Chapter 1

Purpose and Need

Designs of the preappraisal level alternatives presented in this report were based on the ability of the alternatives to reduce salinity in the Salton Sea (Sea), to maintain an acceptable water surface elevation in the Salton Sea, and to use proven technology. Costs are presented for information in future screening. No conclusions are presented regarding whether or not the alternatives should be retained for further consideration.

Purpose and Scope of Study

The purpose of this study is to develop alternatives that would reduce salinity to no more than 40 parts per thousand (ppt) and to maintain a water surface elevation in the Salton Sea to about -232 mean sea level (m.s.l.), using proven technology.

The Salton Sea problems are many and complex because the Sea is an integral part of a dynamic hydrologic system. The physical problems of the Sea are directly related to the characteristics of inflow, to hydrologic factors in the basin, and to the geometry of the basin and the Sea. The salinity concentration and the water level problems will be discussed in this document.

Because of Salton Sea's present physical, chemical, and biological characteristics, the Sea falls short of its potential contribution toward national, regional, and local needs for recreation opportunity, wildlife conservation, and community enhancement. These characteristics are discussed in other documents and are outside the scope of this report.

Description of the Area

Located at the bottom of the Salton Sea basin, the Salton Sea has a surface elevation of about -227 feet m.s.l. (1996) and an estimated surface area of 240,000 acres (376 square miles [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 m.s.l. The

Salton Sea has a volume of approximately 7.5 million acre-feet. Annual inflows of approximately 1.3 million acre-feet contribute about 5 million tons of additional salt.

The Salton Sea basin is a below-sea-level topographic depression extending from Palm Springs, California, on the north, to near the Gulf of California, on the south. This area has, in the recent geologic past, undergone 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 east of the Sea.

The Salton Sea basin comprises more than 500,000 acres of agricultural land (updated from the 1974 report—Interior and Resources Agency of California [RAC]). Because 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.

History

The modern-day Salton Sea, often referred to as the largest manmade water body in California, was formed in late 1905 as the result of a break in a temporary levee along the Colorado River (Interior and RAC, 1974). For a period of about 16 months after the breach, the Colorado 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 1920s, 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 m.s.l.

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 1920s.

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.

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 (appendix F, Currie et al., 1988). 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.

Salinity Concentration Problems

For the last 25 years, the problem that has had the most attention has been salinity. That problem has become more pressing over the past 10 years as salinity concentrations have surpassed that of the ocean. Measurements indicated that the salt concentration at the end of 1995 was about 44 ppt, which is 9 ppt higher than average ocean salinity. An estimated 5 million tons of salt flow into the Sea each year and are left behind as the water evaporates. This rate of salt inflow causes an increase in salinity of about 0.51 ppt each year, provided the volume of water in the Sea remains unchanged.

Ideally, for the saltwater species of fish and other aquatic life in the Sea, a salinity level equivalent to ocean water, around 35 ppt, should prevail. However, biologists regard a salinity level of between 33 ppt and 37 ppt as adequate. With increasing salinity, survival of the fish in the Sea is in jeopardy. The limited reproductive success of some organisms has placed physiological stresses on the fishery food chain, as well as fish eggs, larvae, and adult fish. At some level, one or more of the links will finally break. At this point, the fishery will gradually or suddenly be lost, depending on the link that is broken first.

High salinity also tends to discourage recreational use of the Sea for body contact sports, such as swimming and water-skiing. In general, highly saline water can be irritating to the eyes and skin.

Higher salinity also causes increased corrosion of boats and other recreational equipment. With increasing salinity, there has been a gradual decline in water-related recreational use of the Sea. Figure 1 presents historical changes in the Sea's salinity and elevation.

Water Level Problems

In addition to salinity, a second major problem is water level fluctuation. The Sea's elevation is a balance between inflow and evaporation, and it normally fluctuates within 1 foot during a given year. In the history of the Sea, the elevation rose quickly to its highest point of close to -200 feet m.s.l. during its formation and then fell to around -250 feet m.s.l. until the introduction of agriculture to the area in the early 1920s. Since that time, it has steadily increased to its present height of approximately -227 feet m.s.l. Changes in inflow to and evaporation from the Sea have caused continually changing water levels during much of the Sea's existence.

Water level fluctuations are a serious problem as conditions of inflow and evaporation change. Both the Coachella Valley Water District and the Imperial Irrigation District, the irrigation districts in the area, have had legal action brought against them for damages to shoreline property because of inundation. Water level fluctuations are disruptive to using the Sea and adjoining land.

The gentle slopes of the land under and around the Sea cause a significant change in the shoreline with a relatively insignificant change in water level. Shoreline developments are being flooded as the water level rises, and changes in water level affect both private and public facilities. As the water

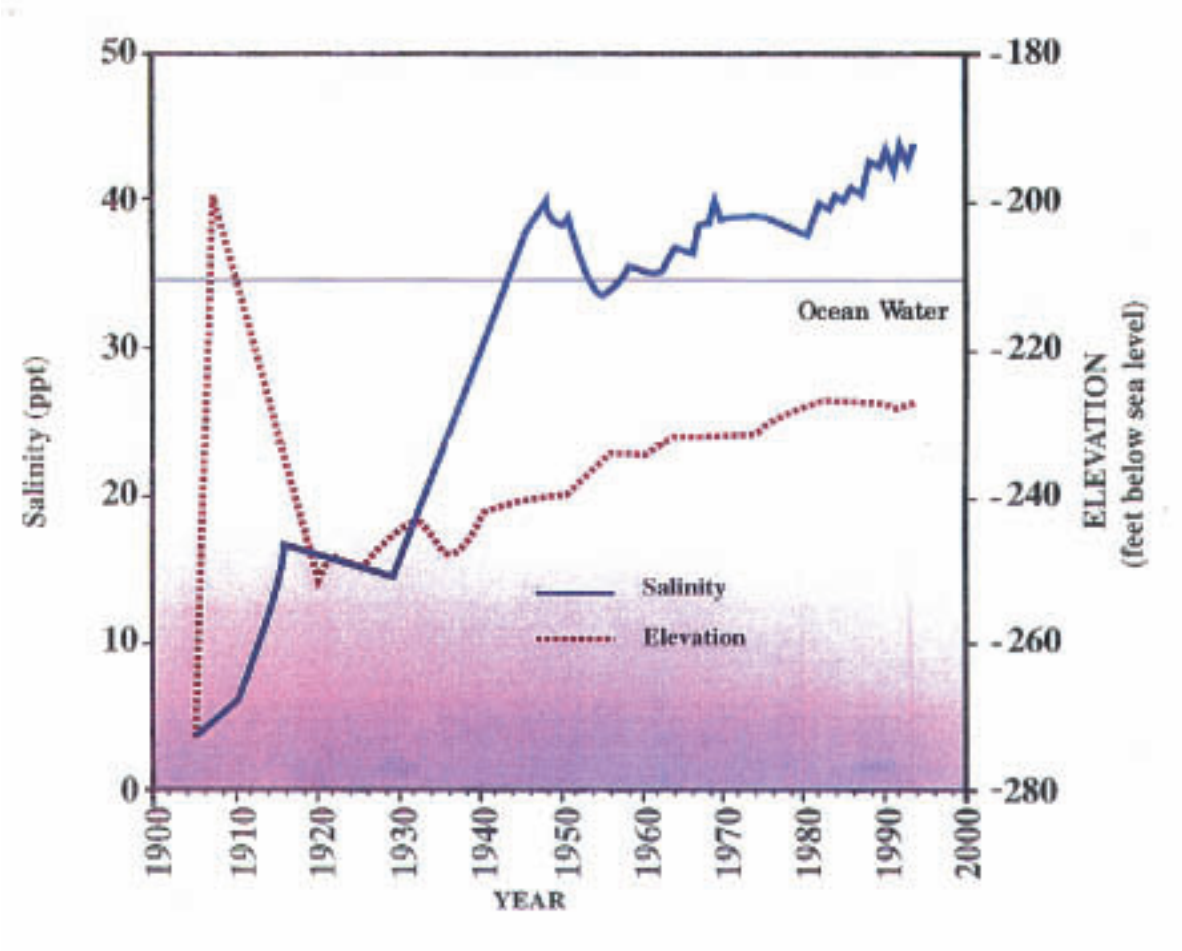

Figure 1.—Historical salinity and elevation through time.

level increases, there are additional costs in levee construction and maintenance. Millions of dollars have been spent trying to solve these issues alone. In addition, agricultural drainage would be adversely affected by water levels higher than those presently prevailing.

Authority

Local authority to pursue remedies to problems facing the Salton Sea comes from the formation of the Salton Sea Authority (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:

- Depository of agricultural drainage, storm water, and wastewater flows—the primary purpose of the Sea
- Protection of endangered species, fisheries, and waterfowl
- Recreation

The Salton Sea Authority is a public agency formed under the provisions of Articles I and II, Chapter 5, Division 7, Title 1 of the government code of the State of California for the purpose of "directing and coordinating activities relating to improvement of water quality and stabilization of water elevations and to enhance recreational and economic development potential of the Salton Sea and other beneficial uses, recognizing the importance of the Salton Sea for the continuation of the dynamic agricultural economy of Imperial and Riverside Counties." 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.

Participants

The principal participants in this appraisal evaluation are the Authority and the Bureau of Reclamation (Reclamation). The Salton Sea Planning and Research Agreement (Agreement) has been executed between these two agencies. This Agreement describes the relationships among the parties, the responsibilities of the parties, cost-sharing arrangements, and the framework for accomplishing study activities. At least 50 percent of the study cost is borne by the non-Federal participants; the remainder is provided by Reclamation.

A Technical Advisory Committee (TAC) has been established to provide technical advice to the Salton Sea Authority. 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 the Authority work with the TAC to develop study tasks and ensure that the study progress meets the needs of the Authority. While the TAC membership is 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 are invited to participate as *ex officio* members.

Program managers working for Reclamation and the Authority are responsible for developing work plans, schedules, and budgets; monitoring the development and completion of the planning and research activities; and providing direction to the development of planning and research activities.

Relationship to Other Projects

The problem of salinity of the Salton Sea and a desire to correct it was recognized first in the mid-1960s. In response to this recognition (Interior and RAC) 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 was completed on the proposed 50-mi^2 evaporation impoundment, but construction of the project never began due to a 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 surface elevations and salinity concentrations 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 participated on the task force, which was dissolved after the Authority was formed.

In September 1997, a *Salton Sea Area Study Alternative Evaluation Appraisal Report, Final Draft* (1997 report), was published in cooperation with the Salton Sea Authority, the California Department of Water Resources, and the Bureau of Reclamation. This report presented results of a study to identify and evaluate 54 alternatives submitted for consideration to improve the physical, chemical, and biological conditions of the Salton Sea.

The 1997 report included a two-fold process. Four criteria were developed to eliminate those alternatives which had no realistic potential for correcting

the problems of the Sea, and 20 evaluation criteria were developed and applied to rank those remaining alternatives that met the elimination criteria.