COLORADO RIVER BASIN
SALINITY CONTROL PROJECTS
TITLE I DIVISION

COACHELLA CANAL UNIT

Definite Plan Report  June 1978

UNITED STATES DEPARTMENT OF THE INTERIOR

Bureau of Reclamation
COLORADO RIVER BASIN
SALINITY CONTROL PROJECTS
TITLE I DIVISION
COACHELLA CANAL UNIT

DEFINITE PLAN REPORT
JUNE 1978

R. Keith Higginson, Commissioner
Manuel Lopez, Jr., Regional Director, Lower Colorado Region
Bureau of Reclamation
As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources, and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.
SUMMARY SHEETS
Coachella Canal Unit

Location: Imperial County, California


Plan: Construction of a new concrete-lined canal, located generally adjacent and parallel to the initial 49 miles of the existing unlined Coachella Canal, will salvage approximately 132,000 acre-feet of water each year that are presently being lost by seepage.

This salvaged water will ultimately be needed to sustain agricultural needs in California. Until this need occurs, the saved water will be used to supplement or replace upstream Colorado River storage water that is currently being released to Mexico as part of our scheduled Treaty deliveries under Minute No. 242 to replace bypassed drainage waters.

The lined canal will be designed to accommodate a flow of 1,550 ft$^3$/s, a decrease from the capacity of 2,500 ft$^3$/s in the existing waterway.

The project will consist of 49 miles of new canal, lined with 3 inches of unreinforced concrete, together with appropriate irrigation turnouts, checks, drops, siphons, flumes, access roads and bridges.

Project Costs (Based on July 1977 Prices):

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<tr>
<td>Construction Cost</td>
<td>$49,764,000</td>
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<tr>
<td>Interest During Construction</td>
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<td>Total Investment Cost</td>
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<td>Total Annual Equivalent Cost Based On Amortization Period of 50 Years at 5-5/8 Percent Interest</td>
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Construction Period:
Approximately 4 Years

Allocation of Costs:

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<td>Total Construction Cost</td>
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<td>Less Nonreimbursable Fish and Wildlife Mitigation</td>
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<tr>
<td>and Nonreimbursable Land Acquisition Cost</td>
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<tr>
<td>Total Reimbursable Federal Investment Cost</td>
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Repayment of Costs:

Repayment of $43,640,000, without interest (based on July 1977 prices), will be made by the Coachella Valley County Water District within a 40-year period following completion of the project.

For an interim period as defined in Public Law 93-320, financial responsibility for these payments will be assumed by the United States in return for use of the salvaged water to help meet the commitment of Minute No. 242 and provide deliveries to Mexico to compensate for bypass of Wellton-Mohawk drain flows.

If it is assumed that the interim period will end about 1987, then the balance owed by Coachella Valley County Water District at that time would be $37,094,000, or an annual payment of $1,091,000 for the balance of the 40-year period.

Project Features:

Lined Canal
Reach 1A and 1B

<table>
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<tr>
<th>Feature</th>
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<tr>
<td>Maximum Capacity</td>
<td>1,550 ft³/s</td>
</tr>
<tr>
<td>Length Reach 1A</td>
<td>32.9 miles</td>
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<tr>
<td>Length Reach 1B</td>
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<tr>
<td>Concrete Thickness</td>
<td>3 inches</td>
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<td>Typical Top Width</td>
<td>59 feet</td>
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<tr>
<td>Typical Bottom Width</td>
<td>16 feet</td>
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<tr>
<td>Typical Depth</td>
<td>12 feet</td>
</tr>
<tr>
<td>Component</td>
<td>Number required</td>
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<tr>
<td>---------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Siphons</td>
<td>8</td>
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<tr>
<td>Parshall Flumes</td>
<td>2</td>
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<td>Checks</td>
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<td>Irrigation Turnouts</td>
<td>3</td>
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<td>Service Roads</td>
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<td>Powerlines</td>
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Definite Plan Report

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Bureau of Reclamation photo - P-212-300-4907 - Coachella Canal Unit
The initial 49 miles of the Coachella Canal traverse the coarse sandy soils of the Imperial East Mesa.
I. TRANSMITTAL AND SUMMARY

A. INTRODUCTION

This Definite Plan Report is a consolidation and updating of previous studies and plans for salvaging water presently lost by seepage occurring in the Coachella Canal. It is a supplement to, and an extension of, the Special Report of August 1973, Coachella Canal Lining. (6)

Water from the Coachella Canal is used almost exclusively for irrigation in the Coachella Valley located north of the Salton Sea in southern California.

The canal originates as a diversion from the All-American Canal at a turnout point near the Mexican Border and runs in a generally northwestern direction for a distance of 123 miles (see Frontispiece Map).

Shortly after the canal's completion in 1948 seepage losses developed as a result of the first 86 miles of the waterway's length being unlined. The problem was further complicated by the fact that the initial 49 miles traversed the coarse, sandy soils of the Imperial East Mesa where the most severe seepage occurred (see Photograph P-212-300-4907).

Studies have indicated that over a 16-year period (1955-1970) the average seepage loss in this 49-mile reach was 141,000 acre-feet per year or 28.3 percent of the total canal flow. (6)

Since California's water diversions are measured at Imperial Dam, it has been necessary to divert more water than is needed for farm use to compensate for this seepage loss. This, in part, has caused California's water use to exceed its apportioned 4.4 million acre-feet per year. Moreover, waters used in this manner are part of the entitlement for other Colorado River water using states. When these states begin using their full apportionments and California is limited to 4.4 million acre-feet per year, the possibility of water shortages to Coachella Valley water users will be greatly increased if the seepage is not alleviated.
The information and statistical data contained in this report constitute a comprehensive summary of the surveys, studies, and corrective measures that have been conducted on this subject to date. It also provides designs and estimates for alleviating the major portion of seepage in the Coachella Canal by replacing the initial 49-mile reach with a new concrete-lined canal that will run generally parallel to the existing waterway.

B. Authority for This Report
This report is prepared under the authority of the Federal Reclamation Laws (Act of June 17, 1902, 32 Stat. 388, and acts amendatory thereof or supplementary thereto), and Title I of Public Law 93-320, cited as the 93rd Congress H.R. 12165 dated June 24, 1974, (88 Stat. 266).

C. Scope
1. Previous Investigations and Reports. In the 30 years that the Coachella Canal has been in use, numerous tests, studies and surveys have been conducted to determine the effectiveness of the waterway and ascertain the approximate amount of water lost by seepage along its 123-mile length.

In addition to this, several official studies and reports have been published relative to the subject.

These documents are included in the list of reference sources at the end of this report.

2. Purpose. The purpose of this report is to present a definite plan for alleviating water losses in the existing Coachella Canal which includes construction of a new concrete-lined canal that will replace and parallel the initial 49-mile reach of the existing Coachella Canal.

3. The Salinity Problem. In 1961, the Mexican Government registered a protest to the sharply increased salinity of the Colorado River water delivered to Mexico. A major factor causing the increased salinity was the pumping of drainage water containing 6,000 milligrams per liter (mg/l) of total dissolved solids (TDS) from the subsoil of the Wellton-Mohawk Irrigation and Drainage District and
discharging the waters to the Colorado River. Consequently, this at times raised the level of salinity in treaty water delivered to Mexico.

Following several temporary solutions and years of discussions and negotiations between United States and Mexican officials, Minute No. 242 was approved by both governments in 1973 as the permanent solution to the salinity problem. Minute No. 242 restricts average annual salinity concentrations of treaty waters delivered to Mexico at the Northerly International Boundary to a level not to exceed 115 p/m ± 30 p/m TDS over the annual average concentration of Colorado River waters arriving at Imperial Dam.

The immediate and temporary solution to meet this requirement was to discharge approximately 215,000 acre-feet per year of saline drainage waters from the Wellton-Mohawk Irrigation and Drainage District to a point below Morelos Dam. This wasted water, then, was not considered as part of the Mexican Treaty allotment.

To compensate for the loss of this saline drainage water, Colorado River water must be released from upstream storage and delivered to Mexico in order to honor our treaty agreements and comply with the terms of Minute No. 242.

The continuing loss of this upstream storage even further aggravates the present overcommitment of Colorado River water. As the water supply becomes more critical in the Colorado River Basin, especially after the Central Arizona Project becomes operational, to continue to bypass the drainage flows would be an extravagant waste. In an effort to alleviate this problem, Congress in 1974, as part of Public Law 93-320, authorized construction of a desalting plant designed to treat the drainage water and recover most of it for use as treaty water deliveries to Mexico.

Public Law 93-320 further provides for lining the initial 49 miles of the Coachella Canal to recover a large portion of the water currently lost by seepage. The United States, during the interim period, is entitled to the use of this salvaged water to meet the requirements of the Minute.
4. Coachella Canal Water Losses and Salvage Potential. Major seepage in the Coachella Canal will be almost eliminated by lining the initial 49 miles. A new canal, lined with concrete, will be smaller and relatively impervious.

Present average seepage of 141,000 acre-feet per year is projected to be only 9,000 acre-feet per year after lining representing an annual salvage of 132,000 acre-feet.

5. Utilization of Salvaged Water. The water savings acquired by construction of a lined canal will, under provisions contained in Public Law 93-320, serve to help meet the commitment made to the Republic of Mexico under the terms of Minute No. 242 for an interim period as defined in Sec. 102.(a) of Public Law 93-320.

California's state allocation of 4.4 million acre-feet of Colorado River water per year is based on a March 9, 1964, Arizona v. California Supreme Court decree that limits California to 4.4 million acre-feet of Colorado River water in any year when only 7.5 million acre-feet of mainstream water are available for apportionment in the Lower Colorado River Basin to California, Nevada, and Arizona combined.

The restriction on California water usage has not been enforced because Nevada and Arizona have not yet completed planned constructions which, when completed, will allow utilization of their full allocations. Full operation of these projects is expected to occur by about 1987, at which time Colorado River water diverted to the Central Arizona Project will escalate the three state total to the full 7.5 million acre-feet per year.

Until this happens water salvaged from lining the Coachella Canal will be used to help fulfill the terms of Minute No. 242. During the interim period no repayment for Coachella Canal construction costs will be required from water users.

D. Plan of Development

1. Reduction of Seepage Losses. Present seepage from the canal is less than it was during the early years of operation. Rapid
infiltration into the dry desert soil was responsible for a large portion of the initial losses.

After the adjacent area was initially wetted, and the groundwater table had risen, the seepage seemed to stabilize somewhat. The amount of seepage is still excessive, however, and intolerable in this water-short area.

2. Acreage Reduction and IID Involvement. The initial 49 miles of the Coachella Canal are presently managed and controlled by the Imperial Irrigation District (IID) which provides irrigation water for the Imperial Valley from the All-American Canal. The District also serves a few farms on the Imperial East Mesa primarily with water from the Coachella Canal.

In 1948, when the Coachella Canal was first placed into service, it was estimated that the irrigation potential on the Imperial East Mesa would be approximately 6,500 acres.

Only about 500 acres of this land have been developed to date, with another 500 acres under partial cultivation.

An important factor in the relatively poor agricultural history of the area was the 1965 directive issued by the Secretary of the Interior that precludes issuance of rights-of-way for irrigation conveyance systems that would allow transportation of Colorado River water across Federal lands thereby increasing the requirement for use of Colorado River water. This ruling has, predictably, restricted agriculture to lands bordering the Coachella Canal. Nevertheless, there are about 4,200 acres of private land on the Imperial East Mesa within the IID service area that may be suitable for development.

In an effort to conserve water and simultaneously reduce the unrewarding commitment by the IID, Congress, in a provision contained in the law authorizing the project (Public Law 93-320), approved purchase of lands adjacent to the Coachella Canal with the IID on a nonreimbursable basis, thereby relieving the District of responsibility to provide service.

When purchase of lands for acreage retirement is complete, the commitment to agriculture adjacent to the Coachella Canal will not
exceed 2,000 acres. This reduced irrigation commitment and the reduced seepage make it possible to scale down the size of the new lined channel from the present 2,500 ft³/s to 1,550 ft³/s, with a corresponding savings in construction cost.

Since the problems that accompany operation and maintenance of a 49-mile portion of the canal would far exceed the benefits derived from sale of irrigation water to a relatively small area, Public Law 93-320 further authorized the Secretary to allow IID credit against its final payments because of the loss of capacity that will be relinquished in the Coachella Canal as a result of the lining project.

Upon completion of the lining project it is expected that the operation of the initial 49-mile reach will pass to the Coachella Valley County Water District (CVCWD) which presently operates and maintains the remainder of the canal.

3. Fish and Wildlife Mitigation. The marked reduction in greenbelt areas and seepage ponds that will occur as a result of construction of a concrete-lined canal will have a serious impact on area wildlife.

To determine the extent of the impact to native habitat and recommend appropriate mitigation measures, an Ad Hoc Committee comprised of Fish and Wildlife officials from Federal and State agencies as well as Bureau of Reclamation personnel was formed.

Nine proposals that were advanced by this committee concerning mitigating measures in conjunction with the Coachella Canal project were subsequently reduced to five.

Implementation of the five measures which are considered to represent a reasonable amount and kind of mitigation will require an expenditure of $3,579,000. This amount is a considerable increase over the amount originally conceived prior to enactment of Public Law 93-320. It has been necessary, therefore, to request additional funding through amendment of the legislation, which Congress will consider in early 1979.
Details of these mitigation measures, together with a breakdown of the cost of each measure, are contained in Chapters V and VI in this report.

E. Project Features

1. New Lined Canal. A comprehensive review of the studies and alternatives presented to date has indicated that the most effective and economical plan for reducing seepage in the Coachella Canal is the construction of a new concrete-lined channel to run generally parallel with the existing canal.

The new canal will be constructed to the East of the present alignment and will extend from the turnout on the All-American Canal to Milepost 49 where it will rejoin the present canal just upstream from the present Siphon No. 7.

2. Water Measurement. The measurement of flow quantities will be accomplished by two Parshall flumes, one at each end of the new canal. Water quantities will also be measured at each turnout and wildlife watering device.

   a. New Structures. The new lined canal will require construction of five new checks and four new check drop structures.

   Water will be routed under existing washes by means of six inverted siphons. Two additional siphons will be necessary to divert water under Highway 78 and the Southern Pacific Railroad Bridge. Three irrigation turnouts will be constructed along the new alignment.

   An operating road 20 feet wide with a 4-inch gravel surfacing will be constructed along the southwest side of the new canal. A 16-foot wide unsurfaced roadway will be built along the northeast side. Fencing will be installed for security as needed.

   b. Utilization of Existing Structures. The Coachella Canal Turnout Structure from the All-American Canal will be used without modification.

   Other features of the existing canal that can be retained include the railroad bridge located at Station 2210+27, Siphon No. 7,
and flood protective works built in conjunction with the original canal.

c. Structures to be Abandoned. The unlined portion of the Coachella Canal, together with irrigation turnouts, drop structures, siphons, and other unsalvageable components will be either abandoned or buried, in the event they constitute a safety hazard.

4. Alternative Plans. The present plan was adopted after consideration of a variety of alternatives.

These include:

(a) Lining the present canal with concrete.

(b) Construction of a new canal returning to the present alignment to utilize existing features.

(c) Lining existing canal with butyl rubber, compacted earth, or chemical soil sealants.

(d) Foregoing new construction and building a series of seepage recovery wells adjacent to the present alignment.

(e) Combination of the above proposals.

(f) No project alternative.

A more comprehensive explanation of the plans described above, together with the reasons for their elimination, is outlined in Section IV. E of this report.

F. Operation, Maintenance, and Replacement

A reduction in operation and maintenance costs will be realized as a result of the canal lining project.

Savings will develop from the following features:

1. Decreased Cost of Weed Control. Weed control along the banks of the existing canal has necessitated a vigorous weed control program. This program has the dual purpose of limiting the non-beneficial use of water by plants along the canal banks, and eliminating cover for burrowing rodents that cause leaks that can ultimately result in major damage to the waterway.
With completion of the lining project a significant savings should be acquired through a reduction of expenditures presently required for spraying, chaining, and burning operations.

2. Elimination of Canal Bank Sloughing. The lined canal will eliminate problems involving collapse of canal banks and erosion of the canal bottom below structures.

3. Water Quality Improvement. With bank stability and elimination of erosion problems the concentration of sand, silt, and clay materials suspended in irrigation waters will decrease.

Reduction in plant detritus from phreatophytes will also decrease the quantity of floating material that presently exists.

4. Cost Breakdown of O&M Benefits. Operation and maintenance costs for the initial 49 miles of the Coachella Canal presently amount to about $100,000 each year. Under the existing arrangement 60 percent of this cost is assumed by the CVCWD. The remaining 40 percent is paid by the IID.

It is estimated that the canal lining project will result in an O&M cost saving of approximately $44,000 a year. However, since the CVCWD is scheduled to assume jurisdiction over that portion of the canal presently operated by the IID (see Section I.D.2 of this report) its share of maintenance costs after construction will be 100 percent instead of the 60 percent it currently pays.

On this basis there would be an overall cost reduction, but the CVCWD would not benefit appreciably from the $44,000 a year saving generated by the canal lining project.

The present and future cost breakdown is as follows:

<table>
<thead>
<tr>
<th>Present O&amp;M Costs</th>
<th>Future O&amp;M Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid by CVCWD</td>
<td>$ 60,000</td>
</tr>
<tr>
<td>Paid by IID</td>
<td>$ 40,000</td>
</tr>
<tr>
<td>Total</td>
<td>$100,000/year</td>
</tr>
</tbody>
</table>

Total Reduc tion in O&M Costs $44,000/year

* Total amount to be paid by CVCWD
G. **Repayment Contract**

The total construction cost of $49,764,000 includes the sum of $3,579,000 for fish and wildlife mitigation and $2,545,000 for land acquisition costs.

The proposed amendatory legislation stipulates that these costs will be nonreimbursable. Accordingly, with passage of the proposed amendatory legislation, the $6,124,000 expended for these items would be deducted from the sum to be repaid by water users.

Repayment of $43,640,000 without interest will be made by the Federal Government or the Coachella Valley County Water District over a 40-year period following completion of the project depending on each agency's use of the salvaged water.

In accordance with provisions contained in Public Law 93-320, and explained earlier in this report, financial responsibility for these payments will initially be assumed by the United States, in return for the use of Colorado River water delivered to Mexico to compensate for the loss of bypassed Wellton-Mohawk drainage flows. If it is assumed that this arrangement will terminate following completion of the Central Arizona Project, or about 6 years after the lined canal becomes operative, then in 1987, for instance, the balance to be assumed by CVCWD would be $37,094,000, or an annual payment of $1,091,000 for the remaining 34 years of a 40-year repayment period.

H. **Environmental Analysis**

A complete environmental analysis is contained in the "Environmental Statement," (1) and in a report on "Recommendations for Fish and Wildlife Mitigation Measures." (5)

The major unavoidable adverse effects of the project are relative to the loss of currently available water provided by extensive seepage from the existing canal.

Under the Fish and Wildlife Service's "Ecological Planning and Evaluation Procedures," values of fish and wildlife habitat can be defined and expressed in "Habitat Units" (HU).

Total losses estimated to be incurred by the project are valued at 12,167 HU (10,149 HU for wildlife habitat and 2,018 HU for aquatic habitat).
Several measures were developed by an interdisciplinary Ad Hoc Committee and agreed upon by State and Federal fish and wildlife agencies as reasonable amounts and types of mitigation for adverse impacts to fish and wildlife.

The total recommended mitigation replacement was 8,345 habitat units, or 68.5 percent of the estimated habitat losses. Cost for these mitigation features is $3,579,000; amendatory legislation is required to fully implement and fund these mitigation features.

I. Cooperation and Acknowledgments

The informational data contained in this report have been secured through cooperation with numerous individuals and agencies in the private sector as well as various branches of Federal, State, and local governments.

Among those government agencies that made significant contributions were: the U.S. Department of Agriculture, Soil Conservation Service; the U.S. Fish and Wildlife Service; the Bureau of Land Management; the California Department of Fish and Game; the Environmental Protection Agency; the Arizona Game and Fish Department; the Bureau of the Census; the Corps of Engineers; the National Park Service; the U.S. Weather Bureau; and the California Department of Parks and Recreation.

Grateful acknowledgment is also extended to contributing officials of the Coachella Valley County Water District, the Imperial Irrigation District, the University of California, Riverside, the Chamber's of Commerce at Indio and Coachella, and the Wellton-Mohawk Irrigation and Drainage District.
II. GENERAL DISCUSSION

A. General Description of the Project Area

1. Location. The Coachella Canal is located in the extreme southeast corner of California. It emanates at a turnoff from the All-American Canal a half mile north of the Mexican Border and runs in a northwesterly direction for 123 miles. The canal is used exclusively for irrigation and services some of the most productive agricultural acreage in the country.

The canal primarily carries irrigation water for the Coachella Valley, an agricultural area consisting of about 67,000 acres in irrigation rotation located in Riverside County between the San Bernardino Mountains and the Peninsular Range. It also serves some acreage on the Imperial East Mesa, a sparsely settled area east of the Imperial Valley and separated from the Coachella Valley by the Salton Sea.

Since the project area involves only the initial 49 miles of the canal's length, this report will deal only superficially with the Coachella Valley and concentrate primarily on that section where actual construction will occur.

The 49-mile reach where the new canal will be built encompasses an area extending from the All-American Canal to a point approximately 10 miles east of the southeast shoreline of the Salton Sea. Milepost 49 which represents the final terminus of the lining project is the site of Siphon No. 7 (see Frontispiece map).

2. Physiography. The initial 49 miles of the canal will be constructed across the Imperial East Mesa generally parallel with the existing waterway to a point located at the western edge of the Chocolate Mountains.

The first 37 miles borders a range of sand hills on the east side of the canal alignment.

The Imperial East Mesa is generally level, consisting of sandy soil of substantial depth and permeability interspersed with silt, clay, or gravel layers.
The northernmost 12 miles of the project are flanked by the Chocolate Mountains and consist primarily of relatively stable fan deposits of alluvial material washed down from the slopes.

The first 49 miles of the existing canal lie across a high risk seismic zone which crosses known or projected faults in six separate areas. A summary of these areas, together with their location, is contained in the Geology Report of the "Final Environmental Statement Colorado River Basin Salinity Control Project, Title I, hereafter referred to as the "Final Environmental Statement." (1)

Elevation of the project area and vicinity ranges from about 160 feet above sea level at the base of the sand hills to 50 feet below mean sea level at the north end of the East Highline Canal.

3. Climate. The climate in the project area is a generally arid, hot desert environment primarily due to the fact that the Peninsular Range intercepts most of the moisture from air moving inland from the Pacific Ocean.

Summers are long and hot with frequent daytime temperatures over 100 degrees. Winters are relatively mild with virtually no snow and only occasional temperatures slightly below freezing. Annual rainfall averages only 3.4 inches, much of which occurs in the form of violent local thunderstorms.

Strong winds from the west and northwest generally occur in the spring. During the summer winds are generally of low velocity and are from the southeast.

4. Vegetation. Unlike the verdant acreage that borders the canal in the upper reaches of the Coachella Valley, the portion of the waterway that crosses the Imperial East Mesa contains relatively sparse vegetation.

The aerial views shown in Photographs P-212-300-4908 and P-998-300-01017 are indicative of the type of terrain adjacent to the initial reaches of the canal.

The desert shrub community represents the most prevalent form of vegetation in the area and comprises 93 percent of the total biological inventory. (1)
Rising elevation of ground water generated by seepage from the canal has also created some dense stands of riparian vegetation on the banks of the canal and in low lying areas to the west of the existing canal.

About 500 acres of citrus, watered by trickle irrigation, presently occupy the project area. An additional 500 acres are currently being prepared for cultivation.

Noncontinuous narrow strips of vegetation averaging about 2 to 3 feet in width grow along the entire length of each bank of the Coachella Canal just above the high water mark (Photograph P-212-300-4804). In some reaches, where considerable sloughing of the canal bank occurs, there is no bank line vegetation. The larger concentrations of hydrophytes and phreatophytes along the bank line are controlled by periodic herbicidal spraying.

Some other vegetation is removed during regular operation and maintenance activities along the canal.

5. Fish and Wildlife. A large variety of fish, amphibians, reptiles, birds, mammals, and insects can be found in the area covered by this report.

A complete inventory of wildlife observations over an extended period is contained in the Final Environmental Statement.

6. Population. Population in the immediate project area is limited to a few citrus growers, squatters, and occasional trailer occupants. Specific population figures are unavailable, but population on lands adjacent to the initial 49-mile reach of the Coachella Canal can safely be estimated to number less than 100 persons.

The Lower Coachella Valley, serviced by the canal's upper reaches is demographically rural. Indio's 1972 population was reported at 19,000. The city of Coachella's population was 9,000. Other Lower Valley communities are unincorporated and include Thermal and Mecca.

The closest urban developments to the immediate project area are Niland, population 1,200, located 5 miles west of station 2450+00 on the new canal alignment; Calipatria, population 1,800, located 16 miles
west of station 1,990+00; Brawley, population 13,000, located 20 miles west of station 1,250+00; and Holtville, population 2,500, located 23 miles west of station 400+00. Yuma, population 28,800, is about 20 miles east of the Coachella Canal turnout from the All-American Canal.

7. Services and Economy. Both Indio and Coachella have police and fire departments, recreational facilities, a library, and schools. Indio has two general hospitals. A junior college is located at nearby Palm Desert.

The area's economic base is agriculture which is oriented toward specialized crops.

Off-season vegetables, table grapes, citrus fruits, and dates account for about 75 percent of the acreage. Other crops include cotton, alfalfa, and a variety of other produce. Typical views are shown in Photographs P-212-300-10351 and P-212-300-4801.

More than a dozen manufacturing plants in the Indio-Coachella area employ approximately 700 people. These plants primarily produce construction materials.

Retail and service industries have been growing in recent years with increasing opportunities for clerical, sales, and service workers, particularly during the tourist season.

B. History of Studies and Events

Since the early 1920's agriculture in the Coachella Valley has evolved, to a large degree, through cultivation of specialized crops.

By the late 1930's 90 percent of America's domestic date production and 80 percent of the early table grapes were produced in this area. During this period of the Valley's history all crop irrigation was accomplished by pumping water from underground storage.

Despite an ideal combination of soil and climate, agriculture during these early years failed to materially increase. In 1937 all agriculture in the Valley occupied 15,273 acres. By 1945 that figure had only been increased to 18,937 acres. (2)

The problem involved a rapidly dwindling supply of ground water, complicated by the fact that the area received only about three inches of rain each year.
Plans to alleviate the condition had been formulated as part of the Boulder Canyon Act of 1928 which provided, among other things, for construction of a canal for the purpose of diverting Colorado River water to the Coachella Valley and Imperial East Mesa.

Construction of the Coachella Canal began in 1938, but work was halted in 1942 at Mile 86 by a shortage of manpower and materials induced by World War II. (2)

Construction resumed again in 1944 and the final 37 miles of the project were completed and opened to users in 1948. The final 37 miles, unlike the initial 86-mile reach, were lined with reinforced concrete.

In accordance with previously developed contracts the operation and maintenance of the canal were then turned over to the Coachella Valley County Water District and the Imperial Irrigation District.

Rapid agricultural development in the Coachella Valley followed. A distribution system designed to serve 74,800 acres within the CVCWD was completed in 1954, and by 1973 65,802 acres of the Coachella Valley were cultivated.

During this period concern over seepage losses in the initial 86 miles of the canal's length became more and more evident.

Between 1948 and 1962 several studies were conducted in an attempt to quantify the loss and suggest and develop remedial measures. (7)

In 1962 an investigation titled the "All-American Canal Water Salvage Investigation - Coachella Division" was authorized. (11)

The purpose of that investigation was to determine the amount of water that could be salvaged by reduction of canal losses and evaluate the economics of a salvage program.

Completion of the report was delayed pending resolution of certain legal and institutional problems, the details of which are summarized in Chapter III.

In August 1973 a Bureau of Reclamation Special Report titled "Coachella Canal Lining," hereafter referred to as the "1973 Special Report" was published. (6)
The 1973 Special Report, on the basis of various investigations and studies, identifies and quantifies the seepage losses that occur in the Coachella Canal and outlines designs and estimates for lining the initial 49 miles of the waterway where the preponderance of seepage losses occur.

C. Changes Since the 1973 Special Report

The methods and procedures outlined in the 1973 Special Report are for the most part consistent with that portion of the text of Public Law 93-320 which, in 1974, authorized lining the initial 49 miles of the Coachella Canal.

However, since passage of the Congressional legislation authorizing the project, certain problems and events have occurred that necessitate an update of some of the proposals contained in the original report.

A summary of the required changes follows.

1. Modification of Canal Alinement. The original proposal called for construction of a new lined canal running generally parallel with the existing waterway, but returning to the present alinement at inverted siphons and other structures that would be costly to replace.

In 1975 the CVCWD requested that Reclamation reevaluate the plan to utilize the existing siphons. This review identified several advantages that would be realized by constructing new siphons in lieu of using the existing devices. With the gradient independent of existing structures, excavation quantities could be reduced with a corresponding reduction in total cost. This would partially offset the cost of new structures. The hydraulics of the canal would also be substantially improved, therefore, less "lead time" is required in changing the rate of flow. Furthermore, by constructing new siphons, only one water outage would be required during construction. Under the original plan there were seven structures that would require water outages during construction of the canal replacement. Each required water outage could necessitate a minimum of 3 weeks to
allow for canal rundown and dry up, performance of earth and concrete work at each tie-in, and for refilling of the canal unless temporary bypass facilities were constructed. Since irrigation of farmlands within the District is performed year-round, water outages of this duration would cause some crop damage.

In addition to this, some of the existing siphons are undersize with respect to floodflows passing over them. This has resulted in washouts occurring at siphon inlet or outlet transitions on several occasions. Construction of new siphons will eliminate this hazard. The Water District has since expressed its desire to enter into a repayment contract for construction of the canal with new siphons.

2. Land Acquisitions - Imperial East Mesa. Original planning in the 1973 report called for 1,700 acres of additional rights-of-way. Five hundred acres of this land involved patented tracts and the remaining 1,200 acres were located on withdrawn public lands.

Revised estimates due to canal alignment relocation now require the acquisition of additional land from private individuals.

The amended planning is based on long-term projections developed as a result of the token use to date of Coachella Canal water by users on the Imperial East Mesa, plus plans to buy the lands and retire them from service.

IID has a current obligation to serve certain non-Federal lands on the Imperial East Mesa lying within the District. There are about 6,500 acres of land in this category with approximately 40 percent of that acreage located some distance from the Coachella Canal. This distant land cannot be served due to the present restriction against crossing Federal lands with water conveyance facilities for delivery of irrigation water, thereby further increasing the use of Colorado River water. Regulations issued by the Secretary on February 24, 1965, (43 CFR, 2871.0-8) preclude issuance of right-of-way for such purposes. However, approximately 4,200 acres of the private lands on the East Mesa are located adjacent to the canal and could qualify for receiving water from the District. Title I of the authorizing Act provides that these lands may be purchased by the United States on
a nonreimbursable basis thus relieving the District of the responsibil-
ity to provide irrigation service. Acquisition of these lands is pre-
ently underway. It is anticipated that following Federal acquisition,
not more than 2,000 acres of developed lands will be irrigated from
the lined canal pursuant to pending agreements between CVCWD and
IID providing service to these lands.

3. Reduction in Size of Lined Canal. The existing canal with
a capacity of 2,500 ft$^3$/s was designed and constructed with the
intent of providing irrigation to 8,500 acres of land located on the
Imperial East Mesa. A typical view of the existing (unlined) canal is
shown in Photograph P-212-300-12242.

Land acquisitions and irrigation restrictions will preclude the
need for water for all but a small portion of that area. Additionally,
the lined canal will eliminate nearly all of the seepage presently
encountered with the unlined canal.

Accordingly, the new canal is designed for a maximum flow of
1,550 ft$^3$/s.

estimate of $300,000 for wildlife mitigation. Indexed to July 1977
prices this figure would be escalated to $446,000.

In 1975 after the enactment of Public Law 93-320 and in accord-
ance with provisions contained in the Fish and Wildlife Coordination
Act of 1958 (Public Law 85-624) mitigation concepts relative to all
Title I projects were formulated by Fish and Wildlife Ad Hoc Committees.

A total of nine Coachella Canal mitigation features was submitted
by this committee for consideration.

These proposals have been analyzed and reviewed by a
Reclamation task force. After consideration of all available data and
information a total of five proposals has been selected as offering a
reasonable degree of fish and wildlife mitigation.

A tabulation of the selected proposals together with their esti-
mated costs is as follows:
Features                                                                 |
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Windmills and Select Habitat</td>
</tr>
<tr>
<td>Finney Lake Restoration</td>
</tr>
<tr>
<td>Land Acquisition and Development - Salton</td>
</tr>
<tr>
<td>Sea National Wildlife Refuge - Tracts 10 and 12</td>
</tr>
<tr>
<td>Land Acquisition - Isolated Parcels</td>
</tr>
<tr>
<td>Land Acquisition and Development - Wister Habitat Area</td>
</tr>
<tr>
<td>Total Estimated Cost</td>
</tr>
</tbody>
</table>

Additional information concerning the mitigation items outlined above is contained in Chapters V and VI of this report.

D. Need for Additional Funding

The changes and modifications outlined above, plus cost indexing of the originally authorized funds for lining of the Coachella Canal, have necessitated additional funding.

A total of $21,450,000 was included in the original authorization for construction of a new concrete-lined canal. Cost indexing this figure to July 1977 prices adds an additional $11,191,000 for a modified authorized ceiling of $32,641,000.

Other changes have further increased the estimated construction cost. These changes include $12,317,000 for construction of new siphons in lieu of existing siphons as originally envisioned, and refinement of April 1973 estimated material quantities. An additional $1,673,000 will be needed due to approved land appraisals in excess of original estimates. Also $3,133,000 is needed for additional fish and wildlife mitigation measures recommended by the Ad Hoc Committee as explained in Paragraph C.4 (above).

The total of these changes amounts to $17,123,000 which escalates the estimated construction cost to $49,764,000 based on July 1977 prices.
Table 1 below itemizes the cost of these changes.

**TABLE 1**

**INCREASED COST OF COACHELLA CANAL LINING**

<table>
<thead>
<tr>
<th>Coachella Valley Unit</th>
<th>Unit: $1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
<td><strong>Authorized Amount P.L. 93-320</strong></td>
</tr>
<tr>
<td>Coachella Canal Replacement</td>
<td>20,400</td>
</tr>
<tr>
<td>Fish and Wildlife Mitigation</td>
<td>300</td>
</tr>
<tr>
<td>Land Acquisition Imperial East Mes:</td>
<td>750</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>21,450</td>
</tr>
</tbody>
</table>

* Based on 1973 prices.

It will be necessary, prior to construction, to secure Congressional authorization for the additional $17,123,000 noted above.

The additional funding for fish and wildlife mitigation, together with costs for previously unanticipated land acquisitions, is recommended to be nonreimbursable.

Funding of additional reimbursable features for the Coachella Canal will be added to the original project construction cost ceiling and repaid by water users.

Amendatory legislation proposals for Public Law 93-320 have been submitted to accommodate the needed changes.

Cost breakdown for the project in terms of reimbursable and nonreimbursable costs is shown in Table 2.
Bureau of Reclamation photo - P-212-300-4908 NA - Coachella Canal Unit
View of the Coachella Canal looking southeast. Note sand hills at upper left portion of photo.
View of the unlined portion of the Coachella Canal showing vegetative growth in seepage areas.
Narrow strips of vegetation about 2 to 3 feet in width grow along the entire length of the existing canal just above the high water mark.
Bureau of Reclamation photo - P-212-300-10351 - Coachella Canal Unit
Agriculture, oriented toward specialized crops, represents the economic base in the Coachella Valley.
Unlike the sparse vegetation that borders the canal on the Imperial East Mesa, the upper reaches of the waterway are flanked by verdant acreage sustained by controlled irrigation.
Reduced irrigation commitments on the Imperial East Mesa will permit a reduction in the size of the new canal. Present canal (above) was designed to accommodate a flow of 2,500 ft$^3$/s. The lined canal will be reduced to 1,550 ft$^3$/s.
### TABLE 2
**REIMBURSABLE AND NONREIMBURSABLE COSTS**  
Coachella Valley Unit

<table>
<thead>
<tr>
<th>Item</th>
<th>Reimbursable Costs</th>
<th>Nonreimbursable Costs</th>
<th>Total Project Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Features</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coachella Canal Replacement</td>
<td>12,317,000</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Additional Fish and</td>
<td>--</td>
<td>3,133,000</td>
<td></td>
</tr>
<tr>
<td>Wildlife Mitigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional Land Acquisitions</td>
<td></td>
<td>1,673,000</td>
<td></td>
</tr>
<tr>
<td>Total Additional Costs</td>
<td>12,317,000*</td>
<td>4,806,000*</td>
<td>17,123,000*</td>
</tr>
<tr>
<td>Original Cost Ceiling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indexed to July 1977 Prices</td>
<td>31,323,000</td>
<td>1,318,000</td>
<td>32,641,000</td>
</tr>
<tr>
<td>Total Project Costs</td>
<td>43,640,000</td>
<td>6,124,000</td>
<td>49,764,000</td>
</tr>
</tbody>
</table>

* If authorized.

### E. References and Reports
Preparation of this report has been accomplished, in part, by reference to various studies and reports that have previously been prepared relative to the problems and needs of the Coachella Canal. These documents are listed as reference sources at the end of this report.
III. PROBLEMS AND NEEDS

A. The Salinity Problem

The salinity level of Coachella Canal water is generally satisfactory considering that it is almost used exclusively for irrigation. However, a salinity problem that occurred in the Colorado River in 1961 has added emphasis to the need for prompt action to find ways to control salinity and conserve water in the lower reaches of the river.

The problem developed over a 1944 treaty between the United States and Mexico which allots 1,500,000 acre-feet of Colorado River water annually to the Republic of Mexico. Although the original treaty failed to mention "water quality," the Mexican Government lodged a protest against the United States in 1961 when the total dissolved solids in treaty water delivered at Morelos Dam suddenly increased from 800 parts per million (p/m) TDS to 1,500 p/m TDS.

The increase in salinity was mainly caused by drainage water containing approximately 6,000 p/m TDS that was pumped from the aquifers in the Wellton-Mohawk Irrigation and Drainage District in Arizona, and was subsequently discharged into the Colorado River as part of the treaty waters a short distance upstream from the International Boundary in conjunction with the elimination of over-deliveries of Colorado River water to Mexico. (10)

1. Minute No. 242. Following the protest by the Republic of Mexico a conference was held between United States and Mexican officials to determine what action should be taken on the salinity problem.

As a result of this meeting, Mexican and American conferees made a joint recommendation to their respective Presidents. On August 30, 1973, their joint recommendations were incorporated in Minute No. 242, an international agreement, which is titled: "Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River."
The agreement restricts salinity concentrations of treaty waters delivered at the Northerly International Boundary to a salinity level not to exceed 115 p/m ± 30 p/m TDS over the average annual salinity of Colorado River waters arriving at Imperial Dam.

2. Interim Solution. In order to comply with the terms of the 1973 agreement, about 215,000 acre-feet per year of Wellton-Mohawk drainage water are presently being routed, via a bypass canal, to the Santa Clara Slough (see Drawing No. 998-300-54). The solution is complicated, however, by the fact that these drainage waters are not receiving credit as part of the 1944 treaty arrangement. To compensate for this loss, a volume of water approximately equal to the bypassed drainage must be released from upstream storage on the Colorado River for delivery to Mexico.

B. Water Losses and Salvage Potential

1. Public Law 93-320. In an era when economic growth and agricultural development have resulted in overcommitment of Colorado River water resources, the present policy of releasing upstream water for the sole purpose of maintaining salinity requirements demanded by Minute No. 242 even further compounds the problem associated with water shortages.

In an effort to replace the water loss incurred by compliance with the terms of Minute No. 242, the Congress on June 24, 1974 approved Public Law 93-320 which, in addition to authorizing a desalting complex and other system improvements on the Lower Colorado River, contains a measure designed to salvage water presently being lost by seepage from the unlined Coachella Canal.

Section 102(a) of this law states: "To assist in meeting the salinity control objectives of Minute No. 242 during an interim period, the Secretary is authorized to construct a new concrete-lined canal or, to line the presently unlined portion of the Coachella Canal of the Boulder Canyon Project, California from Station 2+26 to the beginning of Siphon No. 7, a length of approximately 49 miles. The United States shall be entitled to temporary use of a quantity of water, for
the purpose of meeting the salinity control objectives of Minute No. 242, during an interim period, equal to the quantity of water conserved by constructing or lining the said canal. The interim period shall commence on completion of construction or lining said canal and shall end the first year that the Secretary delivers mainstream Colorado River water to California in an amount less than the sum of the quantities requested by (1) the California agencies under contracts made pursuant to section 5 of the Boulder Canyon Project Act (45 Stat. 1057), and (2) Federal establishments to meet their water rights acquired in California in accordance with the Supreme Court decree in Arizona against California (376 U.S. 340)."

2. Seepage Losses. The first 86 miles of the Coachella Canal's total length of 123 miles are unlined. This has resulted in large seepage losses since the canal has been in operation. The first 49 miles of this unlined portion extend through extremely porous sandy soil and account for approximately 88 percent of the total seepage.

According to recorded measurements, losses in the 86 miles of unlined canal average approximately 160,000 acre-feet per year, or roughly one-third of the total volume diverted into this waterway. A computation of evaporation indicated that loss from this source was minor compared to the seepage loss. At the present time, this loss enters the ground-water table and eventually makes its way to the Salton Sea after phreatophytes and other vegetation have used some of the water.

Average seepage losses over a 16-year period (1955-1970) were as follows:

Mile 1 to Mile 49, 141,000 acre-feet per year.
Mile 50 to Mile 87, 19,000 acre-feet per year.

An analysis of Table 3 shows that the initial seepage was considerably higher during the first few years of operation due to rapid infiltration into the dry desert soil. Because of this, the "average seepage losses" used in this report were computed for the period 1955 to 1970.
<table>
<thead>
<tr>
<th>Year</th>
<th>Delivered to Coachella Canal at Turnout</th>
<th>Diversions from Check 6A</th>
<th>Losses at Turnout To Check 6A</th>
<th>Delivered to Coachella Division at Check 6A (M.P. 49.3)</th>
<th>Losses to M.P. 87</th>
<th>Delivered to CVCWD at M.P. 87</th>
<th>Coachella Canal Losses, Turnout to M.P. 87</th>
<th>Losses As Percent of Column 1</th>
<th>Operational and Conveyance Unit</th>
<th>Coachella Farm Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>349,530</td>
<td>1,110</td>
<td>160,760</td>
<td>187,660</td>
<td>31,360</td>
<td>156,300</td>
<td>192,120</td>
<td>50.0</td>
<td>65,430</td>
<td>90,870</td>
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<tr>
<td>1951</td>
<td>486,000</td>
<td>0</td>
<td>166,040</td>
<td>319,960</td>
<td>42,660</td>
<td>277,300</td>
<td>208,700</td>
<td>42.9</td>
<td>109,250</td>
<td>168,010</td>
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<tr>
<td>1952</td>
<td>495,850</td>
<td>760</td>
<td>163,550</td>
<td>331,540</td>
<td>37,800</td>
<td>293,740</td>
<td>201,350</td>
<td>40.6</td>
<td>91,060</td>
<td>202,660</td>
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<td>1953</td>
<td>519,440</td>
<td>1,230</td>
<td>165,440</td>
<td>352,770</td>
<td>29,790</td>
<td>322,980</td>
<td>195,230</td>
<td>37.6</td>
<td>81,780</td>
<td>241,200</td>
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<td>4,850</td>
<td>176,890</td>
<td>390,370</td>
<td>24,640</td>
<td>365,730</td>
<td>201,530</td>
<td>35.2</td>
<td>95,430</td>
<td>270,300</td>
</tr>
<tr>
<td>1956</td>
<td>547,780</td>
<td>4,250</td>
<td>155,250</td>
<td>388,520</td>
<td>30,170</td>
<td>358,110</td>
<td>185,420</td>
<td>33.8</td>
<td>74,970</td>
<td>263,140</td>
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<tr>
<td>1957</td>
<td>491,680</td>
<td>720</td>
<td>142,440</td>
<td>348,520</td>
<td>30,420</td>
<td>318,100</td>
<td>172,860</td>
<td>35.2</td>
<td>41,990</td>
<td>276,110</td>
</tr>
<tr>
<td>1958</td>
<td>491,830</td>
<td>2,360</td>
<td>145,020</td>
<td>344,450</td>
<td>14,550</td>
<td>329,900</td>
<td>159,570</td>
<td>32.4</td>
<td>20,360</td>
<td>309,540</td>
</tr>
<tr>
<td>1959</td>
<td>492,900</td>
<td>2,620</td>
<td>132,930</td>
<td>357,530</td>
<td>18,120</td>
<td>339,230</td>
<td>151,050</td>
<td>30.6</td>
<td>19,140</td>
<td>320,090</td>
</tr>
<tr>
<td>1960</td>
<td>493,250</td>
<td>770</td>
<td>138,210</td>
<td>354,270</td>
<td>11,350</td>
<td>342,920</td>
<td>149,560</td>
<td>30.3</td>
<td>14,570</td>
<td>328,350</td>
</tr>
<tr>
<td>1961</td>
<td>508,310</td>
<td>1,590</td>
<td>153,940</td>
<td>352,780</td>
<td>10,890</td>
<td>341,890</td>
<td>164,830</td>
<td>32.4</td>
<td>16,550</td>
<td>325,340</td>
</tr>
<tr>
<td>1962</td>
<td>554,410</td>
<td>2,580</td>
<td>158,350</td>
<td>393,480</td>
<td>28,040</td>
<td>365,440</td>
<td>186,390</td>
<td>33.6</td>
<td>19,080</td>
<td>346,360</td>
</tr>
<tr>
<td>1963</td>
<td>525,310</td>
<td>2,180</td>
<td>131,520</td>
<td>391,610</td>
<td>32,960</td>
<td>358,650</td>
<td>164,480</td>
<td>31.3</td>
<td>27,390</td>
<td>331,260</td>
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<td>1964</td>
<td>503,350</td>
<td>1,820</td>
<td>141,000</td>
<td>360,530</td>
<td>20,140</td>
<td>340,390</td>
<td>161,140</td>
<td>32.0</td>
<td>16,850</td>
<td>323,540</td>
</tr>
<tr>
<td>1965</td>
<td>501,520</td>
<td>1,100</td>
<td>151,250</td>
<td>349,270</td>
<td>16,890</td>
<td>332,280</td>
<td>168,140</td>
<td>33.5</td>
<td>24,620</td>
<td>307,660</td>
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<tr>
<td>1966</td>
<td>468,150</td>
<td>650</td>
<td>127,790</td>
<td>339,710</td>
<td>18,270</td>
<td>321,440</td>
<td>146,060</td>
<td>31.2</td>
<td>4,430</td>
<td>317,010</td>
</tr>
<tr>
<td>1967</td>
<td>446,830</td>
<td>0</td>
<td>127,370</td>
<td>319,460</td>
<td>13,220</td>
<td>306,240</td>
<td>140,590</td>
<td>31.5</td>
<td>5,120</td>
<td>301,120</td>
</tr>
<tr>
<td>1968</td>
<td>463,240</td>
<td>0</td>
<td>127,220</td>
<td>336,020</td>
<td>16,440</td>
<td>319,580</td>
<td>143,660</td>
<td>31.0</td>
<td>5,960</td>
<td>313,620</td>
</tr>
<tr>
<td>1969</td>
<td>475,630</td>
<td>0</td>
<td>130,340</td>
<td>348,290</td>
<td>17,520</td>
<td>330,770</td>
<td>147,860</td>
<td>30.9</td>
<td>14,530</td>
<td>316,440</td>
</tr>
<tr>
<td>1970</td>
<td>434,090</td>
<td>0</td>
<td>116,450</td>
<td>317,640</td>
<td>7,770</td>
<td>309,870</td>
<td>124,220</td>
<td>28.6</td>
<td>6,690</td>
<td>303,120</td>
</tr>
<tr>
<td>Average</td>
<td>494,570</td>
<td>1,570</td>
<td>147,670</td>
<td>345,130</td>
<td>22,810</td>
<td>322,330</td>
<td>170,680</td>
<td>34.5</td>
<td>39,820</td>
<td>282,500</td>
</tr>
<tr>
<td>Average</td>
<td>498,340</td>
<td>1,590</td>
<td>141,000</td>
<td>355,750</td>
<td>19,460</td>
<td>336,290</td>
<td>186,460</td>
<td>32.2</td>
<td>25,480</td>
<td>4,972,860</td>
</tr>
</tbody>
</table>

1/ Records taken from "Miscellaneous Data--Colorado River at Imperial Dam and All-American Canal" (U.S.B.R. Form 300-172). Data rounded to the nearest 10 acre-feet.
2/ Records taken from Imperial Irrigation District "Annual Summary, Water Diversion, Transportation, Distribution and Drainage." Data rounded to the nearest 10 acre-feet.
3/ Records taken from the "Coachella Canal Record," CVCWD and rounded to the nearest 10 acre-feet.
3. **Salvaged Water Potential.** Lining the first 49 miles of the Coachella Canal will eliminate a major portion of the seepage that is presently occurring. A new canal lined with concrete will have a smaller cross-sectional area and be almost impervious. Average seepage loss, after lining, is expected to be 9,000 acre-feet per year. When considered against the present losses of 141,000 acre-feet per year the proposed project should save 132,000 (141,000 minus 9,000) acre-feet per year. Water savings resulting from the construction of the lined canal would, under provisions contained in Public Law 93-320, be used during the interim period defined in Public Law 93-320 to replace water bypassed to meet the objectives of Minute No. 242. During this interim period no repayment for Coachella Canal construction costs would be required from the CVCWD water users. Financial responsibility for payments that would fall due during this period will be assumed by the United States in return for use of the salvaged water.

4. **Future Long-Term Water Availability.** Repayment of Coachella Canal construction costs by CVCWD water users would commence at the conclusion of the interim period as defined in Public Law 93-320. This is expected to occur in the mid-1980's when Colorado River water diverted to the Central Arizona Project (CAP) will escalate the three-state (Nevada-California-Arizona) water usage to the full 7.5 million acre-feet per year allocated under provisions set forth in the Colorado River Compact and the 1964 Arizona vs. California Supreme Court Decree.

A potent argument for this water conservation project can be demonstrated by the fact that Colorado River water usage in California has exceeded the 4.4 million acre-feet per year ceiling in 8 out of 13 years that detailed records have been compiled (see Table 4). However, restrictions have not been necessary in the past because the Lower Basin has not exceeded its Colorado River Compact entitlement as Nevada and Arizona have not yet completed planned construction to utilize their full allocations.
Table 4
AVAILABLE SUPPLY OF COLORADO RIVER WATER TO AGRICULTURAL USERS (California)
The First Three Priorities For Agriculture Users Represents 3,850,000 Acre-Feet*
Coachella Valley Unit

<table>
<thead>
<tr>
<th>Year</th>
<th>Available at River (Acre-Feet)</th>
<th>Actual Net Diversions</th>
<th>Available For CVCWD</th>
<th>Actual Net Diversions</th>
<th>Excess</th>
<th>Shortage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>COACHELLA VALLEY COUNTY WATER DISTRICT (Acre-Feet)</td>
<td>At Imperial Dam</td>
<td>At Palo Verde Reservoir</td>
<td>At Imperial Dam</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3,850,000</td>
<td>397,780</td>
<td>72,629</td>
<td>2,891,155</td>
<td>488,436</td>
<td>526,417</td>
</tr>
<tr>
<td>1965</td>
<td>3,850,000</td>
<td>350,760</td>
<td>63,433</td>
<td>2,741,309</td>
<td>694,498</td>
<td>524,686</td>
</tr>
<tr>
<td>1966</td>
<td>3,850,000</td>
<td>404,550</td>
<td>68,947</td>
<td>2,944,495</td>
<td>432,008</td>
<td>489,429</td>
</tr>
<tr>
<td>1967</td>
<td>3,850,000</td>
<td>363,480</td>
<td>67,463</td>
<td>2,819,724</td>
<td>559,333</td>
<td>464,053</td>
</tr>
<tr>
<td>1968</td>
<td>3,850,000</td>
<td>393,520</td>
<td>74,219</td>
<td>2,895,541</td>
<td>486,720</td>
<td>478,583</td>
</tr>
<tr>
<td>1969</td>
<td>3,850,000</td>
<td>393,650</td>
<td>64,966</td>
<td>2,766,924</td>
<td>624,460</td>
<td>495,082</td>
</tr>
<tr>
<td>1970</td>
<td>3,850,000</td>
<td>410,110</td>
<td>66,573</td>
<td>2,848,565</td>
<td>524,752</td>
<td>449,263</td>
</tr>
<tr>
<td>1971</td>
<td>3,850,000</td>
<td>458,570</td>
<td>63,341</td>
<td>2,967,907</td>
<td>360,182</td>
<td>470,683</td>
</tr>
<tr>
<td>1972</td>
<td>3,850,000</td>
<td>439,640</td>
<td>62,039</td>
<td>2,965,910</td>
<td>382,411</td>
<td>511,476</td>
</tr>
<tr>
<td>1973</td>
<td>3,850,000</td>
<td>465,250</td>
<td>63,863</td>
<td>3,047,899</td>
<td>272,988</td>
<td>522,356</td>
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<tr>
<td>1974</td>
<td>3,850,000</td>
<td>458,400</td>
<td>60,492</td>
<td>3,171,977</td>
<td>159,131</td>
<td>558,864</td>
</tr>
<tr>
<td>1975</td>
<td>3,850,000</td>
<td>449,486</td>
<td>62,186</td>
<td>3,070,974</td>
<td>267,354</td>
<td>570,987</td>
</tr>
<tr>
<td>1976</td>
<td>3,850,000</td>
<td>392,320</td>
<td>64,797</td>
<td>2,876,984</td>
<td>515,899</td>
<td>524,801</td>
</tr>
<tr>
<td>Total</td>
<td>50,050,000</td>
<td>5,377,516</td>
<td>854,948</td>
<td>38,009,364</td>
<td>5,808,172</td>
<td>6,586,680</td>
</tr>
<tr>
<td>Average</td>
<td>3,850,000</td>
<td>413,655</td>
<td>65,765</td>
<td>2,923,797</td>
<td>446,782</td>
<td>506,668</td>
</tr>
</tbody>
</table>

* Source: Agreement requesting apportionment of California's share of the waters of the Colorado River among the applicants in the State, dated August 18, 1931, often referred to as the "Seven Party Priorities Agreement."
It appears significant to point out that if California had been limited to 4.4 million acre-feet per year during the period 1964 to 1976, CVCWD would have been short of water in eight of those years. These shortages would have ranged from about 9,000 acre-feet in 1976 to almost 400,000 acre-feet in 1974.

It should also be noted that in all years except 1973, 1974, and 1975 the overdrafts would have been compensated for by the 132,000 acre-feet per year which could be salvaged by implementation of the Coachella Canal Lining Project.

C. Legal and Institutional Parameters

1. Existing Contracts. On October 5, 1934, a contract was executed between the United States and the Coachella Valley County Water District providing for construction of a canal to deliver water to the Coachella Valley.

Another contract was entered into with the Imperial Irrigation District on December 22, 1947, giving it variable capacity rights in order to deliver water to certain lands on the Imperial East Mesa.

Construction costs for the canal are presently being jointly repaid by CVCWD and IID which also operates and maintains this section of the waterway.

Under the terms of the agreement each district pays costs in direct proportion to its capacity rights.

The capacity rights for the canal's first 49 miles are outlined in Table 5.
Table 5
COACHELLA CANAL CAPACITY RIGHTS
Coachella Valley Unit

<table>
<thead>
<tr>
<th>Station From</th>
<th>Ending Milepost</th>
<th>CVCWD (ft^3/s)</th>
<th>IID (ft^3/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>290+00</td>
<td>5.5</td>
<td>1,500</td>
</tr>
<tr>
<td>290+00</td>
<td>862+00</td>
<td>16.3</td>
<td>1,500</td>
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<td>862+00</td>
<td>1238+00</td>
<td>23.5</td>
<td>1,500</td>
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<td>1238+00</td>
<td>1519+37</td>
<td>28.8</td>
<td>1,500</td>
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<td>1704+35</td>
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<td>1,500</td>
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<td>2293+00</td>
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<tr>
<td>2293+00</td>
<td>2602+74</td>
<td>49.3</td>
<td>1,500</td>
</tr>
<tr>
<td>2602+74</td>
<td>6517+00 (end)</td>
<td>123.4</td>
<td>Single use-CVCWD</td>
</tr>
</tbody>
</table>

2. **Imperial Irrigation District Involvement.** Under the original concept, the portion of the canal under the jurisdiction of the IID would have the capability of irrigating approximately 8,500 acres of land on Imperial East Mesa.

However, in 1963, the Department of the Interior issued regulations that deny rights-of-way for canals and ditches over federally owned land for new irrigation purposes wherever the Colorado River is the source of supply.

This regulation had the effect of precluding development of about 4,200 acres, or about half the potential acreage of Imperial East Mesa scheduled to be irrigated by the Coachella Canal.

Of the remaining 4,300 acres under IID jurisdiction, about 500 acres have been developed and another 500 acres are partially developed.

The token development of agriculture lands on Imperial East Mesa during the past 30 years has made IID's investment in the canal unrewarding. Furthermore, any financial participation in lining the canal at this time would undoubtedly continue to be an unrewarding financial burden. Because of this the Imperial Irrigation District has declined to participate in a lining project.
In view of the circumstances, Public Law 93-320 included Section 102(a) which states: "The Secretary is authorized to credit Imperial Irrigation District against its final payments for certain outstanding construction charges payable to the United States on account of capacity to be relinquished in the Coachella Canal as a result of the canal lining program, all as determined by the Secretary."

The legislation also authorized the Secretary to acquire by purchase, eminent domain, or exchange, private lands on the Imperial East Mesa which have been granted rights to receive water from the canal.

3. Seven-Party Priorities Agreement. To insure a more equitable distribution of Colorado River water among California water users, an agreement, generally referred to as the "Seven-Party Priorities Agreement," was executed on August 18, 1931.

The document cites the order of priority for Colorado River water use and allots the initial 3,850,000 acre-feet a year of California's share of Colorado River water to agricultural users. These users are designated as priorities 1 through 3.

A partial copy of the agreement, together with a summary of the legal ramifications that have been generated by this document, is included in the 1973 Special Report. (6)

D. Ground-Water Levels

Most of the agricultural land in the project area is underlain by a shallow, semiperched ground water table. This water is undesirable for agricultural consumptive use because of its high mineral content (2,000-4,000 mg/l). Consequently, this semiperched ground water table must be kept at a depth sufficiently below the root zone so that accumulated salts in the soil may be leached below the root zone.

Because the amount of rainfall is insufficient to leach accumulated salts from the soil, irrigation water applied to agricultural crops must exceed normal plant requirements in order to prevent salt accumulations. The quality of irrigation water is 800-900 mg/l.

1. Rise in Ground Water Before Lining. The ground-water table under the Imperial East Mesa has been rising since before the
Coachella Canal was completed in 1948. Much of this was due to early irrigation of the Imperial Valley from the All-American Canal which reduced underflow from the East Mesa.

Upon completion of the Coachella Canal, buildup of ground water under the East Mesa accelerated. By 1963 the water table was virtually at equilibrium in the area between the Coachella and East Highline Canals. (1)

Between 1942 and 1963, ground-water buildup under the Imperial East Mesa rose from a few feet near the East Highline Canal to more than 70 feet directly beneath the Coachella Canal. (1)

A comparison between the 1942 and 1963 ground-water levels can be made by comparing Drawing No. 1292-303-2002 with Drawing No. 1292-303-2006.

2. **Expected Levels After Lining.** The rate of decline in the water table after completion of the Coachella Canal lining project will probably be approximately the same as the rate of rise when the canal became operative in 1948.

Drawing No. 1292-303-2000 shows the predicted decline in ground water after the canal is lined. The prediction is based on results acquired from a conductive sheet electric analog model plus a comparison between 1942 and 1974 water tables.

A few years after completion of the lined canal, open ponded water, which is generated by high ground-water levels, will disappear. The lining of the canal will reduce the inflow to the Salton Sea by about 112,000 acre-feet and 150,000 tons of salt per year (about 8 percent of the total yearly inflow), assuming there is presently 20,000 acre-feet of phreatophyte consumptive use of seepage water and the average quality of the irrigation water is 850 mg/l. The impact on the Salton Sea of lining the canal will be to slightly reduce water surface elevation and accelerate the water quality degradation, both factors occurring over a period of time.

3. **Use of Ground Water for Wildlife Mitigation.** A study conducted by the U.S. Fish and Wildlife Service has determined that
lining of the Coachella Canal will result in some adverse environmental impacts when fish and wildlife habitat is either modified or eliminated.

According to the study an estimated total of 12,167 wildlife habitat units will be eliminated by implementation of the project.

Numerous mitigation measures, some of which involve use of ground water, have been advanced to compensate for the loss of wildlife habitat. One of these concepts would utilize windmills in areas along the new canal which would provide ground water to maintain wildlife habitats. The amount of ground water thus utilized would vary with climatic conditions but could amount to over 200 acre-feet per year with an optimum use of 300 gallons per hour for each of 25 windmills.

A more comprehensive listing of mitigation measures is contained in Chapters V and VI of this report.
COACHELLA CANAL
LINING OF FIRST 49 MILES
PREDICTED DECLINE IN GROUND WATER LEVELS DUE TO LINING

NOTE:
Decline in water levels shown is probable maximum change based on combination of 1946 and 1974 trends and existing mean predictions.

SEPTEMBER 27, 1974
IV. PLAN FORMULATION

A. Reduction of Seepage Losses

Completion of the 49-mile lined canal will result in the salvage of 132,000 acre-feet per year of Colorado River water that is presently lost through seepage. The savings will be brought about by the fact that a new canal with a 3-inch concrete lining will greatly reduce the permeability of the canal bottom and side slopes over that of the existing unlined canal.

Some losses will still occur through joints and cracks, and, to a lesser degree, even through the concrete itself. There will still be minor losses induced by evaporation.

Total losses from the new lined canal are estimated at 9,000 acre-feet per year. This figure, when subtracted from the 141,000 acre-feet per year that is presently being lost from the unlined canal, produces a net saving of 132,000 acre-feet per year. (6)

Salvage of this water will end the necessity of diverting water at Imperial Dam to offset seepage losses. However, as explained earlier in this report, the salvaged water will initially be used to help meet treaty obligations with Mexico. Furthermore, once Nevada and Arizona begin using their full water apportionments, California's depletions of Colorado River water will be limited to the 4.4 million acre-feet per year authorized under the 1964 Arizona v. California Supreme Court Decree unless there is a surplus declared.

B. Acreage Reduction

Purchase of lands that border the canal on the Imperial East Mesa will reduce the amount of privately owned acreage that is presently entitled to water from the Coachella Canal.

Developed land in this area totals only about six percent of the amount authorized for retirement under provisions contained in Public Law 93-320. Land already under development will not be purchased because of anticipated high costs and hardships that could be placed upon the present owners.
These developed tracts will continue to receive water from the new canal. Partially developed lands may, or may not, be purchased depending on individual cases, investment costs, and the desires of the owners.

In addition to the potential savings of Colorado River water that will be acquired as a result of these land purchases, the action will also permit a reduction in the size of the initial 49-mile reach of the canal, thereby reducing construction costs.

C. Utilization of Salvaged Water

Water salvaged from the canal lining project will initially be used to help meet the salinity control objectives of Minute No. 242 during the interim period defined by Public Law 93-320 (see Section III.A of this report).

A more permanent solution, as authorized by Public Law 93-320, Title I, includes decreasing drainages of high salinity presently being returned to the Colorado River as well as decreasing salinity concentrations of those drainages by means of a desalting plant.

The permanent solution is scheduled to be in effect by the forecasted end of the interim period, or about 1987.

After the interim period CVCWD is expected to be the principal beneficiary. Table 6 shows that leakages from the first 49 miles magnify the diversions necessary to meet CVCWD farm deliveries.
Table 6
COLORADO RIVER DELIVERIES TO CVCWD
Coachella Valley Unit

<table>
<thead>
<tr>
<th>Farm Year</th>
<th>Imperial Diversions</th>
<th>Coachella Diversions</th>
<th>49-Mile Losses</th>
<th>Other Losses</th>
<th>Regulatory Losses</th>
<th>Delivery</th>
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<tbody>
<tr>
<td>1970</td>
<td>449.3</td>
<td>444.7</td>
<td>127.1</td>
<td>8.6</td>
<td>6.8</td>
<td>302.2</td>
</tr>
<tr>
<td>1971</td>
<td>464.5</td>
<td>466.3</td>
<td>125.2</td>
<td>20.1</td>
<td>12.0</td>
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<tr>
<td>1972</td>
<td>511.5</td>
<td>501.4</td>
<td>134.8</td>
<td>23.0</td>
<td>12.0</td>
<td>331.5</td>
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<tr>
<td>1973</td>
<td>522.4</td>
<td>515.0</td>
<td>136.8</td>
<td>17.8</td>
<td>14.1</td>
<td>346.2</td>
</tr>
<tr>
<td>1974</td>
<td>558.3</td>
<td>551.5</td>
<td>157.6</td>
<td>21.8</td>
<td>14.4</td>
<td>351.1</td>
</tr>
</tbody>
</table>


Because deliveries are assessed at the point of diversion, and because diversions will be reduced at the termination of the interim period, lining of the initial 49 miles of the canal could be extremely important to future water needs of the Coachella Valley.

D. Fish and Wildlife Mitigation

Authority for the provision of fish and wildlife measures is under the Fish and Wildlife Coordination Act. Fish and wildlife losses attributable to the Project are defined in the "Colorado River Basin Salinity Control Project, Title I, Final Environmental Statement" dated June 18, 1975, INT FES 75-57. (1)

Mitigation measures were developed by an interdisciplinary Ad Hoc Committee of local State and Federal agencies.

Justifiable and reasonable amounts and kinds of mitigation will be provided in accordance with coordination, agreements, and definition
as discussed in a report on "Recommendations for Fish and Wildlife Mitigation" submitted to the Commissioner on December 14, 1975, and as contained in amendatory legislation. (5) (13)

Responsibility for design, construction, and development of mitigation measures will be the full responsibility of the Fish and Wildlife Service and California Department of Fish and Game. By agreement, funding to be provided by the project is based upon design and cost estimates developed by the two wildlife agencies and coordination with the Bureau of Reclamation. No additional funding by the Bureau of Reclamation will be required.

In summary mitigation measures include:

1. Windmills and Select Habitat. Twenty-five windmills with storage tanks to provide drinking water for wildlife and maintenance of small amounts of vegetation and designation of approximately 5,800 acres of Federal land for wildlife use.

2. Tracts 10 and 12. Acquisition and development of 363 acres of private land to become a part of the Salton Sea National Wildlife Refuge.

3. Finney Lake Restoration. Restoration of an existing lake within the Imperial Wildlife Area to provide and develop additional fish and wildlife habitat.

4. Isolated Parcels. Acquisition of approximately 2,000 acres of private land to be managed for preservation of biological resources.

5. Wister Habitat. Acquisition and development of 160 acres of private land to become a part of the Imperial Wildlife Area.

E. Alternatives

The desirability of salvaging Colorado River water by reducing seepage losses in the unlined portion of the Coachella Canal has been recognized since shortly after the waterway became operational in 1948.

Based on a wide variety of factors including extensive studies, present and future water needs, and monetary considerations, it is
believed that the plan approved under provisions of Public Law 93-320 and modifications as proposed by draft amendatory legislation represents the most efficient and effective means of accomplishing this objective.

Several alternatives were considered as follows:

1. Use of Butyl Rubber Lining on Existing Canal. One possible method of eliminating a portion of the seepage that presently occurs in the Coachella Canal involves installation of a butyl rubber lining along the initial 49-mile reach.

Experiments involving the use of butyl rubber lining as a substitute for concrete were conducted in 1964 along a portion of the Fern Canal in Imperial Valley, California. (8)

A study of the rubber lined canal over a one-year period showed the lining to be moderately successful in controlling seepage. There were, however, a number of adverse impacts associated with the use of this material.

One major problem developed as a result of accumulation of silt along the canal bottom. This had a tendency to cause weeds to grow through the lining material to an extent that frequent dewatering was necessary in order to control aquatic growth.

In addition to this, the lining appeared conducive to tearing apart at crevices and low points in the canal bed when exposed to the pressure of high water. Overlap joints where individual prefab panels were joined together had a similar tendency to tear.

Cost of materials and installation was also a prohibitive factor. A 1965 Bureau of Reclamation Report conducted one year after installation of a butyl rubber lining in the Fern Canal (3) developed the fact that cost of butyl rubber installation was approximately 50 percent more than the cost of concrete lining. Admittedly, the comparative estimates noted above are based on 1965 prices. Nevertheless, it is reasonable to assume that the cost of lining a canal with butyl rubber today would still be approximately half again as much as lining the same installation with concrete.
A major element in the cost advantage of concrete over butyl rubber is due to the fact that there are several area contractors who are equipped to perform this type of work and have a history of highly competitive bidding on projects of this kind.

In addition to the cost factor the occasional dewatering, which would be necessary in a butyl rubber lined canal, would not be practical in the Coachella Canal due to the year round need for frequent irrigation and the absence of an alternative source.

For this same reason the flow of the present canal could not be interrupted initially for the length of time necessary to dewater it and install new lining.

2. Use of Prefabricated Asphalt Lining on Existing Canal.
Concurrent with the 1964 experiments using Butyl Rubber lining, similar experiments were conducted at the Fern Canal to evaluate the effectiveness of prefabricated asphalt as a possible lining material.

The lining was comprised of sheeted prefabricated asphalt in 12- and 24-foot panels which, upon installation, were overlapped and jointed. Periodic checks over a 1-year period developed the fact that the material accomplished its intended purpose, to substantially reduce leakage. However, after 1 year of use, accumulated sediment was measured at 3 to 7 inches in the invert and 0 to 9 inches near the toe and side slopes of the canal.

Occasional weeds also grew through the lining material making dewatering a necessity if aquatic growth were to be controlled.

Cost of installation was also prohibitive. Materials plus installation were estimated at $4.88 per square yard or almost double the cost of lining a similar unit with concrete.

3. Lining the Present Canal with Concrete. The practicability of lining the existing canal bed with concrete instead of constructing a parallel waterway along a new alignment was evaluated early in the planning process.

The chief drawback to the plan was the need to provide a continuous supply of irrigation water during the construction period.
Several methods to accomplish this were evaluated but all proved too costly.

The present plan for construction of a new canal along a parallel alinement was chosen since the existing waterway could provide service during the period of construction.

An additional factor in favor of a new alinement involves the fact that the present canal bed is not in its present state adaptable for lining without extensive preliminary preparation work.

4. **Lining Existing Canal With Compacted Earth.** Another method for reducing the present seepage rate would be to line the existing canal with compacted earth. The chief drawback to this approach is that the solution would be only a temporary one. Also, as in the case of concrete lining, it would necessitate dewatering the canal for a prohibitive length of time.

5. **Use of Chemical Soil Sealants.** A procedure that would not require dewatering activities involves the application of chemical soil sealants to the existing channel. The method of application consists of introducing the chemical sealant directly into the streamflow and retaining the solution in a given area by means of a removable plastic screen until the sealant achieves its intended purpose.

Tests conducted with this material, under experimental conditions, have met with some limited success. (9) The disadvantage to this method lies in the fact that seepage reductions would be minimal. Also, the remedy is of a temporary nature. Biotic growth would continue to encroach the channel and the effectiveness of the soil sealant would begin to diminish after a relatively short period of time.

6. **Construction of New Alinement With Retention of Existing Structures.** A plan that originally received serious consideration involved construction of a new alinement that would return to, and join, the present canal at inverted siphons and other appurtenant structures.

Although this method of construction would be less costly and avoid some duplication, the plan was abandoned after a review of the
situation determined that a gradient independent of existing structures would substantially improve the hydraulics of the new canal.

Also, by constructing new siphons only one water outage would be required during construction. This factor assumed major significance upon determination that three weeks must be allowed for each canal rundown, dry up, construction period, and tie in. Were the seven existing siphons to be tied into the new alinement with seven periods of nonirrigation, some crop damage would occur.

In addition to this some of the presently used siphons are undersized with respect to washouts passing over them. As a result damage has occurred at inlet or outlet transitions on some of the existing structures. See Photograph P-212-300-12852.

Construction of new siphons will eliminate this hazard, together with acquiring the additional advantages outlined above.

7. Recovery of Seepage by Pumping. A possible alternative to construction of a new canal would be to drill a system of wells parallel to both sides of the existing waterway. A portion of the present loss could then be salvaged by pumping.

However, studies have indicated that seepage control by means of pumping is not complete. Quality of the recovered water would also deteriorate because of contamination by lower quality ground water adjacent to the canal. (6)

In addition to this the OM&R costs of a well system would be high and, when considered in conjunction with other adverse impacts, would eventually offset any initial savings acquired by application of this method.

8. The No-Project Alternative. The problems and events that necessitate construction of a new lined canal have been examined earlier in this report and in the 1973 Special Report.

Should no action be taken to reduce seepage losses, ground water would continue to be a problem, seepage ponds would tend to increase in both size and number and gradually extend into new areas farther away from the canal.
Some of the existing siphons are undersize with respect to floodflows passing over them. This has resulted in washouts on several occasions. Construction of new siphons will eliminate this hazard.
Additional adverse effects would also occur outside the immediate project area. In an era of water shortages complicated by ever increasing demands on a limited supply of Colorado River water, the loss of large amounts of water by seepage is a condition that cannot be permitted to continue for an indefinite period.

California, during some years, is already exceeding its allotment of Colorado River water. Within a few years new water projects in Nevada and Arizona will necessitate commitment of full water allocations to these states.

This will dramatically increase the necessity for recovery of water presently lost by seepage.
V. DESIGNS AND ESTIMATES

A. Canal Realignment and Lining

1. Location. The new canal will extend from the Coachella Canal Turnout of the All-American Canal to Siphon No. 7 located near Milepost 49 on the existing waterway.

To permit efficient construction practices, the area included in the project is divided into two reaches.

Reach 1A originates at the outlet transition of the Parshall flume located 0.12 mile north of the All-American Canal Turnout, and includes the next 32.9 miles of the new channel.

Reach 1B extends from the end of Reach 1A 15.5 miles to the inlet transition located at Siphon No. 7. To facilitate final change-over, the initial 0.12 of a mile between the All-American Canal Turnout and the inlet transition to the Parshall flume will also be included in the construction contract with Reach 1B. In addition to this, for construction purposes, Reach 1B includes the removal or burying of such structures along the abandoned canal as might be appropriate to insure the safety of persons in the area. Alignments of the old and new canals, together with existing and proposed appurtenant structures, are shown on Map No. 212-326-70 (Frontis-piece).

2. Capacity. Design flow in the new canal is 1,550 ft³/s.

During construction the existing canal capacity will remain unchanged until a temporary bypass at the railroad bridge in Reach 1B is constructed and activated. During the construction of that feature the canal flow will be limited to approximately 1,000 ft³/s.

3. Design. Typical design features of the new canal are shown on Drawing No. 1292-D-2020. Both reaches of the canal will be lined with unreinforced concrete 3 inches thick. Service roadways constructed from native soils will parallel both sides of the canal, with the left side having a 4-inch gravel surfacing. Designs and specifications are prepared by the Bureau of Reclamation, Engineering and Research Center, Denver, Colorado.
B. Use of Existing Structures

1. Coachella Canal Turnout. The present turnout for the existing Coachella Canal located at the diversion point from the All-American Canal will be used without modification. An air view of the Coachella Canal diversion from the All-American Canal is shown in Photograph P-212-300-12613. Drawing No. 1292-303-2703 shows plan and profile of the diversion area.

2. Railroad Bridge. The railroad bridge located at Station 2210+27 will be retained without modification.

   It will be necessary, however, to construct an inverted siphon under the center span.

   To accomplish this irrigation water will be rerouted via a bypass canal during the construction period.

3. Flood Protective Works. Levees, detention dams, and other flood control works that were built in conjunction with the original canal will be retained.

   The existing siphons No. 1 through No. 6 will also remain in place to serve as protection for the new barrels. Existing barrels will be sealed by a reinforced concrete wall and covered with earth after the new canal is activated. The tops of several existing retaining walls alongside the washes will be raised to accommodate 100-year storm runoff.

4. Siphon No. 7. Siphon No. 7 on the existing canal, located at Station 2561+78 near the end of the new lined channel will be retained without modification except for a new scour device to be provided in the wash just downstream from the barrel.

5. Other Bridges. Two concrete operating bridges on the existing alinement will be retained for the purpose of providing access to the new canal and the general area.

   The existing bridge servicing Highway 78 over the old canal will be retained so the existing canal prism can serve as an underpass for recreational traffic to cross the highway.
The Coachella Canal diversion from All-American Canal (above) will be retained without modification. The outlet transition for the new, lined canal will be located 600 feet north of the present turnout structure, or approximately in the top center of the photo.
GENERAL NOTES

*For typical canal section, see 032-9-3800.
*For explanation of symbols, see 032-9-3700.
C. Structures to be Abandoned

1. Existing Canal Alinement. The unlined portion of the Coachella Canal between the Coachella Turnout and Milepost 49 will be abandoned except at locations that are scheduled to be integrated into the new system (see Item B above).

2. Structures. Irrigation turnouts, drop structures, checks, and siphons (except as noted above) will be stripped of salvageable material after which they will be abandoned and covered with earth when deemed advisable for esthetic or safety purposes.

D. New Structures

1. Irrigation Turnouts. Three new irrigation turnouts will be constructed to serve the serviceable lands on the East Mesa.

   One of these will be located just upstream from Siphon No. 1 at Station 1994+90. Two additional turnouts will be constructed between Siphon No. 1 and Siphon No. 2 at Stations 2099+18 and 2138+33.

2. Drops and Checks. To maintain design flows and levels, five standard checks and four check drops will be located along the 49-mile alinement. All of the check drops will be constructed along Reach 1A. Drawings 1292-D-2012 and 1292-D-2015 show details of these features.

3. Siphons. An inverted siphon will be used to divert canal water under Highway 78 in Reach 1A (see Drawing 1292-D-2018). A similar siphon will be constructed under the existing railroad bridge located at Station 2210+27 in Reach 1B.

   Six additional siphons numbered 1 through 6 will be constructed along Reach 1B for the purpose of passing canal water under washes that intersect the canal alinement. Siphon No. 2 is shown on Drawing 1292-303-2181.

   Locations of these siphons are indicated on General Map 212-326-70, Frontispiece.

4. Flumes. To insure accurate flow measurements, 2 Parshall flumes will be constructed; one at each end of the 49 miles of new canal. Typical design of a Parshall flume is shown in Drawing 1292-D-2005.
A foot bridge will be constructed across the throat of each flume for personnel access and to permit more effective calibration and measurement of water routed through the structures.

5. Transmission Lines. Power transmission lines will be constructed in the most economical location from existing powerlines. They will provide energy to electric motors used to operate gates in the checks and sensory devices located at control points.

Wherever possible, the transmission line will be located at the extreme edge of the rights-of-way to minimize interference with canal maintenance.

The transmission line will not be constructed as part of the initial project but will be installed later by the CVCWD by contract with USBR and IID.

6. Fences. Parshall flumes, checks, check drops, and siphon inlets transitions will be fenced with 8-foot high chain link fence, topped with two-way cantilevers supporting 6 strands of barbed wire.

7. Roadways. The entire length of the lined canal will be flanked by two operating roads.

An 20-foot wide service road with 4-inch gravel surfacing will be constructed along the southwest bank of the new canal. Another service road 16 feet wide will be graded along the northeast bank but will be unsurfaced.

At station 20+00 concrete abutments will be placed on each side of the canal for a bridge to be built in the future. These 37-foot long abutments will be used eventually for a bridge which will provide highway access to a recreation area being planned by the Bureau of Land Management.

8. Signs. Use of operating roads and canal banks by the general public will be discouraged by installation of "Trespassing - Loitering Forbidden by Law" signs. Signs will be installed by the CVCWD after construction is complete.

E. Automation

1. Remote Control - Automatic Checks. Checks will be provided with motorized controls having an interface matching the sen-
COACHELLA CANAL RELLOCATION
REACH 1A

NOTE
For general notes see (2005)

See Section A-A for details.

Specifications for Highway Bridges

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<thead>
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</tr>
<tr>
<td>1402/100</td>
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<td>1402/00</td>
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SCALE OF FEET
1" = 10'
SEQUENCE OF DETOUR CONSTRUCTION

1. Construct detour.
2. Construct siphon along existing highway.
3. Finish highway.

NOTES
For general notes see (2005).

SECTION A-A

NOTES TO SECTION A-A

A. Include safety barriers and guard rail.
B. Include siphon along existing highway.
C. Include finish highway.
D. Complete construction.

COLORADO RIVER DAMA SALTON CONTROL PROJECT
DIVISION 25/COACHELLA UNIT-ENEPAL
COACHELLA CANAL RELOCATION
REACH A-6
STATION 07+56
SIPHON-GENERAL PLAN AND SECTION

SCALE OF FEET

100'
sory gate opening equipment used by the CVCWD. This equipment will be furnished and installed by the CVCWD.

Meter wells will also be installed at all check structures in order that automatic control can be based on both upstream and downstream water levels.

2. Parshall Flume Automation. Automation equipment for the Parshall flume will be chosen and installed by the CVCWD.

F. Flow Measurement
   1. Methods. Flow measurement may be performed either manually or by sensory equipment located at the sites of the two Parshall flumes.
   2. Operation. Overflow diaphragm weirs will be angled upstream to provide sufficient weir length to insure that 25 percent of the design flow is passed when using 100 percent of the freeboard depth. Checks will be spaced along the canal in a manner to insure that the depth of water is maintained at a minimum half depth under a condition of zero flow with all gates in a closed position to prevent uplift from ground-water pressure.

G. Subsurface Investigations and Materials
   Materials excavated from the canal alignment fall into three general classifications.
   1. Poorly Graded Fine Sand. From Station 0+00 to Station 770+00 and from Station 1400+00 to Station 1742+00 the material is 90 to 95 percent poorly graded fine sand and usually contains only about 5 percent nonplastic fines to serve as a binder and retain moisture.
   2. Sand Underlain With Clay. From Station 770+00 to Station 1020+00 the surface material is poorly graded fine sand to a depth of 0.5 to 1.5 feet. This is underlain with lean clay to an approximate depth of 15 feet. The clay contains an average of 80 percent low-to-medium plastic fines and 20 percent fine sand.
   3. Silty Sand. The material from Station 1020+00 to Station 1400+00 is classified as sandy silt or silty sand depending only on proportion. This contains from 50 to 80 percent fines with the
remainder being poorly graded, fine sand 7 to 10 feet in depth which is underlain with lean clay.

4. Borrow Areas. Two borrow areas have been identified that contain appropriate embankment material that can be used for fill sections as needed. Both areas are immediately adjacent to the new canal right-of-way, on Government-owned land.

Borrow area No. 1 is located at Station 1092+50. Borrow area No. 2 is at Station 1154+00. Both areas are rectangular parcels about 1,300 feet long and 400 feet wide.

An aggregate borrow area for concrete materials is located immediately east of the Southern Pacific Railroad right-of-way about 2 miles southeast of the railroad siphon at Station 2181+61 at the canal-railroad intersection.

The Frontispiece Map indicates the location of borrow areas.

H. Rights-of-Way

Fee titles will be required for all patented lands along the new alignment.

In areas where the two canal alignments are relatively close, the rights-of-way will consist of a combination of old and new land acquisitions.

In portions of the project area where the canal alignments are widely separated, the old right-of-way will either be returned to private owners or revert to the jurisdiction of the Bureau of Land Management.

About 1,700 acres of additional rights-of-way must be acquired for the new canal. Approximately 500 acres of this are on patented lands. The remaining 1,200 acres are on Reclamation withdrawn lands.

The acreage noted above is in addition to acquisition of land withdrawn from irrigation commitments by provisions of Public Law 93-320 (see Section IV.B of this report).

I. Fish and Wildlife Mitigation Features

The Fish and Wildlife Coordination Act requires that losses to fish and wildlife attributable to the construction of a new lined canal be evaluated and mitigation measures recommended for consideration.
Several measures, developed by an interdisciplinary Ad Hoc Committee and agreed upon by State and Federal fish and wildlife agencies, were recommended as being reasonable amounts and kinds of mitigation for adverse impacts to fish and wildlife.

If authorized, funds in the amounts of $990,000 and $2,589,000 will be transferred to the Fish and Wildlife Service (FWS) and the California Department of Fish and Game (CDFG), respectively, for land acquisition, design, construction, and development of the mitigation measures. No additional funding will be required from the Bureau of Reclamation for completion of measures. It will be the responsibility of FWS and CDFG to obtain all necessary clearances, permits, water rights, water allocation use permits, etc., required for the measures. OM&R performance and funding of the measures will be the full responsibility of FWS and CDFG.

As summarized in Chapter IV, major features and costs are as follows:

1. **Windmills and Select Habitat.** Major construction features of the 25 watering devices will consist of drilling 8-inch diameter wells, installing 100 feet of 6-inch casing, windmills with 10-foot diameter vanes, armored gear boxes, 28-foot, 4-post towers, and fiberglass water storage tanks. Each windmill would be capable of producing a maximum of 300 gallons of water per hour operating under optimum conditions. Estimated cost is $406,000.

2. **Finney Lake Restoration.** Originally, plans consisted of dredging channels 15 to 20 feet deep and 75 to 120 feet wide through encroaching cattails. Because of the high cost of dredging, CDFG personnel will use explosives instead of dredging to modify 40 acres of the lake's habitat. Estimated cost is $1,200,000.

3. **Tracts 10 and 12.** Acquisition and developing 363 acres by cut and fill earthwork to construct dikes, ponds, and marsh. Existing tile drainage system to be rehabilitated. Estimated cost is $990,000.

4. **Isolated Parcels.** No construction features are contemplated on this acreage. The only cost associated with this measure is the
purchase of land from private ownership at an estimated cost of $741,000.

5. **Wister Habitat.** Development will include grading 160 acres of land, constructing perimeter roads, levees, ponds, and supply ditches. Estimated cost including acquisition of land is $242,000.

Total investment cost for the five measures is $3,579,000 and includes acquisition of land, construction, and development.

The amendatory legislation requests that these costs be nonreimbursable.

**J. Construction Problems**

1. **Weather Conditions.** Weather conditions at the construction site are unusual and could have an adverse effect upon operations.

   Although winter temperatures rarely drop below freezing, summer temperatures sometimes reach a high of 125°F, which could necessitate use of ice to cool the concrete along with special pouring and curing procedures.

   During the spring the area is subject to occasional wind storms, with gusts up to 60 miles per hour. The combination of high sustained winds and sand dunes on the northeast side of the project area will require use of a greater than normal amount of water and possibly result in curtailment of operations during occasional sand storms.

2. **Dewatering.** A high ground-water table created by canal seepage is located beneath the existing canal. By locating the new canal uphill, and some distance away from the present canal, dewatering operations during construction of Reach 1A should be negligible. In Reach 1B where topography and hydraulic gradient constraints require the new canal to abut the existing canal, dewatering operations will be necessary resulting in higher construction costs in this reach.

3. **Sand Hills Impact Range.** From approximately Station 650+00 to Station 800+00 the new canal alinement will cross the former Sand Hills U.S. Navy Impact Range. This range was used during World War II. Prior to deactivation the range was ostensibly cleared of exposed ordinance.
Nevertheless, this will not insure that unexposed ordinance could not be accidentally exploded during excavation activities.

To alleviate this potential hazard, a specific safety program will be developed, in cooperation with the U.S. Navy, prior to the actual construction.

4. Watering of New Canal. The existing canal will be used for irrigation water until final connections are made to the All-American Canal Turnout and Siphon No. 7.

During the construction period it will be necessary to fill completed concrete-lined portions of the new canal with water to prevent concrete buckling caused by temperature changes and concrete heaving caused by ground-water pressures.

This will be accomplished by pumping water from the existing canal through small pipes to the completed sections of the new waterway.

K. Operation, Maintenance, and Replacement

The canal lining project will result in a reduction in operating and maintenance costs.

The savings will be acquired as a result of decreased maintenance needs generated by construction of a concrete-lined canal.

Weed control costs, involving periodic spraying, chaining, and burning operations will be substantially reduced.

Canal bank sloughing and erosion of canal bottoms will be all but eliminated with correspondingly lower maintenance costs.

It is estimated that present O&M costs of $100,000 will be reduced to $56,000 as a result of the canal lining project, for a net savings of $44,000 annually.

L. Cost Estimate

The estimated construction cost based on July 1977 prices is $43,640,000.

In addition to this, land acquisitions for the purpose of retirement of water-right acreage ($2,545,000) and fish and wildlife mitigation costs ($3,579,000), will increase the Government's investment to $49,764,000.
The canal construction cost of $43,640,000 will be repaid over a period of 40 years by the CVCWD except during the interim period when the United States will assume the annual payments.

Costs for land acquisition and fish and wildlife mitigation should be nonreimbursable.

A breakdown of construction costs is contained in the Project Cost Estimate Summary Sheet (Form 7-1720-5/72) which follows this chapter.

M. Construction Schedule

Construction of the Coachella Canal, including planning, will require approximately 4 years.

Based on commencement of construction in the Fall of 1978, the goal for completion is projected for the close of the calendar year 1981.

Program goals and projections are shown on Form PF-2 which follows.
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<tr>
<th>PROPERTY CLASS</th>
<th>DESCRIPTION</th>
<th>CCE SHEET NUMBERS</th>
<th>LABOR AND MATERIALS BY CONTRACTOR</th>
<th>LABOR AND MATERIALS BY GOVERNMENT</th>
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Note: The estimated cost of Project 19,550,000. Prices as of July 1977.
### Colorado River Basin Salinity Control Projects - Title 1 Division

#### Coachella Canal Unit

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<th>PROGRAM ITEM</th>
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<td>12. TOTAL OBLIGATIONS</td>
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**Notes:**

- **Recommended:** [Recommended by Office Date]
- **Approved:** [Approved by Office Date]
- **Revised:** [Revised by Office Date]

**Department of the Interior**

- **United States:**
  - **Control Schedule**
  - **Colorado River Basin Salinity Control Projects - Title 1 Division**
  - **Coachella Canal Unit**

**Office:** Boulder City, Nevada

**Date:** January 1978

**Region:** [Region]

**Options:**
- **General Investigations**
- **Loan Program**
- **Construction**
- **Other**
VI. ENVIRONMENTAL CONSIDERATIONS

A. Previous Environmental Studies

This section of the report consists of a summarized update of environmental information on the Coachella Canal Lining contained in the Environmental Statement. (1)

A comprehensive account of the project's environmental factors, together with their impacts and proposed mitigation measures, can be found in the Environmental Statement and the report on Recommendations for Fish and Wildlife Mitigation Measures. (5)

Also, a chapter concerning "Environmental Considerations" relative to the Coachella Canal lining project is part of the "1973 Special Report." (6)

B. Existing Environment

The project site is situated on the Imperial East Mesa, where ground surface elevations range from about 160 feet above to 50 feet below mean sea level. Surficial deposits are predominantly sandy, unconsolidated, stratified, and intercalated with silt, clay, or gravel lenses. Most of the project area is a high risk seismic zone. Geothermal anomalies exist in the lower- and mid-section of the clay alinement.

The ground-water gradient is generally from east to west. Depth to ground water varies from 5 feet to 30 feet in the vicinity of the new canal alinement.

Vegetation is typical Sonoran Desert and consists primarily of creosote bush with lesser amounts of bursage, joint fir, and salt bush. Predominant vegetation in desert washes is ironwood, palo verde, creosote bush, and bursage. In low areas adjacent to the existing canal, ground water has created ponding where riparian marsh vegetation exists. Hydrophyte and phreatophyte species include cattails, common reed, sedges, rushes, willow, cottonwood, arrowweed, saltcedar, and mesquite.

Fish found in the canal and seepage ponds are typical of fishes found in the Lower Colorado River. Largemouth bass is by far the most abundant species in the project's watered areas.
Wildlife species in the project area are numerous; however, population densities are relatively sparse. Rodents and birds makeup the greatest numbers in species and populations. Large mammals found in the area include deer, coyote, fox, badger, and skunk. The endangered Yuma Clapper Rail (Federal list) and the rare California Black Rail (State list) are known to use the seepage pond's marsh habitat for nesting.

The majority of the land required for the project and that land immediately adjacent is undeveloped desert shrub. The only development is approximately 1,000 acres of private land which is in citrus.

Off-road vehicle use in the area is by far the most popular recreational activity along the canal. The majority of this activity is associated with the nearby sandhills. There is some trespass fishing and swimming activity in the existing canal.

There are no known archeological resources within the new canal rights-of-way. The adjacent Imperial County Sand Hills is listed on the Registry of National Landmarks. As a result of no archeological or historical resource sites having been identified within the new canal rights-of-way, the Bureau of Reclamation has made a determination of "No Effect" on such resources pursuant to the procedures established by 36 CFR, Part 800.

C. Unavoidable Adverse Effects

Under Fish and Wildlife Service's "Ecological Planning and Evaluation Procedures," values of fish and wildlife habitat can be defined and are expressed in Habitat Units (HU). Total losses to be incurred by the project are valued at 12,167 HU; 10,149 HU of wildlife habitat and 2,018 HU of aquatic habitat.

The major unavoidable adverse effects of the project are relative to the loss of currently available water provided by the extensive seepage from the existing canal in the form of high ground-water levels and open water areas. With the eventual diminishment of this water, habitat will be severely impacted by loss of 36 acres of open ponded water, 496 acres of hydrophytic vegetation (marsh), and 2,351 acres of mixed phreatophytes.
D. Mitigation Measures

1. Legal and Institutional Parameters. In compliance with provisions contained in the 1958 Fish and Wildlife Coordination Act (Public Law 85-624), an Ad Hoc Committee consisting of fish and wildlife experts from various State and Federal agencies, together with Bureau of Reclamation officials was formed. The purpose of this committee was to determine and quantify adverse impacts to fish and wildlife and, if necessary, to formulate and develop mitigation concepts to compensate for fish and wildlife losses.

The recommended measures for reasonable amounts and kinds of mitigation as taken from the findings of this committee together with the estimated costs are outlined in Chapters II and V of this report.

Benefits that can be expected to develop out of these mitigation features are as follows.

2. Mitigation Benefits.
   a. Windmills and Select Habitat. Twenty-five windmills will be constructed in the project area on Government-owned land that constitutes high-quality habitat.

   These features will produce enough ground water through pumping to maintain a supply of drinking water for area wildlife and support a small amount of vegetation along the overflow drainage.

   A study has determined that each windmill will probably benefit any wildlife within an area of 160 acres around each device. It will also produce an additional 5.6 habitat units on each site where a windmill is located.

   The total environmental benefits that can be attributed to this mitigation feature are estimated at 4,140 additional wildlife habitat units, or 34 percent of the losses incurred by the canal lining project. (5)

   b. Finney Lake Restoration. This feature consists of creating a larger open water area and deeper channels in Finney Lake. The Lake is presently overgrown with cattails which will be removed through the use of explosives.
The modified area will provide increased habitat for ducks and other semiaquatic wildlife. Clapper rails and other rail species can be expected to increase their use of the area.

Removal of the dense cattail stands will also enhance fish habitat by providing better quality water of an adequate depth.

It is estimated that the Finney Lake Restoration Project will replace up to 548 habitat units or 4.5 percent of the losses attributable to the Coachella Canal lining project. (5)

c. Tracts 10 and 12. The purchase, development, and management of 363 acres of private land that currently borders the Salton Sea National Wildlife Refuge will create a prime habitat capable of attracting a wide variety of wildlife.

The new habitat, which consists of two separate areas known as Tract 10 and Tract 12, will be particularly beneficial to bird life.

Of considerable importance is the anticipated colonization by the endangered Yuma Clapper Rail. Increased colonization of the area can also be expected by the Black Rail, a species presently on California's official list of rare wildlife.

When completed this extension of the Salton Sea National Wildlife Refuge will provide an annual replacement of 814 habitat units. This constitutes 6.7 percent of the total losses attributable to the canal lining project. (5)

d. Isolated Parcels. Acquisition of a number of remotely located isolated parcels of land containing springs, ponds, waterholes, or other high quality fish and wildlife habitat will serve to additionally mitigate losses incurred to area wildlife as a result of Coachella Canal construction.

It is estimated that one additional habitat unit will be created for each acre of ground acquired under the plan. Since approximately 2,120 acres are involved in the isolated parcels purchase plan, a total of 2,120 new habitat units would be produced, or 17.4 percent of the total estimated fish and wildlife losses generated by the canal lining project. (5)
e. Wister Habitat. This mitigation measure entails acquisition of a 160-acre parcel of land which will be developed into a high grade marsh habitat for waterfowl, shorebirds, and wading birds, including the endangered Yuma Clapper Rail.

Additionally the area will be conducive to habitation by certain forms of animal life including muskrat, raccoon, and small rodents.

The improved habitat will result in an increase of 723 habitat units or 6 percent of the estimated losses to fish and wildlife in the project area. (5)

The location of lands acquired under this and the previously identified land acquisition programs is shown on Table 7.

A summary of the mitigation measures outlined above is contained in Table 8.
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<td><strong>$3,579,000</strong></td>
<td><strong>68.5</strong></td>
<td><strong>8,345.0</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
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1/ Includes interest during construction.
2/ USBR estimate modified by CDF&G.
4/ CDF&G estimates.
5/ Modified restoration proposal to be designed and implemented by CDF&G using explosives.

3. Management, Operation, Maintenance, and Replacement for Fish and Wildlife Features. The mitigation measures described above, and elsewhere in this report, will require an expenditure of $3,579,000.

Contingent upon the approval of Congress for the necessary funds to develop these features, the appropriated funding will be distributed as follows:

a. Funds in the amount of $2,589,000 will be transferred to the CDF&G for the necessary land acquisition, design, construction, and development of windmills and select habitat, Finney Lake restoration, isolated parcels, and Wister habitat. The USBR and the CDF&G will agree at a later date as to which agency will actually do the acquiring of land with the funds made available by this agreement.
b. Funds in the amount of $990,000 will be transferred to USF&WS for necessary land acquisition, design, construction, and development of the tracts 10 and 12 addition to the Salton Sea National Wildlife Refuge.

Should the USF&WS be unable to accomplish the land acquisition for this mitigation measure, the funds to acquire those lands will be transferred to the USBR and within the limitation of that funding, the USBR will perform the land acquisition.

The CDF&G and the USF&WS will have full responsibility for obtaining all necessary clearances, permits, water rights, water allocation use permits, or such other agreements as might be needed for the successful and timely completion of these mitigation measures. The USBR will cooperate with USF&WS and CDF&G in obtaining such permits to enable those agencies to carry out the mitigation.

The mitigation measures will be 100 percent complete five years from the date that Congress makes funds available, provided the CDF&G, USF&WS, or USBR are not delayed by factors beyond their control in completing such mitigation. Accounting and audit for expenditure of these funds will be performed by the General Accounting Office.

Operation, maintenance, and replacements (OM&R) performance and funding associated with all the mitigation measures will be the responsibility of either the USF&WS or the CDF&G.

Amendatory legislation has also requested that the expenditures listed above be nonreimbursable.
VII. ECONOMIC AND FINANCIAL ANALYSIS

A. General
The lining of the Coachella Canal will salvage about 132,000 acre-feet of water annually. The salvaged water will be used to supplement or replace upstream Colorado River storage water that is being released to Mexico as part of the scheduled treaty deliveries under Minute No. 242.

B. Project Benefits
No benefit evaluation was made for this project because Title I does not require economic justification. However, the water will be used to supplement Colorado River treaty deliveries to Mexico during the interim period. After the interim period, the water will be used for irrigation and will accrue benefits that will be equal to or greater than its present use. There will also be a savings in operation and maintenance costs.

C. Project Economic Costs
The cost for the Coachella Canal lining is estimated to be $49,928,000. The investigation cost of $164,000 is nonreimbursable by the authority of Public Law 92-149. The remaining cost is $49,764,000 for the project.

The interest that would accrue during the construction period is estimated to be $5,119,000.

The estimated present O&M costs of $60,000 for CVCWD will be reduced to $56,000 as a result of the canal lining.

D. Cost Allocation
The nonreimbursable costs are $164,000 investigation cost, $3,579,000 for fish and wildlife mitigation, and $2,545,000 for land purchase. The remaining project costs of $43,640,000 are reimbursable and allocated to irrigation.

E. Repayment
Repayment of $43,640,000 will be completed within a 40-year period without interest following the completion of construction. A portion of the $43,640,000 will be nonreimbursable by the District
because there will be an interim period of about 6 years or until such time as the State of California is limited to 4.4 million acre-feet of water per year by Secretarial Declaration wherein the United States will assume financial responsibility and the annual payments will be written off in return for the water used to replace a portion of the releases made from storage to meet the agreed upon salinity differential commitment of Minute No. 242.

Assuming the Coachella Valley County Water District will begin payments in 1987, the balance at that time would be $37,094,000 or an annual payment of $1,091,000. The annual cost on an irrigated acre basis would be $19.70. Subtracting the Coachella Valley County Water District's $4,000 share of reduction in OM&R costs results in a net cost increase of $19.63 per acre on 55,369 irrigated acres.

Distributing the payment over the 132,000 acre-feet of water saved yields a cost per acre-foot of $8.27. Without the project, water deliveries would be reduced, resulting in a direct impact on the farmer's profit.
REFERENCE SOURCES

1. Final Environmental Statement, Colorado River Basin Salinity Control Project, Title I - June 18, 1975, INT FES 75-57.


3. An Evaluation of the Prefabricated Asphalt and Butyl Rubber Liners One Year After Installation - 1965.


9. An Investigation of Treating a Reservoir by the Stage Treatment With a Small Quantity of Chemical Soil Sealant, Coachella Diversion, All-American Canal System - 1964.


