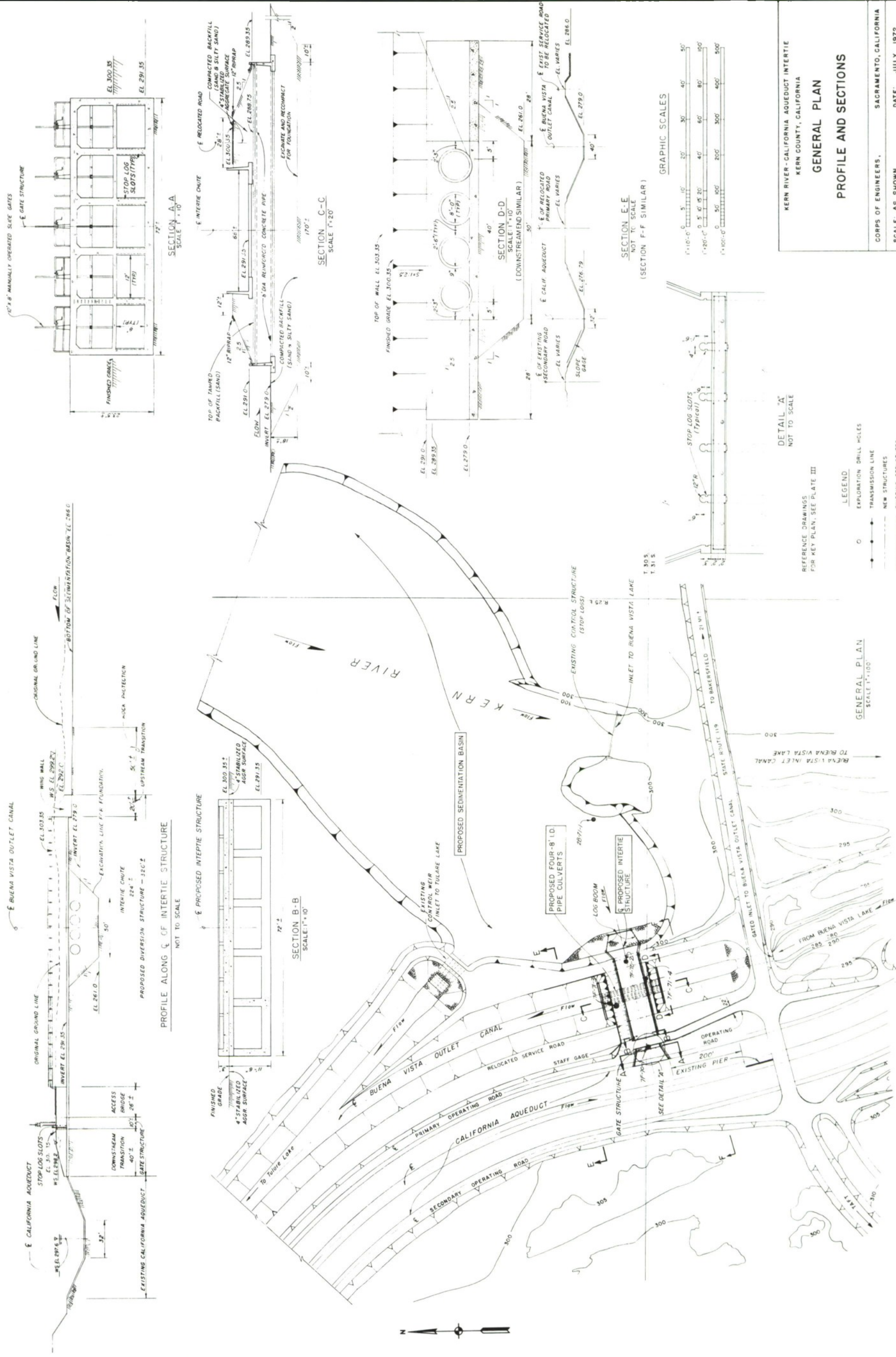
- Road
- Interstate Highway
- State Highway
- Railroad
- County Boundary
- Drainage Basin Boundary
- National Wildlife Refuge
- Base of Floods
- Existing Reservoir

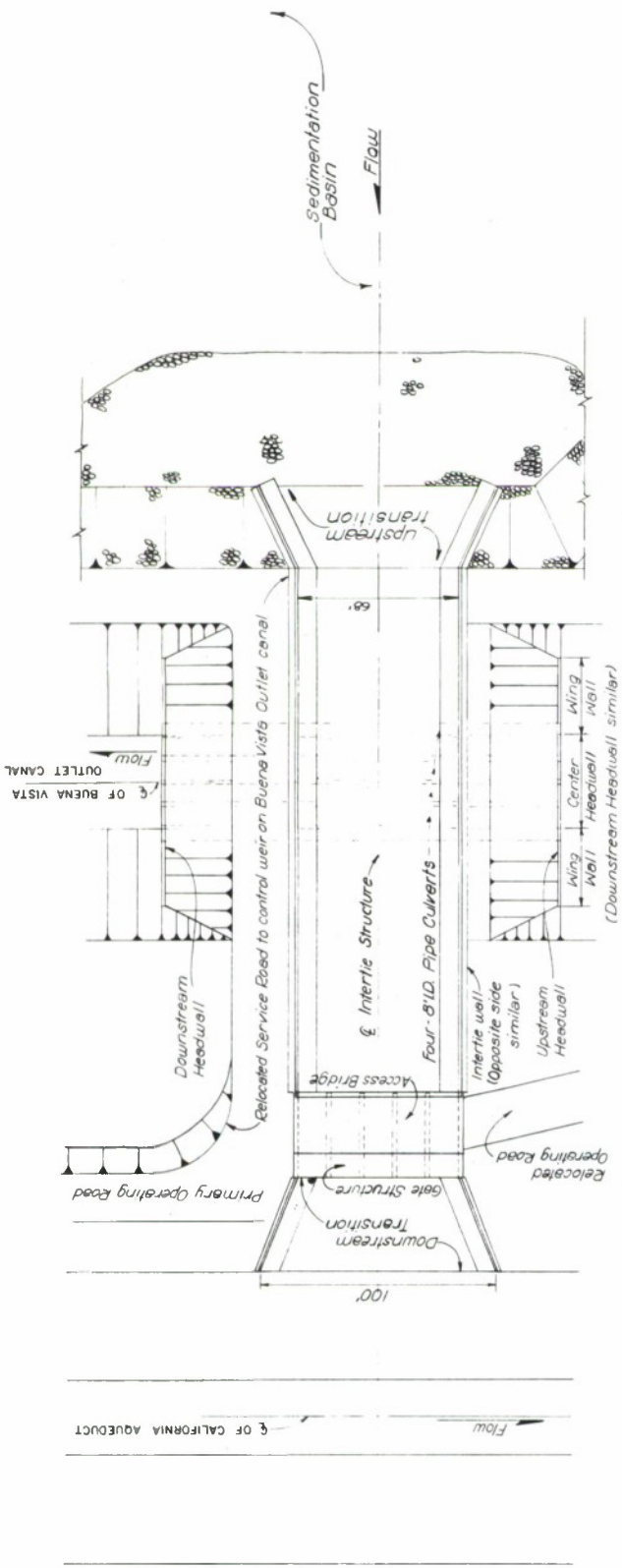
KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE KERN COUNTY, CALIFORNIA		
CORPS OF ENGINEERS,	SACRAMENTO, CALIFORNIA	
SCALE: AS SHOWN	DATE: JULY 1972	
FILE NO. KE 4-9	SHEET	PLATE 1

GENERAL MAP



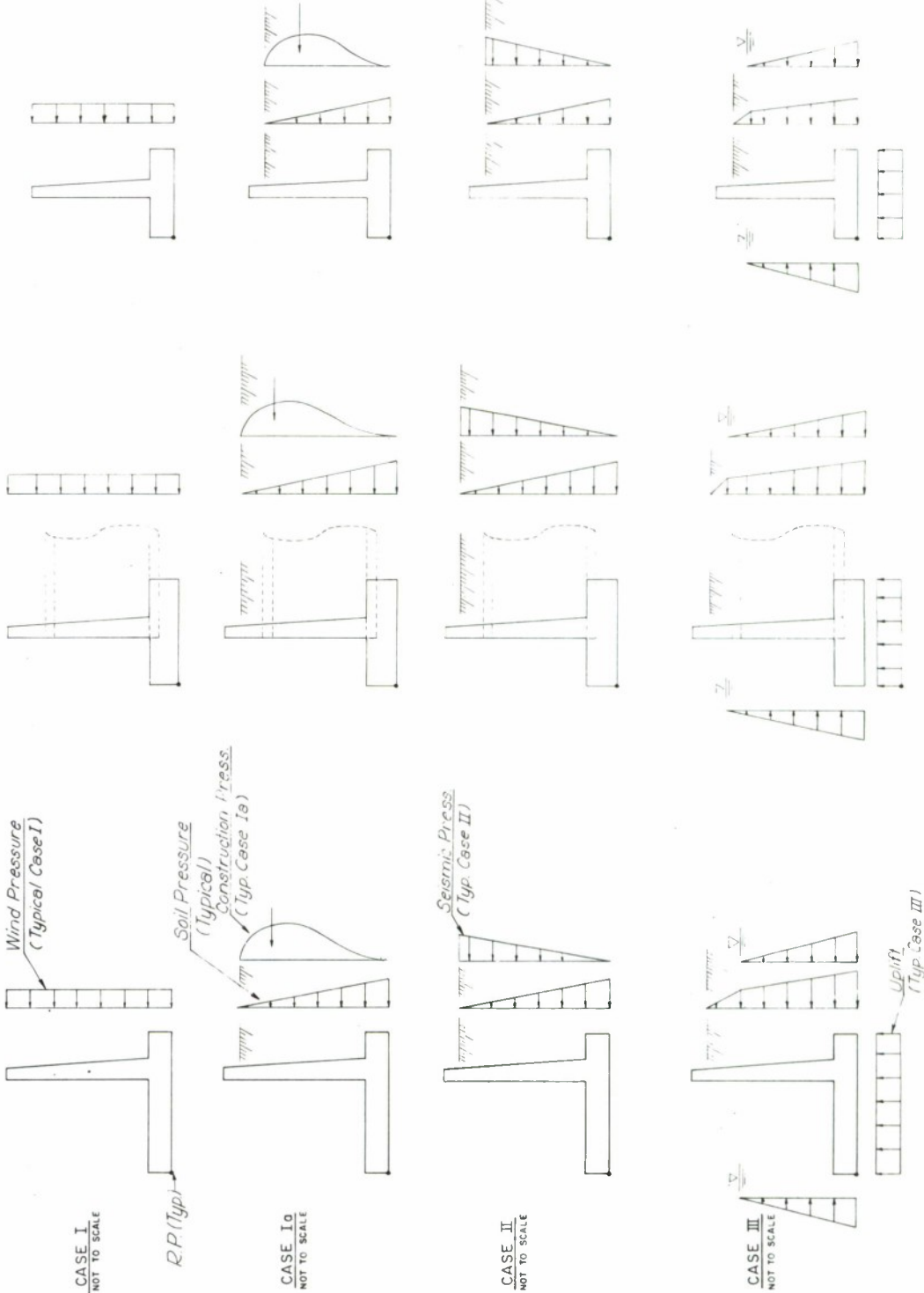






CENTER HEADWALL 6' DIA. PIPE CULVERTS
WING WALLS 8' DIA. PIPE CULVERTS

INTERTIE WALL



INTER TIE WALL							
CASE	ΣV (kips)	ΣH (kips)	ΣM (kip-ft)	$\bar{X}$ (ft)	$\frac{\Sigma H}{\Sigma V}$	PRESSURE IN KIPS/SQ. FT.	
						TOE	HEEL
I	6.08	0.42	40.25	6.62	0.07	Base Pressure	0.350 0.664
Ia	9.86	4.95	53.96	5.47	0.50	Base Pressure	1.039 0.604
II	9.86	5.65	51.24	5.2	0.57	Base Pressure	1.150 0.493
III	6.56	3.06	41.06	6.26	0.467	Base Pressure	0.477 0.618
						Uplift	0.616 1.234
						Total	1.093 1.234

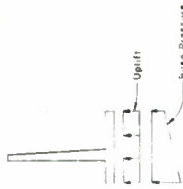
CENTER HEADWALL FOR 8' DIA. PIPE - CULVERTS							
CASE	ΣV (kips)	ΣH (kips)	ΣM (kip-ft)	$\bar{X}$ (ft)	$\frac{\Sigma H}{\Sigma V}$	PRESSURE IN KIPS/SQ. FT.	
						TOE	HEEL
I	229.71	15.72	970.34	4.22	0.07	Base Pressure	0.607 0.413
Ia	414.42	140.91	1,734.79	4.19	0.34	Base Pressure	1.115 0.728
II	414.42	209.74	1,170.44	2.82	0.51	Base Pressure	1.960 0
III	195.10	58.98	746.44	4.03	0.32	Base Pressure	0.540 0.284
							0.816 0.816
						Total	1.356 1.100

WING WALLS FOR 8' DIA. PIPE - CULVERTS							
CASE	ΣV (kips)	ΣH (kips)	ΣM (kip-ft)	$\bar{X}$ (ft)	$\frac{\Sigma H}{\Sigma V}$	PRESSURE IN KIPS/SQ. FT.	
						TOE	HEEL
I	4.22	0.36	14.24	3.37	0.085	Base Pressure	732 394
Ia	7.60	3.93	16.10	2.12	0.517	Base Pressure	2.390 0
II	7.60	4.22	16.25	2.14	0.56	Base Pressure	2.370 0
III	4.46	1.83	13.65	3.07	0.411	Base Pressure uplift	917 660
						Total	1.577 931

STABILITY LOADING CONDITIONS

NOTES:

- CASE I
- Channel empty
 - No backfill in place (and no 8' pipes in place for center headwall).
 - 30 p.s.f. wind load on exposed surface
 - 33 1/3 percent overstress permitted
 - 75 percent of base in compression
- CASE Ia
- Channel empty
 - Backfill in place (moist) (and 8' pipes in place for center headwall)
 - Surcharge load due to construction equipment (D4 Tractor only)
 - Wall loadings computed by Boussinesq equation.
 - Fifty percent overstress permitted
 - Resultant within middle half of base.
- CASE II
- Channel empty
 - Backfill in place (moist) (and 8' pipes in place for center headwall)
 - Seismic acceleration of 0.1g
 - 33 1/3 percent overstress permitted
 - Resultant within middle half of base
- CASE III
- Channel full to max. Water Surface elevation 299.2 (W.S. elev. 289.55 for center head-wall and wingwalls)
 - Backfill behind wall submerged to max. W.S. elevation and saturated above
 - 100 percent uplift
 - Normal working stresses
 - Resultant within middle third of base
- NOTES:
- The base pressures were calculated from the flexure formula
$$\frac{f}{A} = \frac{M}{I}$$
 - The unit weights of soil used for the stability analysis are as follows:
Dry 100 lb/ft³
Moist 120 lb/ft³
Saturated 125 lb/ft³
Submerged 63 lb/ft³
 - The total foundation pressure is equal to uplift pressure plus base pressure as shown in the following diagrams, and limited to 2.0 K/ft² dead load and 3.0 K/ft² dead + live load.
 - For the wingwall stability analysis the backfill partially covering the upstream face of the wingwall was neglected and the resultant was shifted to increase the stability and equalize base pressure.
 - $\frac{\Sigma H}{\Sigma V}$ limited to $\tan 30^\circ = 0.577$



LEGEND

- ΣV = Summation of Vertical Forces
 ΣH = Summation of Horizontal Forces
 ΣM = Summation of Moments About Reference Point
 $\bar{X}$ = Distance from Reference Point to Resultant
 $R.P.$ = Reference Point for Stability Analysis
 $\bar{X}$ = water Surface

KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA
INTERTIE STRUCTURE
STABILITY ANALYSIS

SURVEY NOTES: GRID COORDINATES ARE REFERRED TO CALIFORNIA COORDINATE SYSTEM ZONE II AND BASED ON STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES BMS 34 9600 ICA 4902. ALL ELEVATIONS ARE REFERRED TO SEA LEVEL DATUM OF 1929 AND BASED ON STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES BMS MILE ZERO ELEVATION 309.54. DATE OF SURVEY: 15 JANUARY 1970. CONTOUR INTERVAL IS TWO FEET. ORIGINAL SURVEY SHOWN ON DRAWING FILE NO. KE-19-7.

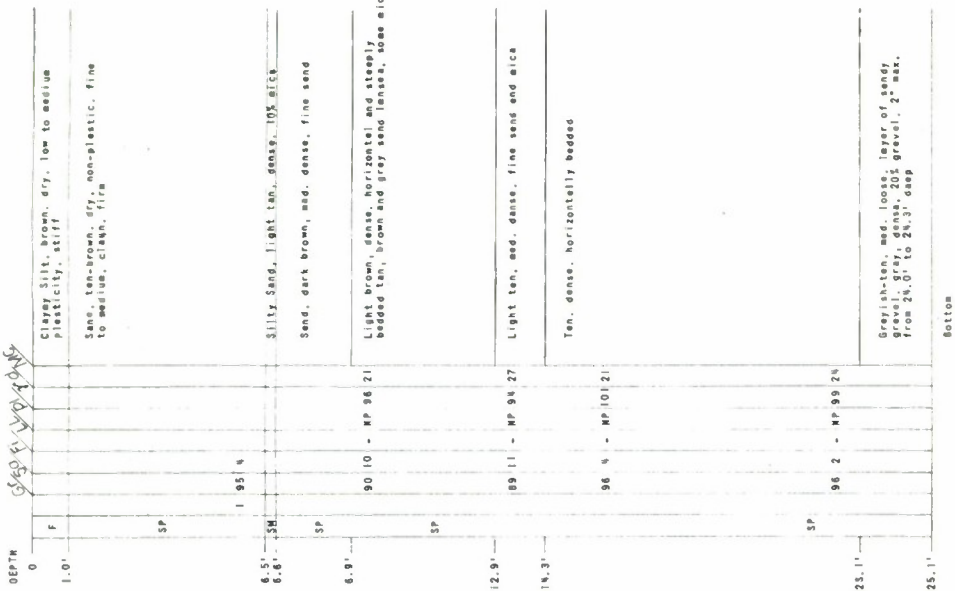
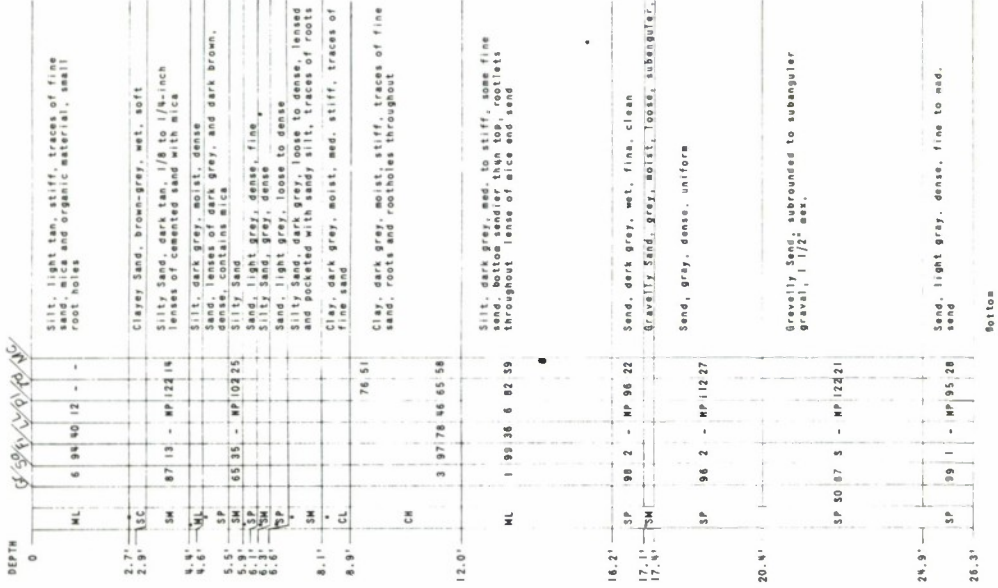


SAFETY PAYS

7F-71-3

7F-71-4

28-71-1



NOTES:

1. See sheet for other logs of borings.
2. General Notes and Legend see sheet

KERN RIVER - CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

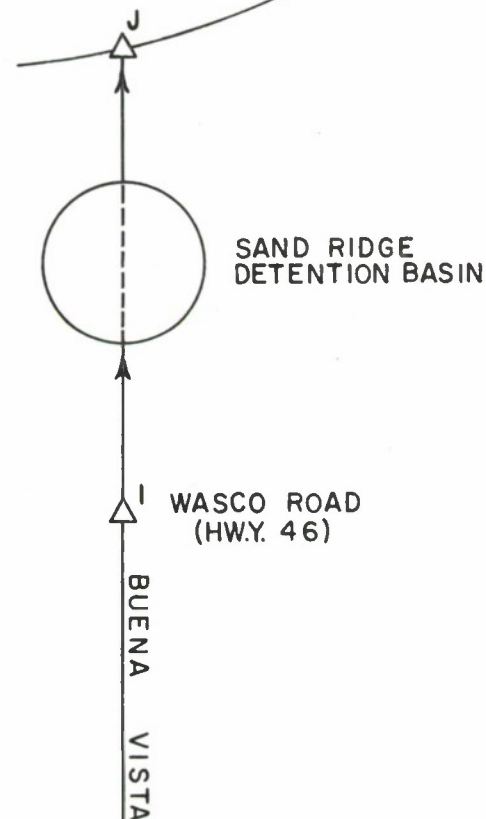
LOGS OF BORINGS

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

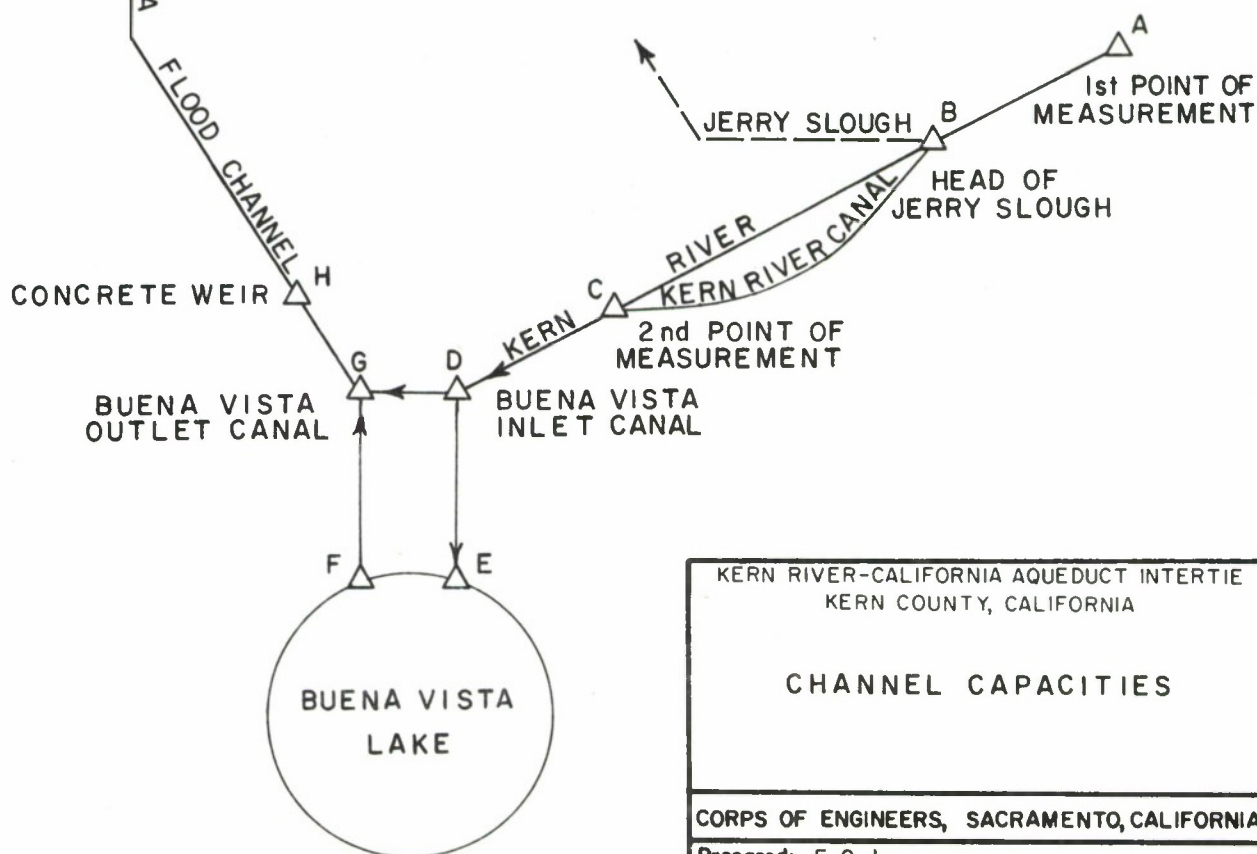
SCALE: 1" = 2' DATE: JULY 1972

FILE NO. KE 4-9 SHEET

TULARE LAKE



KERN RIVER CHANNEL CAPACITIES		
REACH	DESCRIPTION	FLOW (c.f.s.)
AB	1st Point to Head of Jerry Slough	8,000
BC	Head of Jerry Slough to 2nd Point	4,600
CD	2nd Point to Bueno Visto Inlet Canal	5,000
DE	Bueno Visto Inlet Canal	2,000
DH	Bueno Visto Inlet Canal to Concrete Weir	4,000
GF	Bueno Vista Outlet Canal	500
HI	Concrete Weir to Wasco Road (Hwy. 46)	3,000
IJ	Wasco Road to Tulore Lake	2,500



KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

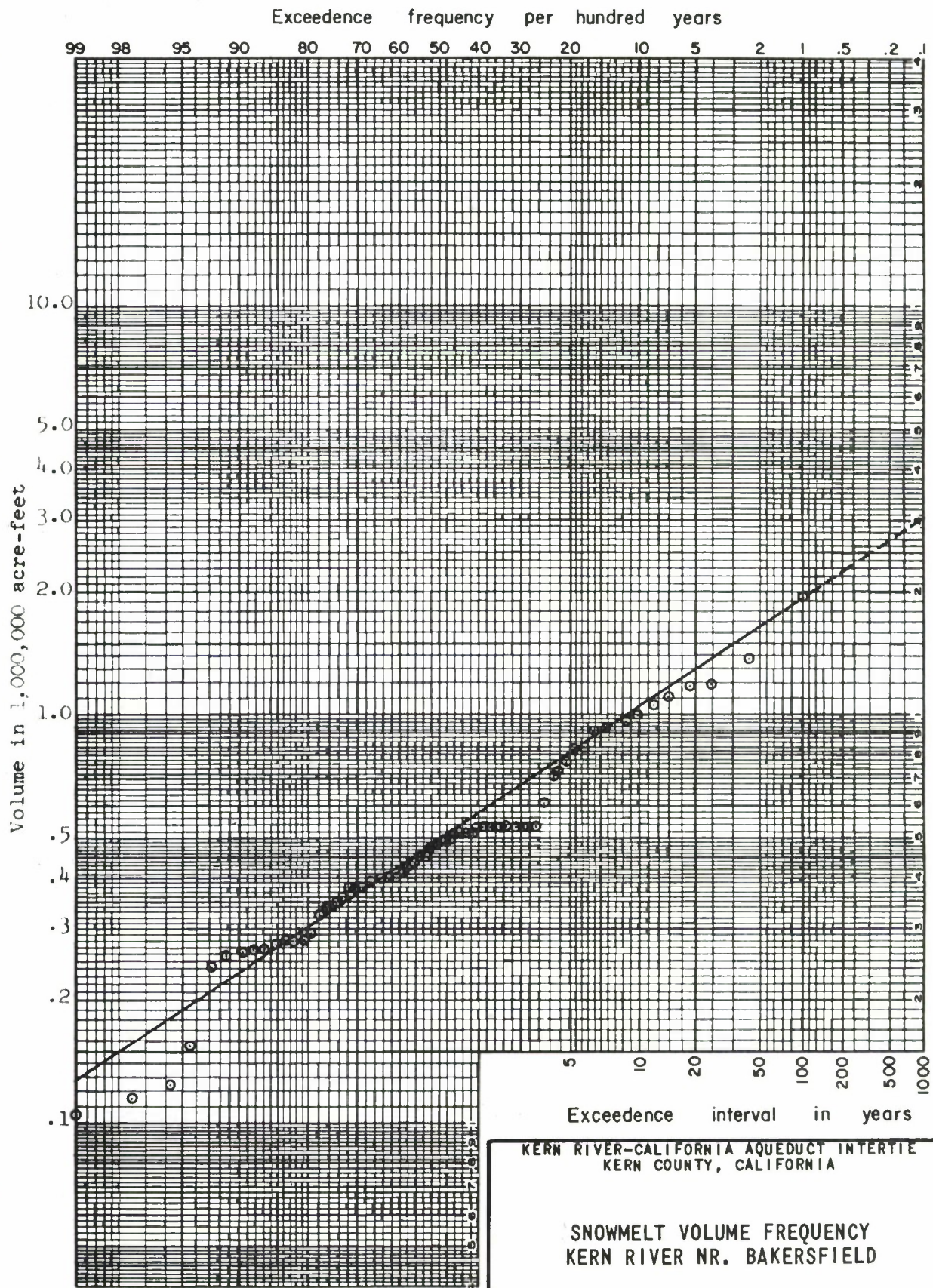
CHANNEL CAPACITIES

CORPS OF ENGINEERS, SACRAMENTO, CALIFORNIA

Prepared: E. G. J.

Date: August 1972

Drawn: D. J. E.



NOTE: Volume is total runoff
for March through September.

KERN RIVER-CALIFORNIA AQUEDUCT INTERTIE
KERN COUNTY, CALIFORNIA

SNOWMELT VOLUME FREQUENCY
KERN RIVER NR. BAKERSFIELD

Corps of Engineers, Sacramento, California

Prepared: E.G.J. Date: July 1972

DEPARTMENT OF WATER RESOURCES

P. O. BOX 388
SACRAMENTO 95802



JUN 19 1972

Colonel James C. Donovan
District Engineer
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Dear Colonel Donovan:

The State of California has an interest in the provision of flood control to regulate floodflows and prevent flood damages to the benefit of residents of the State. The purpose of this letter is to express state interest in one of the flood control projects being studied by the Corps of Engineers.

We are aware that the Corps is preparing a Detailed Project Report for a small flood control project, the Kern River-California Aqueduct Intertie in Kern County. The purpose of the intertie project would be to safely dispose of Kern River snowmelt floodflows by introducing these flows into the California Aqueduct.

We understand the tentative plan of improvement for the project consists essentially of a concrete-lined chute of 3,500 cubic feet per second capacity from the Kern River to the California Aqueduct, crossing the Buena Vista Outlet Canal on fill. Slide gates would be provided in the intertie structure and a sedimentation basin would be provided in the channel of the Kern River immediately upstream of the entrance to the intertie. Culverts with a capacity of about 900 cubic feet per second would be provided beneath the intertie chute to pass flows in the outlet channel from Buena Vista Lake.

We understand that the Kern County Water Agency intends to be the local sponsor for the project and has indicated to the Corps that it could provide the necessary assurances of local cooperation for the project.

JUN 19 1972

Our appraisal of aqueduct operation indicates that successful coordination of releases through the intertie could be achieved unless rare emergency conditions force cessation of aqueduct flows south of the intertie. Therefore, the State would be willing to accept water into the aqueduct when (a) snowmelt flood releases from Lake Isabella are scheduled in advance, (b) water can be used in the aqueduct system in accordance with our operation plans, (c) the aqueduct facilities planned for operation are not inoperable because of rare emergencies, and (d) the quality of water meets standards agreed to in advance by the Corps and the Department.

State participation in the project is also dependent upon execution of an agreement with local interests concerning water rights. We have submitted for review a draft of an agreement incorporating principles tentatively agreed upon with such interests.

The Department will provide the state portion of project costs of lands, easements, and rights-of-way shared with local interests.

We have carefully evaluated potential coordinated operation of the intertie project and the State Water Project and have determined that the intertie operation would not result in any net benefit or damage to the State, other than the flood control benefits claimed for the intertie project. Additional operation and maintenance costs to the State would offset the benefits that otherwise would accrue to municipal and industrial water supply and irrigation.

We hope that this letter satisfactorily expresses the State's interests in the Kern River-California Aqueduct Intertie project so that further studies can proceed. Official state comments on the proposed project must, of course, await review of the detailed project report.

Sincerely yours,

W. H. Gannell
Director

KERN COUNTY WATER AGENCY

1415 18th Street, Room 418

Bakersfield, California 93301

Directors:

Robert L. Smith	Division 1
J. Elliott Fox	Division 2
Jack G. Thomson	Division 3
President	
Floyd S. Cooley	Division 4
Gerald H. Komprath	Division 5
Henry C. Gornett	Division 6
Rodger G. Cole	Division 7



Telephone: 327-7973

William C. Bryant
Engineer-Manager

Edno M. Purvines
Secretary

August 8, 1972

File No. 9.2.2

James C. Donovan, Colonel, CE
District Engineer
Department of the Army
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Dear Colonel Donovan:

This will acknowledge your letter of July 27, relative to Kern County Water Agency's intent to provide assurances of local cooperation for the Kern River-California Aqueduct Intertie Project.

Reference is made to the May 10, 1971 letter from the Kern County Water Agency which expressed its intent to form an improvement district to sponsor the Kern River-California Aqueduct Intertie Project.

This letter acknowledges the increase in costs of the project which amounts to \$515,000 over the \$1 million limit under the Small Projects Act. In view of this increase in non-Federal costs, we wish to confirm the expression of intent as stated in our letter of May 10, 1971.

Yours very truly,

W.C. Bryant
W. C. Bryant
Engineer-Manager

WCB:ep

INCLOSURE 2



C O P Y

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
650 CAPITOL MALL
SACRAMENTO, CALIFORNIA 95814

SPKED-P

27 July 1972

Mr. W. C. Bryant
Engineer-Manager
Kern County Water Agency
1415 - 18th Street, Room 418
Bakersfield, California 93301

Dear Mr. Bryant:

Reference is made to our letter to you of 22 March 1971 and your reply of 10 May 1971 expressing Kern County Water Agency's intent to provide assurances of local cooperation for the Kern River-California Aqueduct Intertie project.

The U.S. Geological Survey recently conducted sedimentation studies on Kern River and evaluated intertie sedimentation basin performance. Results of these studies indicate that a substantially larger sedimentation basin than had previously been considered will be required to settle out Kern River bedload material.

At the 4 May 1972 public meeting in Bakersfield, Sacramento District representatives estimated the total project cost at about \$1,300,000, of which the non-Federal share would be \$300,000. The increase from the \$1,225,000 project cost presented in my letter of 22 March 1971 was due to additional preauthorization study cost and updating the cost estimate.

Enlargement of the sedimentation basin and associated costs have increased total project cost from \$1,300,000 to \$1,515,000. The required non-Federal share of project cost is currently estimated at \$515,000, which includes \$22,000 for lands, easements, rights-of-way and relocations.

INCLOSURE 3

C O P Y

SPKED-P

27 July 1972

Mr. W. C. Bryant

In view of the substantial increase in non-Federal cost, we need information as to whether or not the Kern County Water Agency wishes to confirm the expression of intent to furnish local cooperation requirements stated in your letter of 10 May 1971. If we receive such confirmation, we will complete our draft report and submit it to the Division Engineer.

Sincerely yours,

/s/ James C. Donovan
JAMES C. DONOVAN
Colonel, CE
District Engineer



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

Reference: RB

1500 N. E. IRVING STREET
P. O. BOX 3737
PORTLAND, OREGON 97208

Your reference:
SPKED-P
July 20, 1973

September 27, 1973

District Engineer
Sacramento District, Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Dear Sir:

We have reviewed your June 1973 draft report for the Kern River--California Aqueduct Intertie, Kern County, California, a proposed small flood control project. Our comments are provided under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The proposed project would involve construction of a 160 acre-foot settling basin and a 320-foot-long gated chute emptying into the California Aqueduct just north of State Highway 119. Only snowmelt floodflows would be diverted from the Kern River into the aqueduct. Operation of the intertie would occur once in 10 to 20 years. The primary project beneficiaries would be the owners of agricultural lands in the Tulare Lake Basin. Most of this land is held in a number of large ownerships.

The Kern River is intermittent in the project area, and no fishery exists. A warmwater fishery is present in the California Aqueduct; however, there is no fisherman access in the immediate project area.

Wildlife habitat in the immediate project vicinity consists of valley mesquite and some scattered riparian habitat along the channels. Construction of the project would have some adverse effects through removal of vegetation and deposition of spoil on stands of vegetation. Spoil areas should be chosen which have little woody cover. We are pleased to note that your project plans include the shaping and seeding of the spoil area.

Changes in the pattern of flooding could have a secondary adverse effect on the wildlife of the area. The banks and overflow lands of the various channels often provide the key areas of wildlife habitat and occasional flooding helps to maintain this habitat. The Kern River bypass channel, for instance, contains some of the best remaining mesquite habitat in the valley. It appears from your draft report that the existing system of channels in the area would not be directly affected by the proposed project. However, any conversion of these channels to intensive agricultural use as a result of the project would have an adverse effect on wildlife habitat. Valley mesquite habitat on other lands is expected to be lost to agricultural development either with or without the project as irrigation water becomes available.

We appreciate the opportunity to provide comments at this time. Please keep us informed of the progress of your project planning.

Sincerely yours,

A handwritten signature in cursive script, reading "R. Kahler Martinson". The signature is written in dark ink and is positioned above the typed name.

R. Kahler Martinson
Regional Director

KERN COUNTY WATER AGENCY

1415 18th Street, Room 418
Bakersfield, California 93301

Directors:

Robert L. Smith	Division 1
J. Elliott Fox	Division 2
Jack G. Thomson	Division 3
Floyd S. Cooley	Division 4
Gerald H. Komprath	Division 5
Henry C. Garnett	Division 6
President	
Rodger G. Cole	Division 7



Telephone: 327-7973

Stuart T. Pyle
Engineer-Manager

Edna M. Purvines
Secretary

September 13, 1973

File No. 9.2.2

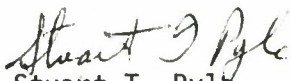
George C. Weddell, Chief
Engineering Division
Department of the Army
Sacramento District
Corps of Engineers
650 Capitol Mall
Sacramento, California 95814

Dear Sir:

We have reviewed the draft of the Detailed Project Report, dated June 1973. We find the report satisfactory, and we have no comments to offer.

The report is returned herewith, as you have requested.

Yours very truly,


Stuart T. Pyle
Engineer-Manager

xc: Mr. Stan Barnes
Mr. Arnold S. Rummelsburg

NORMAN B. LIVERMORE, JR.
SECRETARY

RONALD REAGAN
GOVERNOR OF
CALIFORNIA

OFFICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814

Department of Conservation
Department of Fish and Game
Department of Navigation and
Ocean Development
Department of Parks and Recreation
Department of Water Resources



Air Resources Board
Colorado River Board
San Francisco Bay Conservation and
Development Commission
Solid Waste Management Board
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards

THE RESOURCES AGENCY OF CALIFORNIA
SACRAMENTO, CALIFORNIA

JAN 28 1974

Colonel F. G. Rockwell, Jr.
District Engineer
Sacramento District
U. S. Army Corps of Engineers
650 Capitol Mall
Sacramento, CA 95814

Dear Colonel Rockwell:

The State has reviewed the "Draft Detailed Project Report on the Kern River Intertie, Kern County, California" which was transmitted by your letter of July 20, 1973. Also reviewed was the draft environmental statement on the Intertie which was transmitted to the Governor's Office, State Clearinghouse of the Office of Intergovernmental Management.

Participating in the review were the state agencies listed at the end of this letter. Following are the State's comments.

The report indicates that the proposed plan of improvement would divert floodwaters out of the basin. Since the southern San Joaquin Valley is a particularly water-deficient area, we believe it should be clearly indicated in both the report and the environmental statement that the plan would serve only as a safety valve to dispose of water which, on rare occasions, is in excess and becomes a liability. On such occasions, the flow introduced into the California Aqueduct would be largely utilized in the basin south of the Tehachapi Mountains in lieu of water which would otherwise have been diverted in the same amount from the Sacramento-San Joaquin Delta. The project would provide improved management of water resources.

The position of cooperation and support for the project as expressed in the Department of Water Resources' letter of June 19, 1972, to your office is reiterated. The Department is continuing to work with local agencies to reach agreement on water rights and expects that a satisfactory agreement can be developed.

INCLOSURE 6

The Kern River Bypass Channel area presently supports some of the most productive wildlife habitat in western Kern County. We understand that the project will not affect the need or use of the bypass. Any future change in the operation of the bypass as a direct or indirect result of the project should be critically evaluated.

It should be recognized in the statement that removal of floodwater from the lower Kern River system during high flow periods will have the effect of reducing the total acreage of valuable waterfowl habitat that has historically been created by floodflows. The project reduction of waterfowl botulism (discussed in the report and statement) would tend to offset such loss of habitat.

The report and statement indicate that approximately 460,000 cubic yards of material would be excavated from the channel in constructing the sedimentation basin. Sediments would be spoiled along existing levees and in backwater areas in the project area. Sediments removed from the basin during maintenance operations would also be spoiled in these areas. We believe that such deposition could be highly detrimental to wildlife habitat but that with proper selection of disposal sites such effects could be held to a minimum. Spoil area locations should be delineated in the project reports in order that the impact of the project on wildlife resources can be assessed. The reports should also discuss and recommend mitigation measures, if they are required.

According to the values set forth in the statement, the 1969 snowmelt flood of Tulare Lakebed was much more damaging, on an acreage-flooded basis, than the 1969 rain flood, but without further explanation the figures are misleading.

With regard to the Intertie structure, motor operators should be provided for the slide gates and a power supply provided during any discharge of floodwater into the California Aqueduct. This is mandatory to assure that contaminated flood water resulting from an emergency in or along the Kern River could be prevented from entering the California Aqueduct by rapid closing of the slide gates.

While potential earthquake damage and public safety do not seem to be significant factors for the type of structures being proposed, a brief description of the geology and the magnitude of the maximum credible earthquake should be included to present a full picture.

Colonel F. G. Rockwell, Jr.

-3-

Thank you for the opportunity to comment on this report and statement.

Sincerely yours,

N. B. LIVERMORE, JR.
Secretary for Resources

By Paul L. Clifton

cc: Mr. Mark Briggs
Director of Management Services
State Clearinghouse
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814
(SCH No. 73073071)

Air Resources Board
Department of Conservation
Department of Fish and Game
Department of Food and Agriculture
Department of Health
Department of Navigation and Ocean Development
Department of Parks and Recreation
Department of Transportation
Department of Water Resources
The Reclamation Board
State Lands Division
State Water Resources Control Board

TO: Defense Technical Information Center
ATTN: DTIC-O
8725 John J. Kingman Road, Suite 0944
Fort Belvoir VA 22060-6218

22 October 2008

FROM: US Army Corps of Engineers
Sacramento District Library
1325 J Street, Suite 820
Sacramento CA 95814-2292

SUBJECT: Submission of technical reports for inclusion in Technical Reports Database

The enclosed documents from USACE Sacramento District are hereby submitted for inclusion in DTIC's technical reports database. The following is a list of documents included in this shipment:

- ADB344304 • Lemon Reservoir Florida River, Colorado. Report on reservoir regulation for flood control, July 1974
- ADB344333 • Reconnaissance report Sacramento Metropolitan Area, California, February 1989
- ADB344346 • New Hogan Dam and Lake, Calaveras River, California. Water Control Manual Appendix III to Master Water Control Manual San Joaquin River Basin, California, July 1983
- ADB344307 • Special Flood Hazard Study Nephi, Utah, November 1998 (cataloged)
- ADB344344 • Special Study on the Lower American River, California, Prepared for US Bureau of Reclamation - Mid Pacific Region and California Dept. of Water Resources..., March 1987
- ADB344313 • Transcript of public meeting Caliente Creek stream group investigation, California, held by, the Kern County Water Agency in Lamont, California, 9 July 1979
- ADB344302 • Initial appraisal Sacramento River Flood control project (Glenn-Colusa), California, 10 February 1989
- ADB344485 • Report on November-December 1950 floods Sacramento-San Joaquin river basins, California and Truckee, Carson, and Walker rivers, California and Nevada, March 1951
- ADB344268 • Reexamination Little Dell Lake, Utah, February 1984
- ADB344197 • Special report fish and wildlife plan Sacramento River bank protection project, California, first phase, July 1979
- ADB344264 • Programmatic environmental impact statement/environmental impact report Sacramento River flood control system evaluation, phases II-V, May 1992
- ADB344201 • Hydrology office report Kern river, California, January 1979
- ADB344198 • Kern River - California aqueduct intertie, Kern county, California, environmental statement, February 1974
- ADB344213 • Sacramento river Chico Landing to Red Bluff, California, bank protection project, final environmental statement, January 1975
- ADB344265 • Cottonwood Creek, California, Information brochure on selected project plan, June 1982
- ADB344261 • Sacramento river flood control project Colusa Trough Drainage Canal, California, office report, March 1993
- ADB344343 • Detailed project report on Kern River-California aqueduct intertie, Kern County, California, February 1974

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- ADB344267 • Sacramento River Flood Control Project, California, Right Bank Yolo Bypass and Left Bank Cache Slough near Junction Yolo Bypass and Cache Slough, Levee construction, General Design, Supplement No. 1 to Design Memorandum #13, May 1986
 - ADB344246 • Redbank and Fancher Creeks, California, General Design Memorandum #1, February 1986
 - ADB344260 • Cache Creek Basin, California, Feasibility report and environmental statement for water resources development Lake and Yolo counties, California, February 1979
 - ADB344199 • Sacramento River Deep Water Ship channel, California, Feasibility report and environmental impact statement for navigation and related purposes, July 1980
 - ADB344263 • Sacramento River flood control project, California, Mid-Valley area, phase III, Design Memorandum, Vol. I or II, June 1986
 - ADB344262 • Marysville Lake, Yuba River, California, General Design Memorandum Phase I, Plan Formulation, Preliminary Report, Appendixes A-N, Design Memorandum #3, March 1977

The **distribution statement is A** approved for public release; distribution is unlimited.

The Sacramento District source code is **410637**. Please return any materials that aren't appropriate for the technical reports database.

Please acknowledge receipt of shipment by sending email message to Frances.J.Sweeney@usace.army.mil.

Thank you,

Frances J. Sweeney
Library Manager
USACE, Sacramento District Library
916-557-6660