CHAPTER I

Introduction

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INTRODUCTION

Presented in this chapter is the background of the Salton Sea area and the purpose of and participants in this appraisal evaluation. Also described are earlier studies of Salton Sea salinity and water levels.

1.0 PROJECT

This appraisal-level report presents results of an effort to identify and evaluate alternatives for improving physical, chemical, and biological conditions of the Sea. An evaluation and screening process and its application is presented, 54 alternatives are described and evaluated, and conclusions on alternatives that should be retained for further consideration are made.

1.1 DESCRIPTION OF THE AREA

Located at the bottom of the Salton Basin, the Salton Sea has a surface elevation of about -227 feet msl (1996) with an estimated surface area of 240,000 acres (376 mi^2). The Sea is about 35 miles long and 15 miles wide. At its current elevation, the Sea has a maximum depth of 51 feet with its lowest elevation at approximately -278 feet msl. The Salton Sea has a volume of approximately 7.5 million acre-feet (AF) and annual inflows of approximately 1.3 million AF contribute about 4 million tons of additional salt.

The Salton Basin is a below-sea level topographic depression extending from Palm Springs, California, on the north to the Gulf of California on the south. This area has, in the recent geologic past, undergone historic cycles of filling with water and evaporating as the Colorado River made radical course changes (Waters, 1983). Lake Cahuilla, the most recent predecessor to the Salton Sea, at one time had a surface elevation slightly above sea level. The last filling of Lake Cahuilla has been dated at 300 to 500 years ago (Colorado River Board of California, 1992).

Between the time of the evaporation of Lake Cahuilla and the recent formation of the Salton Sea, the area was similar to the bare desert, characteristic of present-day basins to the east of the Sea.

The Salton Basin comprises over 500,000 acres of land and water.[1] Since there is no outlet from the Basin, evaporation is the only escape for water that enters it. High temperatures and low humidity contributed to rapid evaporation of the water that occasionally filled Lake Cahuilla, leaving a salty crust on the Basin floor. Those same factors are at work on today's Salton Sea, resulting in approximately 5.5 feet of evaporation per year.

1.2 HISTORY

The modern-day Salton Sea, often referred to as the largest man-made water body in California, was formed in late 1905 as the result of a break in a temporary levee along the Colorado River (Reclamation and DWR, 1974). For a period of about 16 months after the breach, the Colorado

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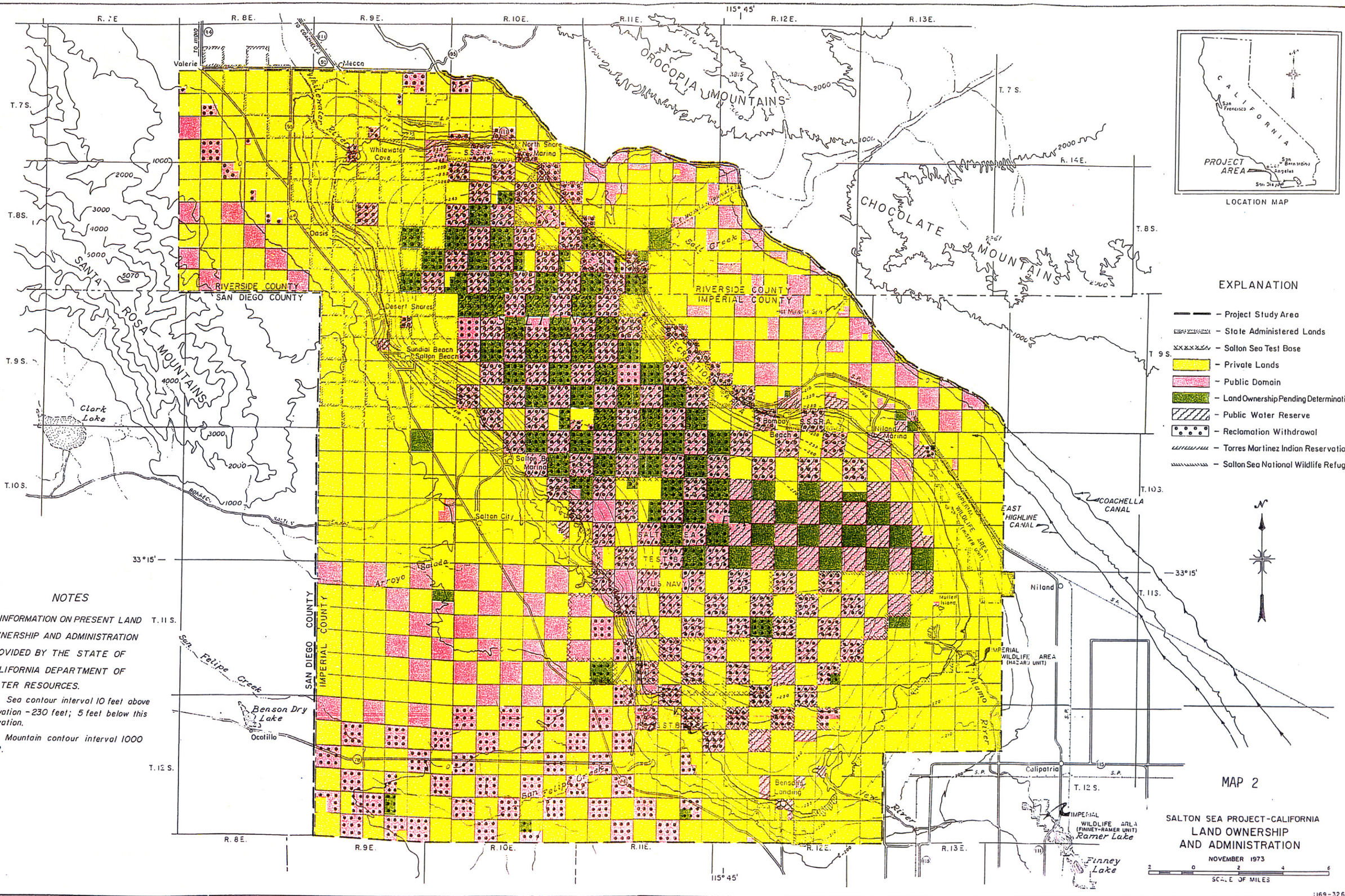
[1] Much of this information is updated from the 1974 Salton Sea Project Federal-State Feasibility Report.



LOCATION MAP

EXPLANATION

- Project Study Area
- State Administered Lands
- Salton Sea Test Base
- Private Lands
- Public Domain
- Land Ownership Pending Determination
- Public Water Reserve
- Reclamation Withdrawal
- Torres Martinez Indian Reservation
- Salton Sea National Wildlife Refuge

NOTES

INFORMATION ON PRESENT LAND OWNERSHIP AND ADMINISTRATION PROVIDED BY THE STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES.

Sea contour interval 10 feet above elevation -230 feet; 5 feet below this elevation.

Mountain contour interval 1000 feet.

MAP 2

SALTON SEA PROJECT-CALIFORNIA
LAND OWNERSHIP AND ADMINISTRATION

NOVEMBER 1973

SCALE OF MILES

1169-326-22

Interior - Reclamation, B.C., Nov. 4-74

River flowed into the below-sea level depression, then known as the Salton Sink, filling it to a depth of more than 80 feet above its lowest elevation. Since that time, the water level in the Sea has been seeking a balance between the harsh desert forces that extract water by evaporation and inflows of water from surface and subsurface sources. For a time following closure of the break in the levee, water levels declined rapidly as evaporation greatly exceeded inflow. A minimum level was reached in the 1920's, after which the level of the Sea once again began to rise, due in major part to importation of water for agriculture. Since then, maximum elevations were reached only to be exceeded in following years. The level of the Sea has been steadily rising since the emergence of agriculture in the area to a current elevation of approximately -227 feet msl.

During the course of historical changes in the Sea's water balance, its salinity has also changed. At the time of the levee break, the salinity of the Sea was about that of the Colorado River, but because of evaporative concentration and redissolution of lakebed salt deposits, the salinity began to rise as water levels fell toward the minimum level of the 1920's.

Subsequently, as water was imported for irrigation, salt loads from irrigation drainage and return flows added salt to the water body. As agriculture expanded and water importation increased, not only did the Sea's water level increase, but salinity also rose steadily, eventually surpassing that of average ocean salinities. Today the Sea's salinity has reached its highest historical level of approximately 44 ppt, or a level about 25 percent greater than that of the ocean.

As depicted on the map on the following page, land ownership is typically in a checkerboard pattern, with sections alternating between Federal and private ownership. Much of the north shore is owned by the Torres-Martinez Desert Cahuilla Indians. The northeast shoreline has been leased to California for use as the Salton Sea State Recreation Area.

In 1924 and 1928, the President of the United States executed Public Water Reserve Order Numbers 90 and 114, respectively, for withdrawal of lands located in and surrounding the Salton Sea. The Public Water Reserve consists of 123,360 acres of public land lying below an elevation of -220 feet. These lands were designated as a repository to receive and store agricultural, surface, and subsurface drainage waters.[2] The State of California designated the Sea for this same purpose in 1968.

Land, recreational, and ecological values associated with the Sea have declined over the last decade, due in large part to the rising salinity and surface elevation. The desire to regain those values to the largest extent possible has prompted the investigations documented in this report.

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[2] Appendix F, *Summary Analysis of Authorities and Responsibilities Associated With the Salton Sea*, Prepared for Meyer Resources, Inc., by Kathrine Currie, Chelsea Congdon, Taylor Miller, Gary Weatherford, and Brian Zanze, December 1988, p. 9.

1.3 PURPOSE

This report documents the process to identify and evaluate alternative solutions to the problems afflicting the Sea. Public discussions and suggestions were encouraged throughout the process, and the identification of alternatives were solicited in a public forum.

After identification of alternative solutions, available data for each alternative were collected and compiled. The alternatives were then evaluated against criteria that would either eliminate them from further consideration or rank them in order of ability to meet the criteria in protecting and enhancing Sea resources.

This document provides a description of all available alternatives and makes recommendations on which ones warrant further consideration and investigation. Alternatives identified in this report as warranting further consideration are candidates for feasibility-level analyses and completion of environmental compliance under the National Environmental Policy Act and California Environmental Quality Act.

1.4 AUTHORITY

Local authority to pursue remedies to problems facing the Salton Sea comes from the formation of the Salton Sea Authority by a Joint Powers Agreement on June 2, 1993. This agreement between the Coachella Valley Water District, Imperial Irrigation District, Imperial County, and Riverside County established the Authority as a recognized State agency. The Authority was formed to work with California State agencies, Federal agencies, and the Republic of Mexico to develop programs that would continue beneficial use of the Salton Sea. In the agreement, "beneficial use" includes the primary purpose of the Sea as a depository for agricultural drainage, storm water, and wastewater flows; for protection of endangered species, fisheries, and water fowl; and for recreational purposes.

The State's authority to participate in this effort stems from responsibilities of the California Water Quality Control Board, California Department of Fish and Game, and DWR. Federal authority to participate is a result of the enactment of Title 11, Public Law 102-575, Reclamation Projects Authorization and Adjustment Act of 1992, dated October 30, 1992, allowing Federal expenditure of up to $10 million for "investigation and development of a method or combination of methods" to address salinity problems at the Salton Sea. This legislation also required non-Federal entities to at least match Federal expenditures.

1.5 PARTICIPANTS

The principal participants in this appraisal evaluation are the Authority, DWR, and Reclamation. An agreement, the Salton Sea Planning and Research Agreement (Agreement), has been executed among these agencies. This Agreement describes the relationship among the parties, the responsibilities of the parties, cost-sharing arrangements, and the framework for accomplishing study activities. The California Regional Water Quality Control Board,

Colorado River Basin Region, has also participated in evaluation and collection of data necessary for alternative evaluation. At least 50 percent of the study cost is borne by the non-Federal participants; the remainder is provided by Reclamation.

Since the Authority does not have staff available to provide technical advice to the Board of Directors, a Technical Advisory Committee (TAC) was established to perform that function. The TAC is composed of staff from the individual Authority member agencies who have knowledge of the Sea and have the ability to work together to address its problems. Reclamation and DWR work with the TAC to develop study tasks and assure that the study progress meets the needs of the Authority. While the TAC membership was limited to member agencies of the Authority, representatives from Reclamation, DWR, California Department of Fish and Game, Coachella Valley Association of Governments, Imperial Valley Association of Governments, Southern California Association of Governments, and California State Secretary of Resources were invited to participate as *ex officio* members.

A Steering Committee was established under the three-party Agreement to guide the direction of the study. Coachella Valley Water District, Imperial Irrigation District, Riverside County, Imperial County, DWR, and Reclamation have representatives on the Steering Committee. Each member can invite representatives from related or supportive entities to attend Committee meetings in order to facilitate constructive input and to exchange information.

Photo 1. Salton Sea Authority Board of Directors.

The Steering Committee is responsible for developing work plans, schedules, and budgets; monitoring the development and completion of the planning and research activities; providing direction to the Project Manager with respect to the development of planning and research activities; and reviewing and providing direction to the Project Manager regarding changes to the schedule and/or work plans.

1.6 EXPENDITURES

Congress appropriated $100,000 in each of fiscal years 1994, 1995, and 1996 and $200,000 in fiscal year 1997 for accomplishing activities authorized under Public Law 102-575. These funds were part of Reclamation's General Investigation budget. In accordance with P.L. 102-575, those funds had to be at least matched by one or more non-Federal entities. Expenditure of the appropriated funds has been lagged appropriations because of delays in execution of a cost-sharing agreement and the lead time required for initiation of activities. While efforts are being made to accelerate task accomplishment to more accurately reflect funding, cost-sharing requirements by non-Federal participants may also dictate the pace of the activities.

Table 1 shows task accomplishment and expenditures for the fiscal year 1994 appropriation.

TABLE 5
FISCAL YEAR 1994 EXPENDITURES

Task	Federal Funds	Non-Federal Funds	Total
Program Management	$22,247.95	-0-	$22,247.95
Program Support	$ 2,899.99	-0-	$ 2,899.99
Bathymetry	$51,271.71	$38,000	$89,271.71
Alternative Dike Structure Eval.	$12,898.99	-0-	$12,898.99
Weather Stations	-0-	$25,000	$25,000
Water Current Model	-0-	$40,000	$40,000
Documentation	$10,447.82	-0-	$10,447.82
Total	$99,766.46	$103,000.00	$202,766.46

Federal funds appropriated for fiscal years 1995 and 1996 and a portion of funds appropriated for fiscal year 1997 were used primarily for the work described in this report. Federal expenditures for this work through December 1996 totaled approximately $184,000. Non-Federal expenditures are being use for calibration, verification, and implementation of the water current model, installation of one additional weather station, and collection of water quality data.

1.7 PRIOR STUDIES AND OTHER ACTIVITIES

Prior Studies

Recognition of a problem with salinity at the Salton Sea and a desire to correct it first occurred in the mid-1960's. In response to this recognition, Reclamation and DWR jointly completed reconnaissance and feasibility studies that investigated the options available to manage the

Salton Sea. Study results were reported in 1969 and 1974, respectively. The 1974 study recommended that an in-Sea evaporation pond be pursued. A draft Environmental Impact Statement (EIS) was completed on the proposed 50-mi^2 evaporation impoundment, but construction of the Project was abandoned due to lack of funding.

In April 1986, the Resources Agency of California created the Salton Sea Task Force at the prompting of the California Department of Fish and Game. This group, consisting of representatives from Federal, State, and local governmental agencies, was formed to investigate practical solutions and associated funding mechanisms to address the problems of high water and salinity levels of the Salton Sea. The State of California also hired a consultant to complete certain studies and act as a staff resource to the Task Force. Reclamation and DWR both participated on the Task Force. The Task Force dissolved after the Authority was formed.

Other Activities

The majority of this report is devoted to the process of identifying and evaluating alternative solutions to the salinity and water surface elevation problems of the Sea. Additional activities are necessary, however, to complete detailed analyses of alternatives selected to pursue further. These activities either provide general characterizations of the Sea or help narrow the area of consideration for a specific type of solution. Each of these activities is documented in separate reports or agency memoranda.

Water Current Model. Currents are known to exist in the Sea. However, current velocity, direction, or depth as well as any effect they may have on chemical, physical, or biological features of the Sea are not known. In order to answer these questions, the University of California, Davis, campus was contracted to develop a generic model of water currents in the Sea. This contract was awarded through the DWR. While the model was developed under this contract, availability of funds required that its calibration and verification be done under separate contract.

Weather Stations. Since the water current model requires information on climatic conditions, three weather stations were installed on the edge of the Sea. One station, known as Salton Sea East (CIMIS Station Number 128) was installed at the intersection of Davis and Pound Roads near Niland, California. A second station, known as Salton Sea West (CIMIS Station Number 127), was installed at the boat launch facility in the community of Salton City. These stations report data into the existing California Irrigation Management Information System (CIMIS) network. Each station is equipped with a micro-datalogger,

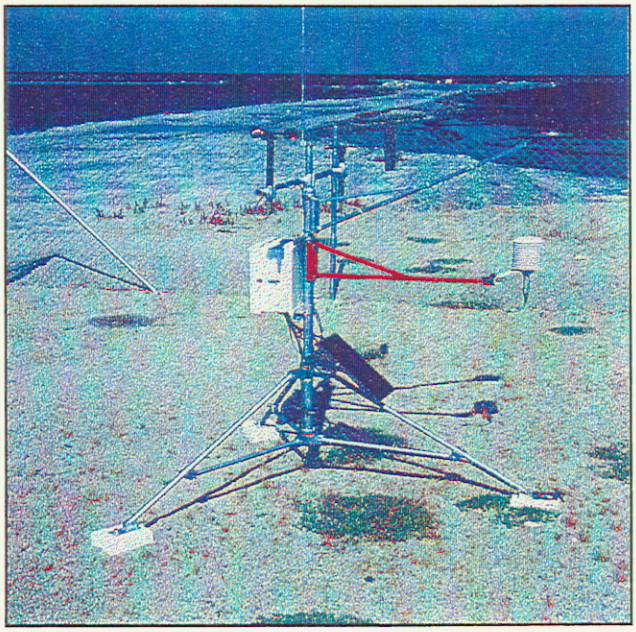

Photo 2. CIMIS Station at Salton City.

solar pyranometer, air temperature/relative humidity probe, anemometer, and wind direction detector. The datalogger is able to extrapolate climatological data measured by various pieces of weather equipment and store this data for extraction at a later time. Over 1 year's worth of data have been collected and are available for use in development of the current model. The third station, unnumbered and known only as Salton Sea North, was installed later at the Salton Sea State Recreation Area Headquarters near the community of North Shore. The station differs from the other two only in that it is not connected to the regular CIMIS system but is accessed directly.

Bathymetry. Design of alternatives, their costs, and impacts on water currents are dependent upon accurate underwater topography. Since topographic measurements had not been taken for over 20 years, a bathymetric survey was completed to obtain accurate topographic information. The bathymetric survey was conducted using sonic depth recording equipment interfaced with a differential global positioning system capable of determining sounding locations within the Sea. The system continuously recorded depth and horizontal coordinates of the survey boat as it was navigated along gridlines covering the Sea. The positioning system provided information to allow the boat operator to maintain course along these gridlines. Water surface elevations recorded by a United States Geological Survey (USGS) gage during the time of collection were used to convert the sonic depth measurements to true Sea bottom elevations.

The 1995 underwater surface areas at predetermined 1-foot contour intervals were generated by a computer graphics program using the data collected. The above-water areas were measured from digitized USGS quad maps of the Sea. The new topographic map of the Sea is a combination of the digitized and underwater-measured topography. Area and capacity tables were produced by a computer program that uses measured contour surface areas and a curve-fitting technique to compute area and capacity at prescribed elevation increments. Results of this 1995 hydrographic survey are contained in the *Salton Sea 1995 Hydrographic GPS Survey* (Reclamation, 1995).

Dike Construction Options. Previous designs for dikes used armored earth embankments. A value engineering effort was undertaken to identify and evaluate other methods of construction. Many concepts were considered, including concrete, plastic, and metal sheet piling, as well as various cross-sections for an earthen dike. It was concluded that an earthen dike would be the most appropriate design, but several possible deviations from previous designs that could save construction costs were suggested. Results of this effort are documented in *A Value Engineering Evaluation of Salton Sea Alternative Dike Structures* (Reclamation and TAC, August 1995).

1.8 REPORT ORGANIZATION

This report provides full documentation of the most current activities undertaken to identify, develop, analyze, and prioritize options for managing salinity and surface elevation of the Sea.

The remainder of the report is organized as follows:

--Chapter II defines Salton Sea problems in several areas;
--Chapter III defines methods of evaluating alternative solutions;
--Chapter IV presents alternatives retained for further consideration;
--Chapter V presents alternatives eliminated from further consideration; and
--Chapter VI presents conclusions and recommends future actions that may be undertaken.

The report concludes with a list of references used in connection with or relevant to this report. A glossary of terms is included as well for easy reference of abbreviated and technical terms. Finally, one appendix is provided which contains the PCM which was developed at the April 8, 1996, workshop. The PCM was the resulting derivation of assigned weights/ranking of evaluation criteria used to analyze proposed alternatives contained in this report.