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DRAFT

ASSESSMENT OF SALINITY AND ELEVATION CONTROL FOR VARIED INFLOW

SALTON SEA RESTORATION PROJECT

April 2002

Prepared for:

Salton Sea Authority
78-035 Calle Estado
La Quinta, CA 92253-2930

Prepared by:

Tetra Tech, Inc.

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Various means to control Salton Sea (Sea) salinity at or below present concentrations are described in this document. It also presents the projected success of these salinity control methods and appraisal-level cost estimates for implementing salinity control. The continued viability of the Salton Sea is highly dependent on the inflows of agricultural runoff from the Imperial and Coachella Valleys. The effects of possible future reductions of those inflows are discussed. The lead agencies for the Project are the U.S. Bureau of Reclamation (Reclamation) and the Salton Sea Authority (Authority), a public agency formed to direct and coordinate actions related to improving conditions at the Salton Sea.

This report was prepared by Tetra Tech, Inc. under contract to the Authority, with funding provided through US EPA Grant X9892990100. Preliminary results of the investigation were presented to the Salton Sea Authority Board of Directors in September 2000. The investigation has been updated with data provided by Reclamation and Parsons Engineering. This report includes appraisal-level cost estimates that are expected to appear in an alternatives report that is under preparation by Reclamation and the Authority. The cost data may be updated when the alternatives report is finalized and published.

1.0 INTRODUCTION

1.1 History and Importance of the Sea

The present-day Sea was formed in 1905, when Colorado River flood flows breached an irrigation control structure and were diverted into the Salton Basin for about 18 months. Since then, agricultural drainage flows from the nearby Imperial, Coachella, and Mexicali Valleys and smaller contributions from municipal effluent and stormwater runoff have sustained the Sea. Over the years, the Sea has developed into a recreation area, wildlife refuge, and sport fishery.

The Salton Basin extends from Banning, California, on the north to Mexico near the international border on the south. The Sea itself is about 35 miles long and 15 miles wide. Recently, the elevation of the Sea has been about 227 feet below mean sea level (msl), with annual fluctuations of about 1 foot. The Sea's recent salinity concentration has been about 44,000 milligrams per liter (mg/L) (25 percent saltier than ocean water). Annual inflows in the recent past have been in balance with the water that has evaporated, or about 1.34 million acre-feet per year (maf/yr). Inflows add about 4 million tons of salt each year. Since the Sea has no natural outlet, the salinity in the Sea continues to rise each year as salts are left behind as water evaporates.

The Salton Sea and nearby wetlands are an integral part of the Pacific flyway, providing habitat and seasonal refuge to millions of birds. About 300 species of birds use the Sea, approximately two-thirds of all bird species in California. The Salton Sea ecosystem supports some of the highest avian biological diversity in North America as well as world wide. The fish in the Sea are a primary source of food for many of those bird species, and the fishery is also important for recreational reasons.

1.2 Need for Salinity Control

The objectives of the Salton Sea Restoration Project are to restore and maintain ecological and socioeconomic values of the Salton Sea to the local and regional human community and to the biological resources dependent upon the Sea.

A delicate balance between inflow and evaporation sustains the elevation of the Salton Sea. Other possible sources of water have been considered to maintain this delicate balance, but none have been identified. Therefore, if the inflow to the Sea is reduced, evaporation will outstrip inflow and the Sea will begin to shrink until a new balance is achieved. Shrinking of the Sea will cause the salts that are currently in the Sea to concentrate. In addition, each year, about 4 million tons of salt are added to the water body from the inflowing waters.

Rising salinity is threatening the highly productive fishery in the Sea. Figures 1 and 2 show the projected salinity and elevation in the Salton Sea, respectively if historic inflows were to continue into the future and the salinity trend with two reduced inflow scenarios. A salinity of 60,000 mg/L is considered the point at which the majority of the fish in the Sea would cease to be able to reproduce. If historic inflows were to continue, the Sea would likely be able to support a fishery for almost 60 years without any restoration actions. However, with less than a 10 percent reduction from historic inflows, the Sea would

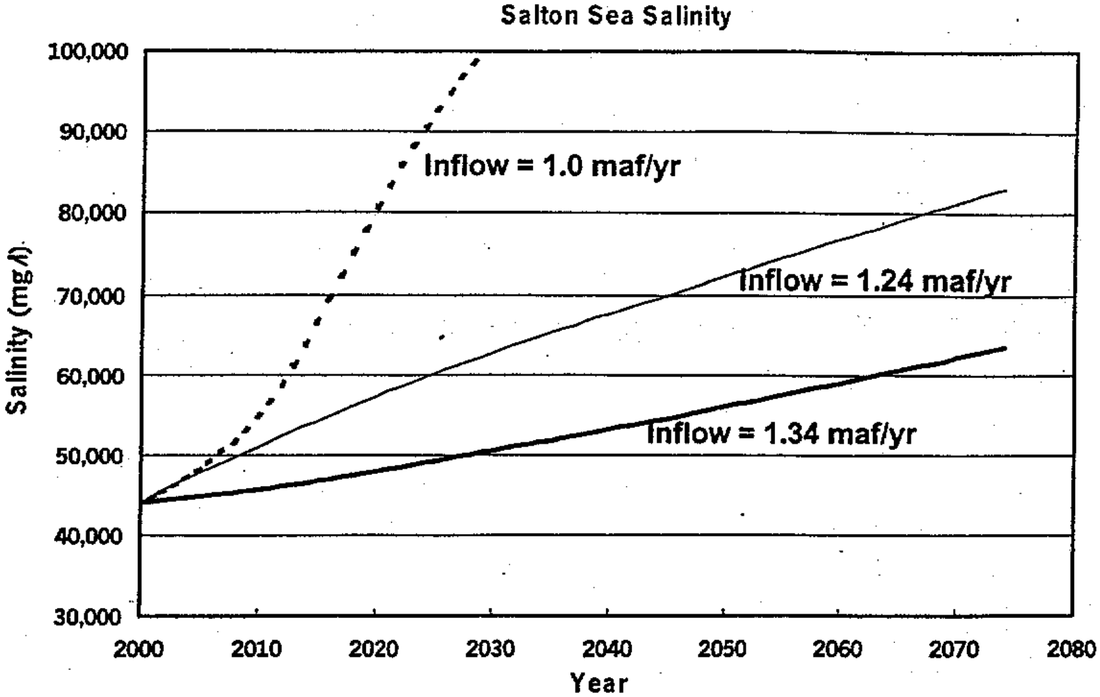


Figure 1. Project future salinity with historic inflows of 1.34 maf/yr and with inflows reduced to 1.24 and 1.0 maf/yr

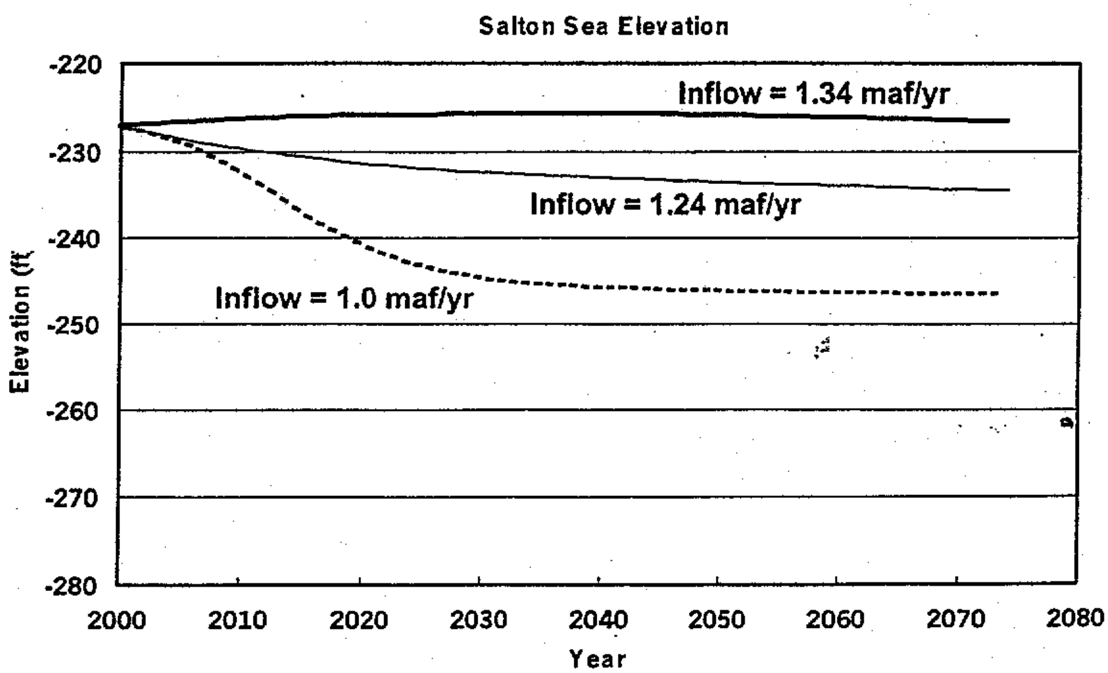


Figure 2. Project future elevation with historic inflows of 1.34 maf/yr and with inflows reduced to 1.24 and 1.0 maf/yr

likely become too salty to support a fishery within the next 25 years. If the inflows to the Sea are further reduced, the fishery could be lost within 10 years. Loss of the fishery and invertebrate populations would severely affect the tens of thousands of birds that forage at the Sea and adversely affect regional populations of fish-eating birds and shorebirds of western North America.

Salinity is the acute, time-sensitive problem that must be dealt with immediately. Eutrophication and other aspects of water quality are chronic, more complex problems. If not adequately dealt with, those problems will also result in the death of the Sea. The investment in controlling salinity will be lost if the other problems are not also addressed.

2.0 SALINITY CONTROL METHODS

The Salton Sea Reclamation Project Act of November 10, 1998, Public Law (PL) 105-372, directs the Secretary of the Interior to "conduct a research project for the development of a method or combination of methods to reduce and control salinity, provide endangered species habitat, enhance fisheries, and protect human recreational values . . . in the area of the Salton Sea. . . ." The Secretary of the Interior is also authorized to engage in a feasibility investigation of the Salton Sea Project by the Act of August 10, 1971 (PL 92-76), and in a feasibility study by PL 105-372.

2.1 Goals and Objectives

This report primarily focuses on control of salinity and elevation. Salinity is reaching critical levels; it is the acute challenge facing the Sea. If the rise in salinity is not stopped, few of the project goals can be met. Other needs such as addressing eutrophication, maintaining the ecological health of the Sea, and enhancing the attractiveness of the Sea for those who live nearby and those who enjoy its assets are equally important components. Each component is also addressed in the goals of the Restoration Project.

The five goals of the Salton Sea Restoration Project are as follows:

1. Maintain the Sea as a repository of agricultural drainage.

2. Provide a safe, productive environment at the Sea for resident and migratory birds and endangered species.

3. Restore recreational uses at the Sea.
4. Maintain a viable sport fishery at the Sea.
5. Enhance the Sea to provide economic development opportunities.

The present report addresses the reasonable and achievable targets for salinity and water surface elevation for the Sea. Previously published reports have identified a salinity objective to reduce and maintain salinity at 40,000 mg/L or lower and a preferred elevation objective of +/- -230 feet msl.

2.2 Other Projects That Could Affect Salinity and Elevation

The Salton Sea Restoration Project is one of a number of actions that could affect conditions at the Sea. Some relevant actions by others are listed below.

- Imperial Irrigation District (IID) Water Transfer Program – The transfer of water from the IID service area to San Diego and the Coachella Valley Water District (CVWD) or the Metropolitan Water District of Southern California (MWD) could reduce inflows to the Sea.
- Constructed Wetlands Projects – Constructed wetlands projects on the New and Alamo Rivers could improve the quality of water flowing into the Sea, but could also cause some reduction of inflows.
- Nesting Habitat Projects at the Sony Bono Salton Sea National Wildlife Refuge – These projects are designed to enhance habitat around the Sea.
- Disease Response and Rehabilitation Programs – These programs of the U.S. Fish and Wildlife Service (FWS), with support from the California Department of Fish and Game (CDFG), combat disease at the Salton Sea by providing response to bird die-offs.
- Improvements to Recreational Facilities – The California Department of Parks and Recreation has received funding for multiple projects to improve facilities at the Salton Sea State Recreational Area.
- Total Maximum Daily Load (TMDL) Program – The TMDL program, being implemented by the Regional Water Quality Control Board, is

designed to provide a long-term reduction in key constituents in the inflowing waters.

- Mexicali Wastewater System Improvements – These improvements would improve the quality of water flowing across the international border.

2.3 Development of Salinity Control Methods

The salinity control methods presented in this document have evolved from those evaluated in the Salton Sea Restoration Project Draft Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) that was published in January 2000. The analysis of salinity control methods has continued since the publication of the Draft EIS/EIR and the receipt of public and agency comment on that document. For example, following publication of the Draft EIS/EIR, and outside engineering review of the alternatives was commissioned and completed by Parsons Engineering in May 2000. In addition, the requirements for salinity control have been adjusted based on new information about the range of possible future inflows to the Sea.

Pilot projects and other design work are continuing to be conducted to refine and improve the salinity control methods discussed in this report and to seek other salinity control methods. For example, desalination has often been evaluated but eliminated from further consideration because of high costs. A desalination technology that would take advantage of waste steam from geothermal activities at the south end of the Sea is now being considered. A pilot project is planned to determine if this desalination process could be cost effective. In addition, work on biological treatment methods is also planned, particularly focusing on reducing eutrophic conditions.

In addition, the Salton Sea Science Office reviewed a proposal put forth by the Pacific Institute. The Pacific Institute proposed a "partial-Sea" solution as a fallback measure to consider under water transfer scenarios that significantly reduce inflows. The Pacific Institute proposal would involve constructing dikes at both ends of the Sea to capture relatively freshwater and allow the main Sea to shrink and become hypersaline. Wetlands would be constructed in the New and Alamo river channels to trap sediments and provide some treatment for the water before flowing into the impoundments.

As new processes and technologies emerge and as impacts of water transfers become known, other approaches may be considered in the future. This document is the culmination of Reclamation and Authority planning and engineering efforts over the past 4 years, but may be amended and improved as new information becomes available.

3.0 MODULAR STRATEGY FOR SALINITY CONTROL

The salinity control methods that are currently being considered have evolved through a process that has involved planning studies, engineering analysis, scientific oversight, and environmental reviews. The amount of salt that would have to be removed from the Sea would depend on the future inflows. If inflows are reduced, the Sea would begin to shrink and salts would be concentrated; therefore, greater amounts of salt would need to be removed to avoid loss of the fishery.

A modular strategy has been used that enables the project planners to develop salinity control methods that can be increased in capacity to respond to changes in inflows. A modular approach allows for the planning and design of a base system that works if recent inflow conditions extend into the future. The system can be expanded if inflows decrease in the future. If, during the planning process, decisions are made on the IID Transfer Project or any other projects that could affect future inflows, then the most likely future inflow scenario can be better defined. In such a case, a salinity control project could be sized to respond to these inflows by selecting the appropriate number of modules that would be needed.

The modular strategy involves two basic types of modules for salinity control:

- Salt removal modules
- Salt disposal modules

Each salt removal module would remove about 1 million tons of salt per year from the Sea. The quantity of salt removed by a single module would increase if the salinity in the Sea should increase in the future. The salt products that would be extracted from the Salton Sea would be stored in salt disposal modules. Therefore, for every salt removal module constructed, one salt disposal module would also be required.

The inflow of water to the Sea in the recent past has been about 1.34 maf/yr, and has typically contained less than 4.5 million tons per year of total dissolved solids. Some salts precipitate as they enter the Sea. Therefore, if there are no elevation changes to halt the increase and gradually reduce the salinity in the

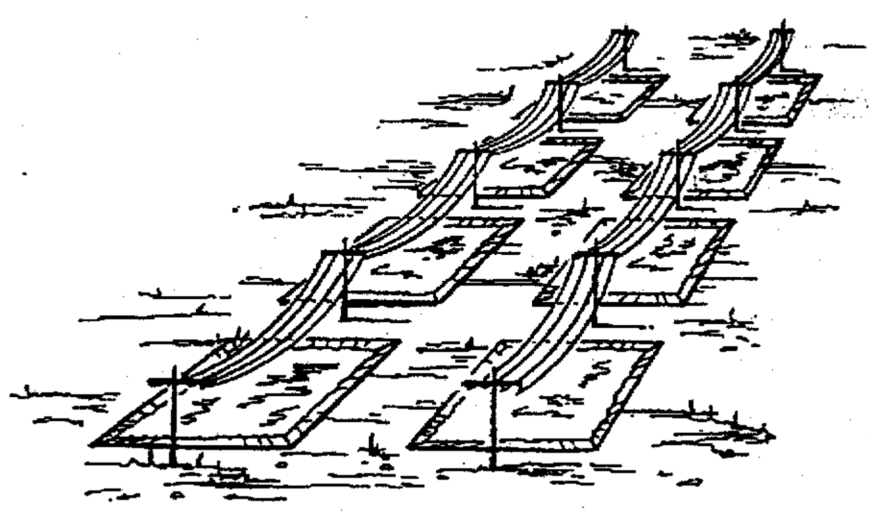
Sea, the minimum configuration for a restoration alternative would involve four modules that remove about 4 million tons of salt each year. A larger number of modules would be needed under reduced inflow scenarios.

3.1 Salt Removal

Two basic strategies are being considered for salt removal: enhanced evaporation systems (EES) and solar evaporation ponds. Within each of these strategies, there are some variations in the specific technologies that are being considered. The following types of modules are being evaluated for salt removal:

- EES using towers with in-line shower technology
- EES technology using ground-based, turbo-enhanced units
- Solar evaporation ponds constructed on land
- Solar evaporation ponds constructed in the Salton Sea

Enhanced Evaporation Systems. The EES process involves spraying water in the air to accelerate the rate at which water evaporates. The two EES technologies being considered are a tower system that would spray water from nozzles along in-line showers or ground-based, turbo-enhanced blower units that operate similar to snow-making and agricultural spraying equipment. An artists sketch of a tower system is provided in Figure 3 and a ground-based system is illustrated in Figure 4. After Salton Sea water passes through either type of EES, the remaining brine would be piped to a disposal module.



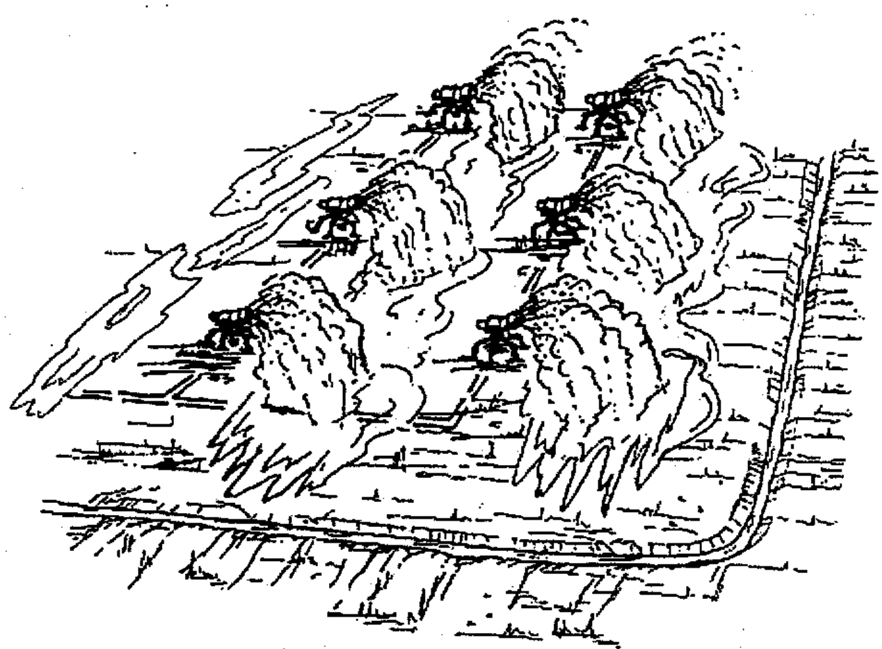


Figure 3. Artist Sketch of an enhanced evaporation system using towers with in-line shower technology

Figure 4. Artist Sketch of a ground-based enhanced evaporation system

A tower EES module that could process one million tons of salt per year would occupy about 0.4 square miles and would involve about 30 towers ranging in height from 100 to 150 feet. A ground-based module that would process the same amount of salt would occupy about 0.8 square miles and would involve about 290 blower units.

Solar Pond Systems. With the solar evaporation pond process, a series of shallow ponds would be constructed for each module. Salton Sea water would be pumped to the first pond and flow by gravity through successive and increasingly more saline ponds. The evaporative process would produce a brine saturated with salts in the last pond that would be pumped to the disposal module. The preliminary design for a solar pond module that removes one million tons of salt each year would involve a series of ten ponds occupying an area of about 4.4 square miles.

Solar evaporation ponds could be located within the Salton Sea by constructing dikes, or on land by constructing berms. Figure 5 provides an illustration of an on-land system while Figure 6 illustrates an in-sea system. Flat and steeper terrain factors were considered for on-land pond systems and shallow and deeper water conditions were considered for in-Sea pond systems. On-land ponds on flat terrain would be the least expensive of these modules. However, in-Sea ponds are the only salinity control measure that would also assist in maintaining elevation, by reducing the evaporative surface area of the Sea.

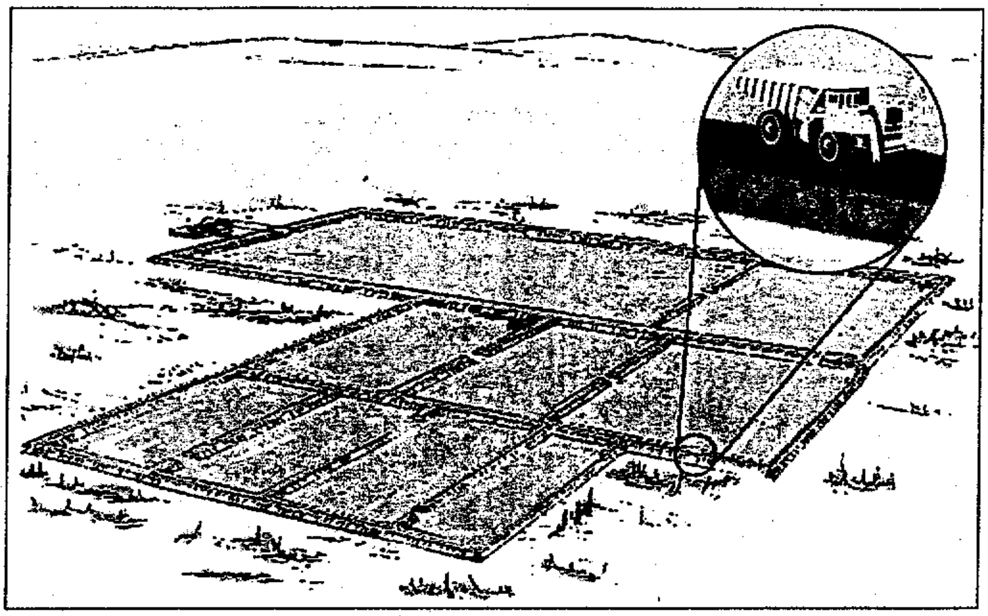


Figure 5. Artist Sketch of an On-Land Solar Pond Module That Processes One Million Tons of Salt per Year

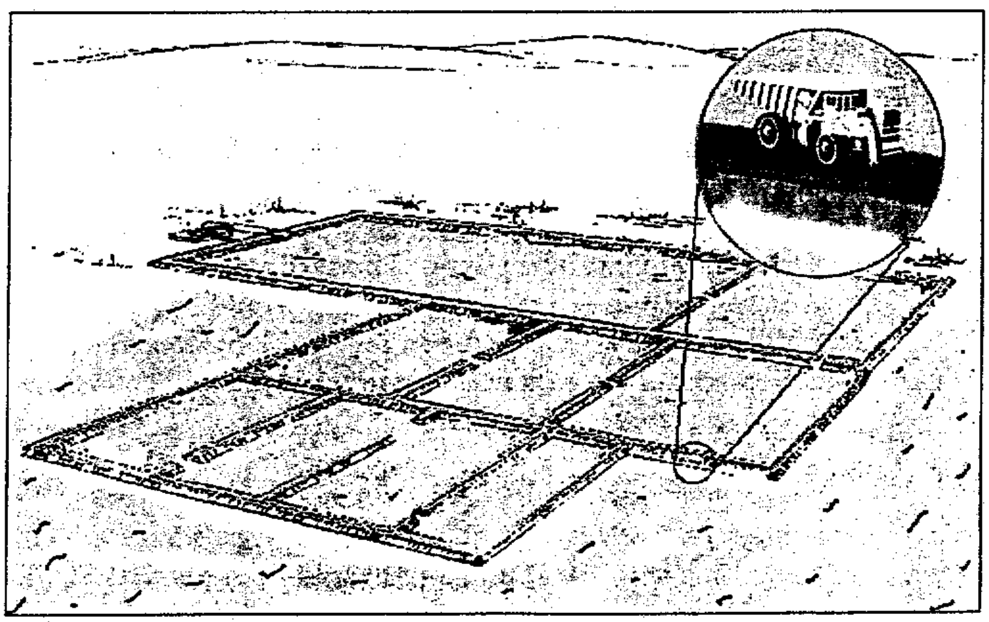


Figure 6. Artist Sketch of an In-Sea Solar Pond Module That Processes One Million Tons of Salt per Year

3.2 Salt Disposal

For salt disposal, either on-land or in-Sea, the disposal options involve terracing the salts in what eventually would be comparable to a sanitary landfill. Initially, saturated brines would be conveyed to shallow ponds that would be constructed using earthen berms. Salts would crystallize in the ponds forming a solid pavement that would cause the bottom of the ponds to raise up over time. Future lifts of the berms would be constructed on that solid salt pavement. After about 30 years, the height of the berms would be raised about 25 feet. From the ground, the disposal facility would look like a large desert landfill.

Salt disposal modules on land on flat terrain would be the least expensive disposal modules.

If inflows to the Sea are reduced, a transition period would occur when elevations are being reduced and salinity control measures are implemented. During this transition period, between 6 and 15 tons per year of salt would have to be removed and disposed of. Once salinity is stabilized, the long-term requirement would be about 3.5 to 4 million tons per year.

3.3 Siting Analysis

At the current stage of alternative development, specific locations where facilities can be sited have not been identified. Instead, a siting analysis was conducted to identify areas that would be generally suitable for locating salt removal and disposal modules. About 60 square miles of suitable area have been identified for possible siting of EES facilities, and about 370 square miles have been identified as suitable for on-land solar pond siting.

4.0 OTHER RESTORATION ELEMENTS

In addition to salinity control measures, the following restoration elements could be included with any alternative. These elements are designed to address the project's multiple goals and objectives when combined with salt removal and disposal actions. These elements are designed to help stem further degradation of the Sea and may be supplemented by later actions developed under the adaptive management efforts of the Salton Sea Restoration Project. The other restoration elements consist of the following possible actions:

- A wildlife disease monitoring and control program
- A created wetlands at the northern end of the Sea
- A recreational improvement fund
- Continuing work on eutrophication assessment and control
- A shoreline clean up program
- Fishery management, including a fish hatchery to preserve the genetic stock of fish in the Sea that are acclimated to high salt levels

The present value cost of these elements of the restoration project has been estimated at $71 million for all of the above elements. For planning purposes, it has been assumed that each of these elements will be included as part of the total project cost in the cost analysis that is presented later in this report.

5.0 SUMMARY OF SALINITY CONTROL METHODS

Five combinations of salt removal and disposal modules, have been evaluated for their effectiveness in controlling salinity and their cost. The combinations vary by the method of salt removal, solar ponds or EES, and the location, in Sea or on land. The number of salt removal and disposal modules required for each alternative will depend on the inflow conditions.

The highest inflow condition (1.34 maf/yr) represents inflows that are similar to historical conditions over the past 40 years. The other conditions illustrate the effects of various factors that could cause the inflows to be reduced in the future. For reduced inflow conditions, it is generally assumed that inflows will decrease by 20,000 af/yr until they reach the future designated inflow level. Table 1 shows the five inflow conditions and key performance and cost data for each. Model results suggest that even with restoration activities, salinity would rise during a transition period. The table shows the predicted peak salinity and the salinity and elevation after 30 years for each alternative and inflow condition.

The salinity control methods and the number of modules required are as follows:

- **In Sea-Ponds** – In-Sea solar ponds with in-Sea terraced salt disposal would be constructed using standard dike construction procedures. If average inflow is 1.34 maf/yr, similar to the recent past, four modules would be required for salinity control. For reduced inflow scenarios, 6 to 12 modules, depending on inflow, would be needed for reduced inflow scenarios, without consideration of elevation control.

- **Ground-Based EES** – Ground-based, EES turbo-enhanced blower units would be constructed on land, and concentrated brine products would be pumped to an on-land terraced salt disposal facility or facilities. If the average inflow is 1.34 maf/yr, similar to the recent past, 6 modules would be required. Depending on inflow condition, 9 to 15 modules would be needed for reduced inflow scenarios.

- **Tower EES** – An on-land EES tower configuration would be constructed with in-line showers and an on-land terraced salt disposal facility. The number of modules required for all inflow scenarios would be the same as for Alternative 2.

- **In-Sea and On-Land Ponds** – This alternative would involve the construction of a combination of in-Sea solar ponds with an in-Sea terraced salt disposal facility and solar ponds with an on-land terraced salt disposal facility. If the average inflow is 1.34 maf/yr, similar to the recent past, this alternative would require two in-Sea modules and two on-land modules. Depending on inflow conditions, three in-Sea modules and three on-land modules, increasing to seven in-Sea modules and seven on-land modules would be needed for reduced inflow scenarios. While construction of these modules is designed to provide salinity control, additional in-Sea modules would be required to provide elevation control.

- **Alternative 5: On-Land Ponds** - On-land solar ponds would be constructed along with on-land terraced salt disposal facilities. The number of modules required would be the same as for Alternative 2 for all inflow scenarios.

The five salinity control methods were evaluated by Reclamation using the Salton Sea Accounting Model. Simulations were performed for the five inflow conditions shown in Table 1. For each inflow condition, a large number of hypothetical sequences of future inflows (stochastic) were modeled for the no project case and for each alternative. The mean simulation results are reported in this document.

Table 1. Summary of Salinity Control Methods: Performance and Cost Data

Method	Factors Potentially Affecting Inflow	Salt Removal/Disposal		Salinity (1000 mg/L)		El (ft msl)		Area[1]	Cost ($M)
		Modules	Area (ac)	Peak	In 30 Yrs	In 30 Yrs	Change	(sq mi)	Total PV
Inflow = 1.34 maf/yr									
No Project	Inflows similar to recent past, provide basis for comparison	NA	NA	NA	51	-226	1	0	NA
In-Sea Ponds		4	14,741	45	40	-224	3	0	600
Ground-Based EES		6	7,966	45	43	-232	-5	15	480
Tower EES		6	9,616	45	43	-232	-5	15	340
In-Sea & On-Land Ponds		2 & 2	8,111 ea	44	43	-227	0	0	400
On-Land Ponds		6	23,236	45	43	-232	-5	15	230
Inflow = 1.24 maf/yr									
No Project	Reductions from historic actions; similar to baseline in IID Transfer EIS or if conservation measures occur by consumptive use fallowing or mitigation fallowing.[2]	NA	NA	NA	63	-232	-5	15	NA
In-Sea Ponds		6	22,198	47	42	-230	-3	10	930
Ground-Based EES		9	11,758	52	45	-241	-14	55	680
Tower EES		9	14,233	52	45	-241	-14	55	470
In-Sea & On-Land Ponds		3 & 3	11,786 ea	48	46	-235	-8	25	630
On-Land Ponds		9	34,663	52	45	-241	-14	55	370
Inflow = 1.14 maf/yr									
No Project	Reductions from historic actions plus conservation measures by delivered water fallowing.[3]	NA	NA	NA	78	-238	-11	40	NA
In-Sea Ponds		8	33,226	48	42	-236	-9	30	1,290
Ground-Based EES		11	12,844	58	47	-244	-17	70	800
Tower EES		11	15,869	58	47	-244	-17	70	550
In-Sea & On-Land Ponds		5 & 5	21,253 ea	55	42	-242	-15	60	1,060
On-Land Ponds		11	40,839	58	47	-244	-17	70	420
Inflow = 1.0 maf/yr									
No Project	Reductions from historic actions plus conservation measures accomplished by on-farm conservation and system improvements.	NA	NA	NA	102	-245	-18	80	NA
In-Sea Ponds		10	35,882	50	44	-243	-16	65	1,780
Ground-Based EES		13	16,793	66	45	-253	-26	120	950
Tower EES		13	20,368	66	45	-253	-26	120	640
In-Sea & On-Land Ponds		6 & 6	23,311 ea	55	42	-249	-22	100	1,250
On-Land Ponds		13	49,878	66	45	-253	-26	120	500
Inflow = 0.8 maf/yr									
No Project	Factors listed above for 1.0 maf/yr, plus other unforeseen actions that may include additional conservation or reduced inflows from Mexico.	NA	NA	NA	145	-251	-24	110	NA
In-Sea Ponds		12	45,954	52	50	-249	-22	100	2,100
Ground-Based EES		15	20,172	72	43	-263	-36	170	1,087
Tower EES		15	24,297	72	43	-263	-36	170	734
In-Sea & On-Land Ponds		7 & 7	27,029 ea	57	47	-257	-30	140	1,443
On-Land Ponds		15	58,347	72	43	-263	-36	170	573

[1] Area shown is the area of sediments that would be exposed by the given change in water surface elevation.

[2] Consumptive use or evapotranspiration (ET) fallowing is used as a mechanism to transfer water that would have been consumed in the agricultural process. It represents about 2/3 of delivered water.

[3] Delivered water fallowing involves transferring consumptive use water and the return or tail and tile water flowing to the Sea.

6.0 COST OF SALINITY CONTROL

Figure 5 illustrates the estimated costs associated with each alternative and shows how the costs vary with inflow condition. The costs are appraisal level estimates that include conveyance of brines, salt removal and disposal, and all of the other restoration elements described in Section 2.5 of this report. Net present value (PV) costs shown in Figure 7 represent the amount of money that would be needed today to fund the construction of the project and provide for 30 years of operation, maintenance, energy, and replacement (OME&R) of the system and its components. Thirty years is used as a planning horizon to provide an equal basis of comparison. More detailed cost factors and assumptions for salt removal and the disposal modules are provided in Appendix A to this document.

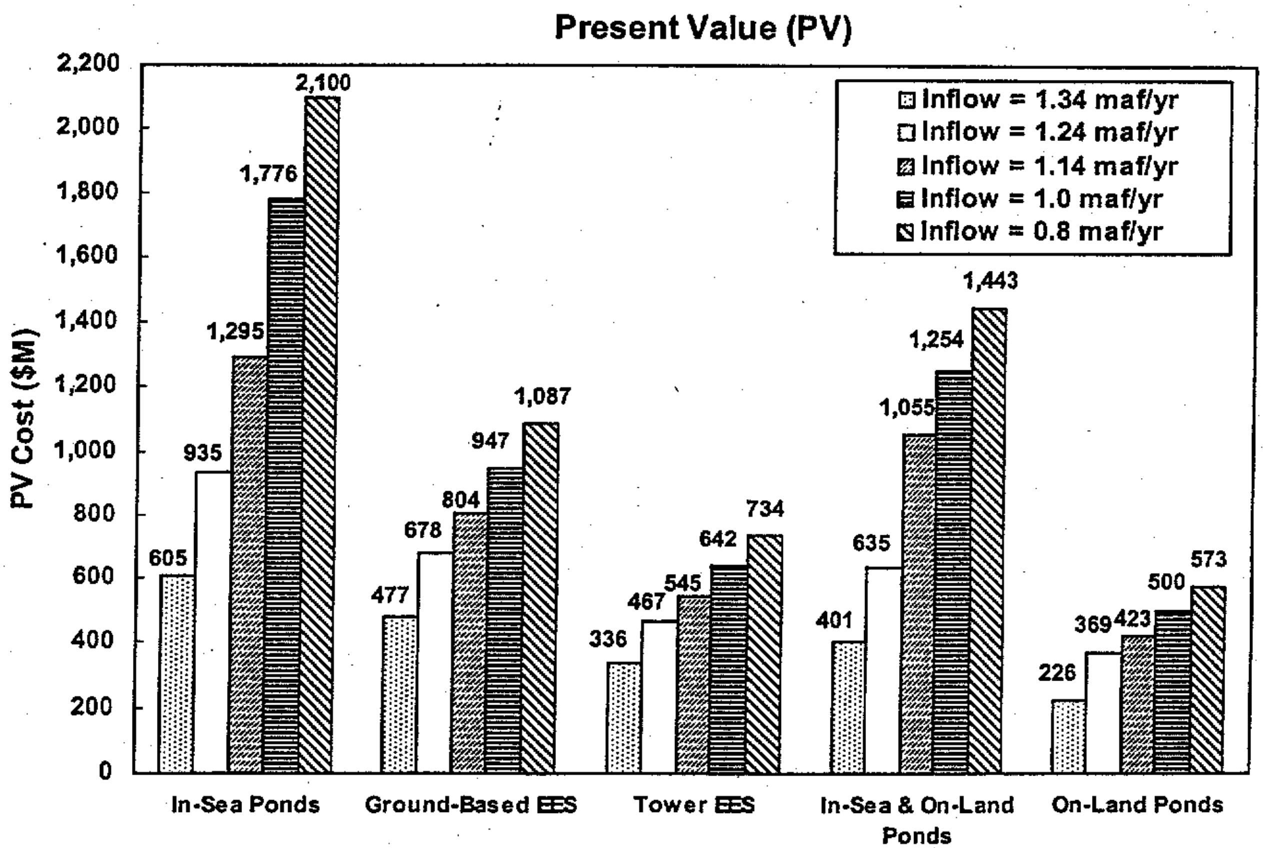


Figure 7. Present Value of salinity Control and Other Restoration Elements

7.0 ELEVATION CONTROL

The extent to which elevation in the Salton Sea can be controlled will be strongly dependent on inflows. Of the methods discussed above, the only salinity control method that could also assist in maintaining elevation would be the construction of in-Sea ponds. In-Sea ponds help control elevation by reducing the evaporative surface area of the Sea. The number of salinity control modules and the associated costs shown in Table 1 are designed to control salinity, but do not address elevation control. Basic salt and water balance concepts were used to estimate how much it would costs to build sufficient in-Sea ponds to also control elevation.

The costs of on-land pond systems and in-Sea pond systems, as shown in Table 1, were plotted against the total surface area of the evaporation ponds that would be associated with the number of modules shown for each inflow condition. The resulting plot is shown in Figure 8. For example, for the historic inflow case of 1.34 maf/yr, the four in-Sea ponds shown in Table 1 would have a total area of about 24 square miles, including the salt disposal modules. For the same inflow condition, six on-land modules would have a combined surface area of about 36 square miles.

Using the relationships shown in Figure 8, an algorithm was set up to first calculate that amount of in-Sea surface area that would be needed to maintain any given elevation. This area is the difference between the natural surface area of the Salton Sea at a given elevation and the surface area that would be needed to balance evaporation and inflow. For example, at elevation –232 feet msl, the area of the Salton Sea would naturally be about 350 square miles. If the inflow were 1.0 maf/yr, the amount of evaporative surface area need to evaporate that inflow would be only about 280 square miles. Therefore, to maintain the elevation at –232 feet msl, the difference between the two areas, 70 square miles would need to be filled by the construction of in-Sea ponds. In addition, more area would be needed to compensate for any water that would be removed for restoration purposes. Once the area of in-Sea ponds is calculated, any additional solar pond area that would be needed for salinity control was assumed to be constructed on land. Finally, the combined cost of in-Sea and on land ponds along with the other elements discussed in Section 4 was calculated form the relationships shown in Figure 6.

The results of the cost calculations are shown in Table 2. Table 2 shows the estimated present value cost of restoration for four possible salinity targets and multiple elevation targets and a wide range of inflow reductions from the historic inflow rate of 1.34 maf/yr. The costs include the present value of operation, maintenance, energy and replacement for a 30-year period. In addition, the costs assume that the transition from current conditions to the new salinity and elevation condition would take place over a 30-year period. Figure illustrates the estimated present value restoration cost of maintaining the Sea at -230 feet, msl for the four different salinity targets over a wide range of inflows. The cost calculations for elevation control are provided in Appendix B to this document.

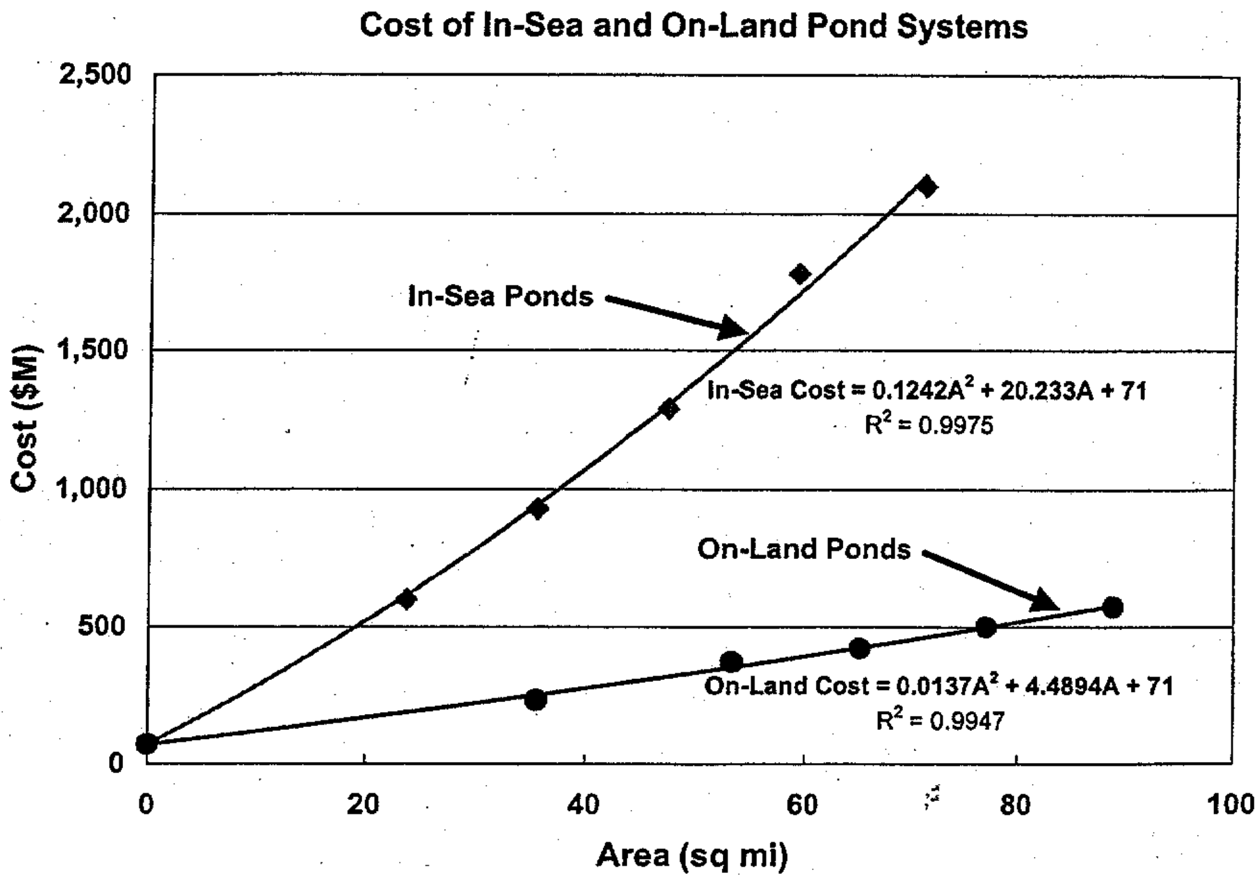


Figure 8. Appraisal-Level Cost of Salinity Control Methods Plotted Against Area

Table 2. Present Value Cost Estimates of Restoration for Various Salinity and Elevation Targets and Inflow Conditions

Elevation Target (ft, msl) >>>		-227	-228	-230	-232	-234	-236	-238	-240
Salinity Target (mg/L)	Inflow (maf/yr)	Total Present Value of Restoration ($M)							
35,000	1.34	740	681	575	487	449	420	NA	NA
	1.29	1,050	977	845	731	630	520	463	471
	1.24	1,417	1,307	1,150	1,011	885	745	594	503
	1.19	1,838	1,717	1,487	1,321	1,171	1,003	818	662
	1.14	2,275	2,143	1,895	1,663	1,483	1,288	1,070	882
	1.00	3,537	3,380	3,082	2,802	2,532	2,218	1,880	1,609
	0.90	4,433	4,260	3,932	3,622	3,321	2,971	2,564	2,185
	0.80	5,289	5,102	4,746	4,410	4,083	3,701	3,254	2,834
40,000	1.34	542	489	397	334	325	NA	NA	NA
	1.29	831	765	647	546	458	376	378	NA
	1.24	1,205	1,101	934	808	695	570	436	405
	1.19	1,606	1,492	1,246	1,101	965	811	643	503
	1.14	2,023	1,900	1,667	1,450	1,260	1,080	880	708
	1.00	3,237	3,088	2,807	2,543	2,288	1,991	1,650	1,396
	0.90	4,102	3,938	3,627	3,334	3,049	2,716	2,329	1,966
	0.80	4,930	4,753	4,415	4,096	3,786	3,422	2,995	2,594
45,000	1.34	378	331	250	241	NA	NA	NA	NA
	1.29	668	591	484	394	316	295	NA	NA
	1.24	1,030	933	754	640	538	425	321	NA
	1.19	1,413	1,306	1,106	920	793	652	498	379
	1.14	1,814	1,698	1,478	1,274	1,079	908	721	563
	1.00	2,985	2,844	2,577	2,327	2,085	1,803	1,475	1,218
	0.90	3,824	3,668	3,371	3,092	2,821	2,504	2,133	1,786
	0.80	4,630	4,460	4,138	3,833	3,537	3,188	2,779	2,394
50,000	1.34	241	199	169	NA	NA	NA	NA	NA
	1.29	538	457	347	266	231	NA	NA	NA
	1.24	883	792	621	499	406	304	NA	NA
	1.19	1,252	1,150	961	786	648	518	376	317
	1.14	1,638	1,527	1,319	1,126	941	761	587	441
	1.00	2,771	2,637	2,382	2,144	1,913	1,643	1,330	1,068
	0.90	3,588	3,438	3,154	2,887	2,628	2,324	1,967	1,634
	0.80	4,373	4,210	3,901	3,609	3,325	2,990	2,595	2,225

Note: NA indicates target combinations that are not attainable.

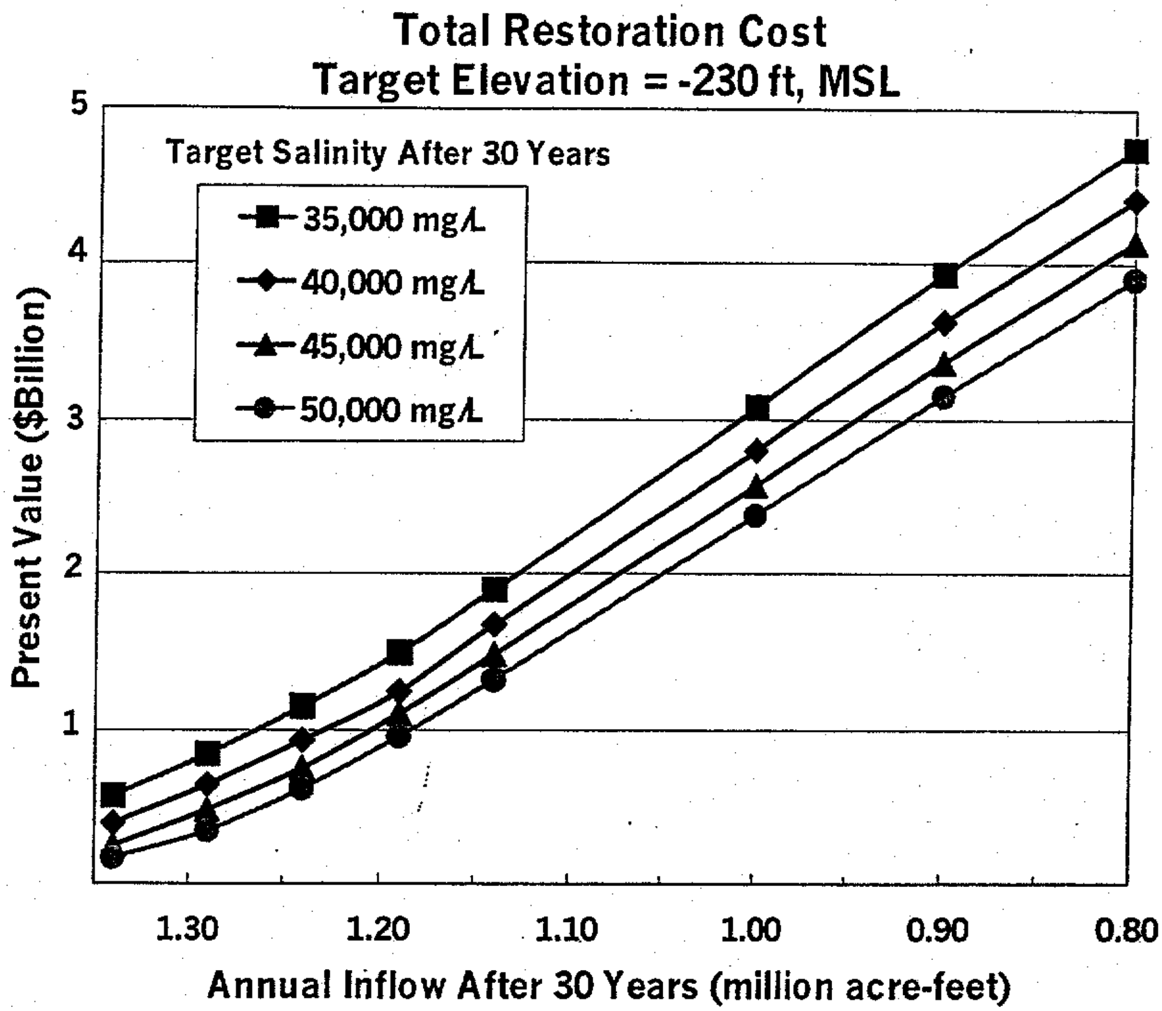


Figure 9. Appraisal-Level Restoration Cost Estimates for a Variety of Salinity and Elevation Targets and Inflow Conditions

8.0 SUMMARY AND CONCLUSIONS

Salinity of the Salton Sea can be controlled by using one of several methods to remove salty water, evaporate the water, and dispose the salt residue products. The least expensive of these methods appears to be on-land solar ponds. However, constructing solar ponds on land would not assist in maintaining the water surface elevation, if inflow to the Sea is reduced in the future. Constructing solar ponds within the Sea would help maintain water surface elevation, but would be significantly more expensive. Possible restoration solutions are discussed for several inflow conditions below.

Inflow = 1.34 maf/yr. At this inflow level, which is representative of average inflow conditions over the past 40 years, restoration can be accomplished with on-land ponds and possibly with the addition of some in-Sea ponds. Table 1 shows that a six module system would reduce the salinity to about 43,000 mg/L in 30 years with about a five foot drop in elevation. The cost of this action, including the elements discussed in Section 4, could be less than $250 million. Table 2 shows that with the addition of some in-Sea ponds, salinity could be reduced to 40,000 mg/L and elevation maintained at –230 ft, msl, just three feet below the Sea's current level for about $400 million.

Inflow = 1.24 maf/yr. This inflow level is comparable to the projected baseline condition used in the January 2002 Draft EIS/EIR for the IID Water Transfer Project and Habitat Conservation Plan. The Draft EIS suggests that under this inflow condition, the elevation in the Sea would ultimately drop about 7 feet and about 25 square miles of sediments would be exposed. An inflow rate of 1.24 maf/yr could also be achieved if transfers are accomplished through consumptive use fallowing or mitigated through fallowing as proposed in the Draft EIS/EIR Habitat Conservation Plan Number 2. Consumptive use or evapotranspiration (ET) fallowing is a mechanism to transfer water that would have been consumed in the agricultural process. It represents about 2/3 of delivered water. Table 1 shows that salinity could be controlled with on-land ponds for under $400 million; however, there would be a significant drop in elevation and 55 square miles of Sea bottom sediments would be exposed. Exposure of this much sediment and organic material has the potential to exacerbate existing dust problems in the Imperial and Coachella valleys. The in-Sea pond system would control salinity and maintain elevation at just a few feet below the current, but the estimated present value cost would be $930 million.

Inflow = 1.14 maf/yr. This inflow level could be achieved if transfers are accomplished through delivered water fallowing. Table 1 shows that the EES and on-land pond systems are not very effective in controlling salinity. They also cause an additional 6 foot reduction in elevation combined with the 11 foot elevation drop with no restoration project, for a total change of 17 feet. The in-Sea pond system would control salinity at an estimated present value of nearly $1.3 billion, but there would still be a 9-foot drop in elevation. Table 2 shows that with the additional in-Sea ponds, salinity could be reduced to 40,000 mg/L and elevation maintained at –230 ft, msl, just three feet below the Sea's current level, but the present value cost would rise to nearly $1.7 billion.

Inflow = 1.0 maf/yr. This inflow level could be achieved if transfers are accomplished through a variety of conservation measures which could include some fallowing. Table 1 shows that the EES and on-land pond systems are not effective in controlling salinity. The peak salinity would exceed 60,000 mg/L which would cause at least a temporary loss of the fishery. They would also cause an additional 8 foot reduction in elevation combined with the 18 foot elevation drop with no project, for a total change of 26 feet. This reduction in elevation would cause about 120 square miles of sediments to be exposed. The in-Sea pond system would control salinity at an estimated present value of nearly $1.8 billion, but there would be a 16-foot drop in elevation. Table 2 shows that with additional in-Sea ponds, salinity could be reduced to 40,000 mg/L and elevation maintained at –230 ft, msl, but the present value cost would rise to about $2.8 billion. At this level the in-Sea construction project would become so large that a number of technical and environment issues would render it at least impractical and possibly unfeasible.

Inflow = 0.8 maf/yr. This inflow level could be achieved if transfers are accomplished through a variety of conservation measures with no mitigation and if other factors such as reduced flows from Mexico further reduce inflow. At this level it is not practical to control salinity. The in-Sea ponds offer some salinity control, but at a cost of over $2 billion and with an elevation drop of 22 feet. At this level, about 100 square miles of sediments would be exposed. Table 2 shows that with additional in-Sea ponds, salinity could be reduced to 40,000 mg/L and elevation maintained at –230 ft, msl, but the present value cost is estimated to rise to about $4.4 billion. As discussed, such an in-Sea construction project would become so large that a number of technical and environment issues would render it at least impractical and possibly unfeasible. For example, in-Sea pond systems would need to cover an area on the order of 150 square miles.

APPENDIX A

This appendix provides supporting data and figures for the analysis of salinity control measures evaluated in the main text of this report.

<u>List of Tables</u>

<u>List of Figures</u>

Table A-1. Features of Modules That Remove Approximately 1 Million Tons of Salt per Year

FEATURES	EES		Solar Ponds		
	Ground-based EES	Tower EES	In-Sea Ponds (Shallow Water)	On-Land Ponds (Flat Terrain)	On-Land Ponds (Steep Terrain)
Liquid Inflow (ac-ft/yr)	17,000	17,000	17,000	17,000	17,000
Area Required (ac)	255	530	2,800	2,800	2,800
On-Land Area (sq mi)	0.4	0.8		4.4	4.4
In-Sea Area (sq mi)			4.4		
SYNOPSIS	Ground-based turbo-enhanced evaporator units would spray water onto a sloping area; brine would be collected at the downslope side and recirculated or pumped to a disposal area; 288 units, arranged in a 6 X 48 array would operate 80% of the time.	Water would spray from "shower lines" strung between 32 towers constructed at heights of 100' and 150'. Brine would collect in ponds and be pumped to a disposal facility. The system would operate 60-65% of the time during the year.	For each module a series of 10 ponds would be constructed, with the largest being about 1 sq mi. Water would be pumped into the largest pond and flow by gravity through the others in an essentially continuous flow process, with salinity increasing in successive ponds. Concentrated brine would be pumped from the final concentrator pond into a crystallizer/disposal facility. Ponds could include islands and snag/nesting and roosting features to enhance and diversify habitat. In-Sea dikes include a service road on top and rip-rap protection on the Sea-side. Total length, height, and width of dikes/berms for a typical single capacity module would be as follows: Location / Length (mi) / Height (ft) / Top (ft) / Base (ft) In-Sea 18.9 11' 30' 104' Land-Flat 18.9 6' 12' 44' Land-Steep 24.1 10' 12' 64'		

COST FACTORS	Ground-based EES	Tower EES	In-Sea	Flat Land[a]	Steeper Land
Initial Capital Cost ($M)	17.2	22.6	94.5	13.6	22.6
Yearly OM&R Cost ($M)	0.41	0.90	0.43	0.29	0.47
Yearly Energy Cost ($M)	3.17	0.30	0.02	0.16	0.12
Total PV ($M)	60.8	37.3	100.0	19.1	29.8
PV Cost Per Ton ($/ton)	**2.03**	**1.24**	**3.33**	**0.64**	**0.99**

Note:
a Capital costs take into account efficiencies that could be achieved by constructing more than one module.

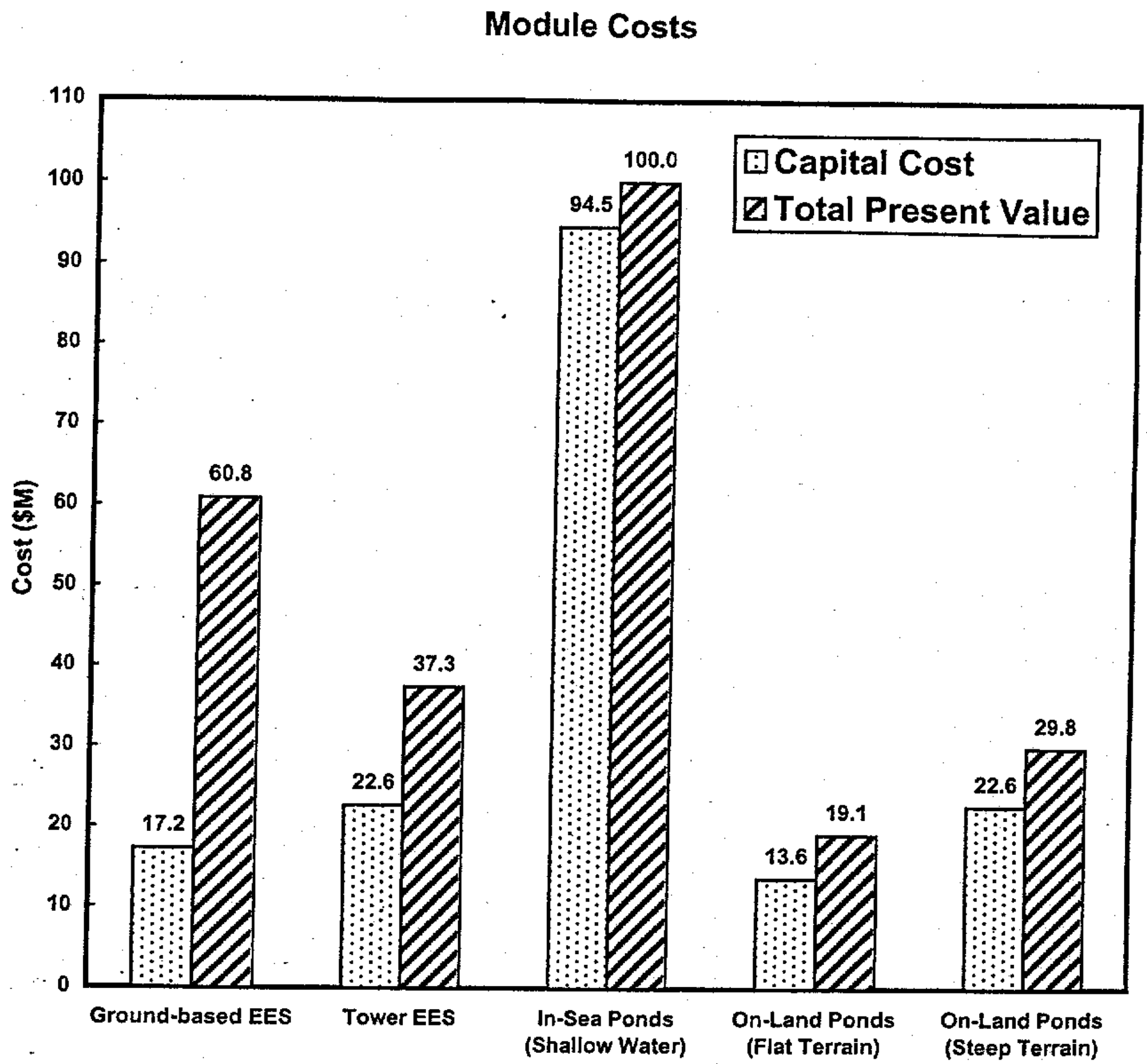


Figure A-1. Estimated Cost of Salt Removal Modules That Remove About 1 Million Tons/Year

Table A-2. Features of Salt Disposal Modules

FEATURES	In-Sea Terrace	On-Land Terrace (Flat Terrain)	On-Land Terrace (Steep Terrain)
Brine Inflow (ac-ft/yr)	2,225	2,225	2,225
Area Required (ac)	1,023	1,023	1,023
Area Required (sq mi)	1.6	1.6	1.6
SYNOPSIS	Solid salts would be extracted in a series of 3 crystallizer ponds. On-land berms or in-Sea dike heights would be raised through a series of lifts throughout their design life. After 30 years, the total volume of fill in berms would be about six times the initial volume. During initial construction, berms/dikes would be similar in size to those described for solar ponds; after all lifts are constructed, maximum berms heights would be about 25 feet. The total length of berms or dikes for a single capacity module would range from about 7.6 miles in-Sea or on flat on-land terrain to 13.9 miles on steep terrain. Efficiencies in dike/berm construction could be achieved by constructing more than module at a given location.		

COST FACTORS	In-Sea	On-Land Flat	On-Land Steep
Initial Capital Cost ($M)	34.9	3.5	6.5
Yearly OM&R Cost ($M)	0.31	0.25	0.33
Total PV ($M)	38.6	6.5	10.4
PV Cost Per Ton ($/ton)	**1.29**	**0.22**	**0.35**

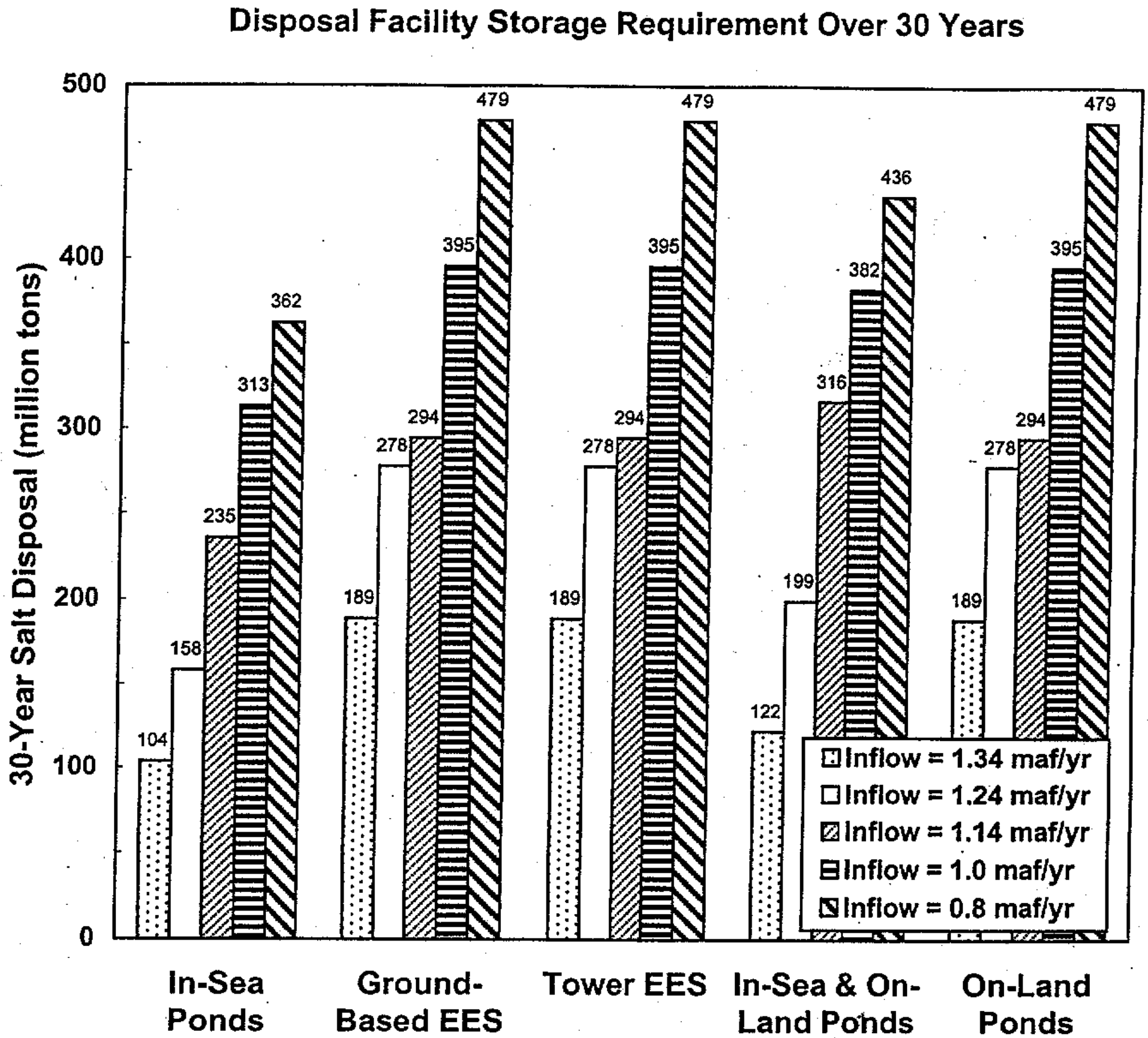


Figure A-2. Quantity of Salt Disposal Over 30 Years

Table A-3. Land Area Identified for Potential Siting of Salinity Control Facilities

Potential Siting Areas in Square Miles

	Salt Removal				**Salt Disposal**	
FEATURES	**Tower EES**	**Ground-based EES**	**In-Sea Ponds**	**On-Land Ponds**	**In-Sea**	**On-Land**
Total Available Area (sq mi)	71	80	72	530	46	470
Most Suitable (sq mi)	3	9	9	41	13	3
Suitable (sq mi)	10	8	61	394	28	98
Least Suitable (sq mi)	58	63	1	95	4	369

Potential Siting Areas in Acres

	Salt Removal				**Salt Disposal**	
FEATURES	**Tower EES**	**Ground-based EES**	**In-Sea Ponds**	**On-Land Ponds**	**In-Sea**	**On-Land**
Total Available Area (ac)	45,241	51,083	46,142	339,206	29,259	301,020
Most Suitable (ac)	2,106	5,593	5,993	26,519	8,493	2,074
Suitable (ac)	6,172	5,059	39,255	252,033	17,965	62,901
Least Suitable (ac)	36,963	40,431	894	60,654	2,801	236,045

Table A-4. Preliminary Appraisal-Level Cost Estimates for Other Restoration Elements

	Programs Included With All Alternatives							
	Program Management	Wildlife Disease Control	Created Wetlands	Recreation & Information Programs	Eutrophication Assessments	Fish Recovery	Fishery Management	Totals
Capital Cost	0.0	1.0	22.0	10.0	3.0	0.2	15.0	51.2
Yearly OMER Cost	0.5	0.5	0.06	0.0	0.0	0.1	0.5	1.7
Total PV	6.0	7.0	22.7	10.0	3.0	1.4	21.0	71.1

Table A-5. Summary of Salinity Control Alternative Requirements for Different Inflow Conditions

Alternative	Salt Removal and Disposal			
	Number of Modules		Surface Area (acres)	
	On Land	In Sea	On Land	In Sea
Inflow = 1.34 maf/yr				
In-Sea Ponds	0	4	0	14,741
Ground-Based EES	6	0	7,966	0
Tower EES	6	0	9,616	0
In-Sea & On-Land Ponds	2	2	7,687	7,687
On-Land Ponds	6	0	23,236	0
Inflow = 1.24 maf/yr				
In-Sea Ponds	0	6	0	22,198
Ground-Based EES	9	0	11,758	0
Tower EES	9	0	14,233	0
In-Sea & On-Land Ponds	3	3	11,798	11,798
On-Land Ponds	9	0	34,663	0
Inflow = 1.14 maf/yr				
In-Sea Ponds	0	8	0	30,426
Ground-Based EES	11	0	12,844	0
Tower EES	11	0	15,869	0
In-Sea & On-Land Ponds	5	5	19,390	19,390
On-Land Ponds	11	0	40,839	0
Inflow = 1.0 maf/yr				
In-Sea Ponds	0	10	0	38,682
Ground-Based EES	13	0	16,793	0
Tower EES	13	0	20,368	0
In-Sea & On-Land Ponds	6	6	23,318	23,318
On-Land Ponds	13	0	49,878	0
Inflow = 0.8 maf/yr				
In-Sea Ponds	0	12	0	45,954
Ground-Based EES	15	0	20,172	0
Tower EES	15	0	24,297	0
In-Sea & On-Land Ponds	7	7	27,028	27,028
On-Land Ponds	15	0	58,347	0

Table A-6. Annual and Total 30-Year Salt Disposal Requirements in Millions of Tons

Alternative Number	Salt Disposal (Million Tons)	
	30-Year Total	Annual Average
Inflow = 1.34 maf/yr		
In-Sea Ponds	104	3.5
Ground-Based EES	189	6.3
Tower EES	189	6.3
In-Sea & On-Land Ponds	122	4.1
On-Land Ponds	189	6.3
Inflow = 1.24 maf/yr		
In-Sea Ponds	158	5.3
Ground-Based EES	278	9.3
Tower EES	278	9.3
In-Sea & On-Land Ponds	199	6.6
On-Land Ponds	278	9.3
Inflow = 1.14 maf/yr		
In-Sea Ponds	235	7.8
Ground-Based EES	294	9.8
Tower EES	294	9.8
In-Sea & On-Land Ponds	316	10.5
On-Land Ponds	294	9.8
Inflow = 1.0 maf/yr		
In-Sea Ponds	313	10.4
Ground-Based EES	395	13.2
Tower EES	395	13.2
In-Sea & On-Land Ponds	382	12.7
On-Land Ponds	395	13.2
Inflow = 0.8 maf/yr		
In-Sea Ponds	362	12.1
Ground-Based EES	479	16.0
Tower EES	479	16.0
In-Sea & On-Land Ponds	436	14.5
On-Land Ponds	479	16.0

Table A-7. Summary of Appraisal-Level Cost Estimates for Different Inflow Conditions

Alternative Number	Appraisal-Level Cost Estimates			
	Salinity Control		Other	Total
	Capital	PV	PV	PV
Inflow = 1.34 maf/yr				
In-Sea Ponds	499	534	71	605
Ground-Based EES	125	406	71	477
Tower EES	158	265	71	336
In-Sea & On-Land Ponds	295	330	71	401
On-Land Ponds	104	155	71	226
Inflow = 1.24 maf/yr				
In-Sea Ponds	815	864	71	935
Ground-Based EES	187	607	71	678
Tower EES	236	396	71	467
In-Sea & On-Land Ponds	513	564	71	635
On-Land Ponds	209	298	71	369
Inflow = 1.14 maf/yr				
In-Sea Ponds	1,159	1,224	71	1,295
Ground-Based EES	224	733	71	804
Tower EES	283	474	71	545
In-Sea & On-Land Ponds	904	984	71	1,055
On-Land Ponds	248	352	71	423
Inflow = 1.0 maf/yr				
In-Sea Ponds	1,632	1,705	71	1,776
Ground-Based EES	270	876	71	947
Tower EES	340	571	71	642
In-Sea & On-Land Ponds	1,087	1,183	71	1,254
On-Land Ponds	301	429	71	500
Inflow = 0.8 maf/yr				
In-Sea Ponds	1,943	2,029	71	2,100
Ground-Based EES	314	1,016	71	1,087
Tower EES	395	663	71	734
In-Sea & On-Land Ponds	1,262	1,372	71	1,443
On-Land Ponds	351	502	71	573

Notes: Salinity Control = Salt removal, disposal and conveyance
Other = Other restoration elements (Sections 5.1 through 5.6)

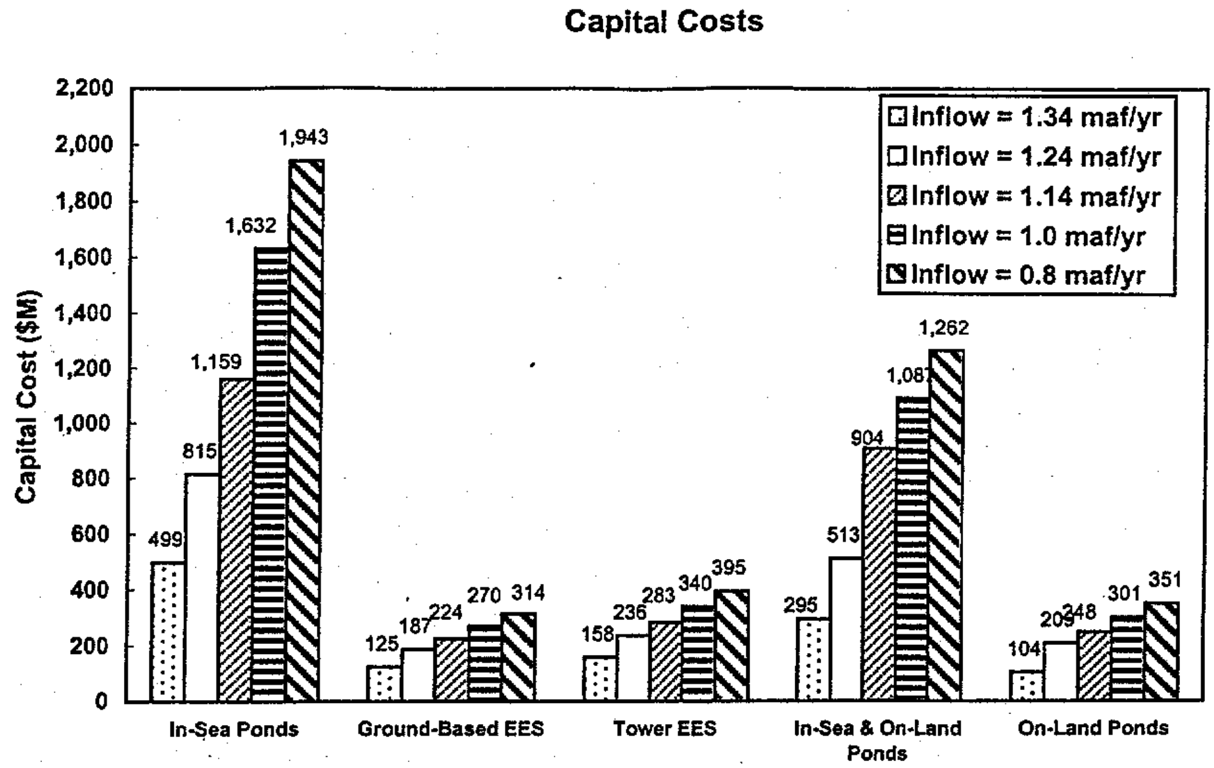


Figure A-3. Capital Cost of Salinity Control Measures

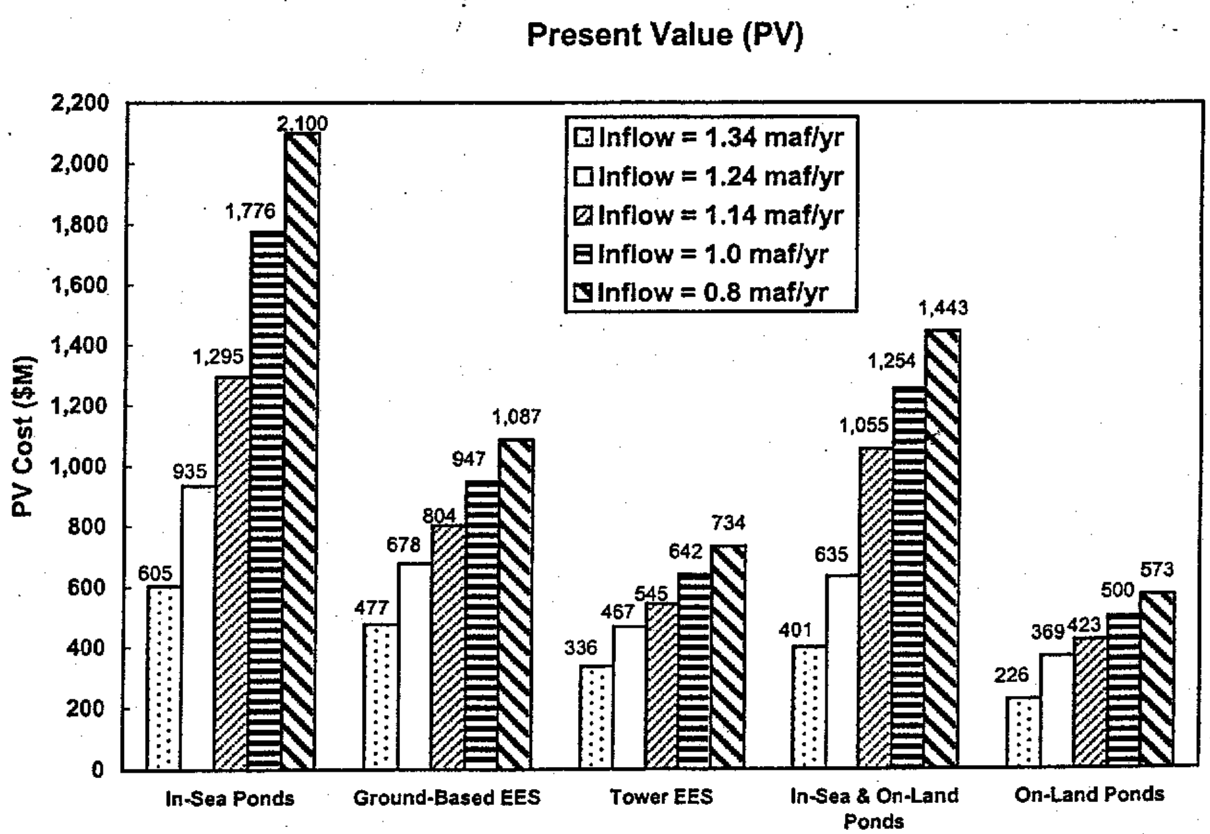


Figure A-4. Present Value of Salinity Control and Other Restoration Elements

APPENDIX B

This appendix provides supporting data and figures for the analysis of elevation control measures evaluated in the main text of this report.

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 0 acft/yr

Inflow at end of 30 years (ac-ft/yr) 1,340,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)		-	3	10	16	23	30	40	50
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,t,U}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.62	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	32	29	21	15	8	0	0	0
	In-Sea Ponds after Restoration (sq mi)	17	14	8	1	0	0	0	0
	Average In-Sea Pond Area (sq mi)	25	21	15	8	4	0	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	74,026	63,636	43,365	23,625	11,490	0	0	0
	On-Land Evaporative Capacity needed (af/yr)	63,030	80,217	113,898	146,807	171,875	196,035	208,384	220,367
	On-land Pond Area (sq mi)	21	27	38	49	58	66	70	74
	PV In-Sea Ponds ($M)	570	481	316	166	79	0	0	0
	PV Additional Evap ($M)	100	129	189	250	300	349	375	400
	Total PV of Restoration ($M)	740	681	575	487	449	420	NA	NA
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	22	18	11	5	0	0	0	0
	In-Sea Ponds after Restoration (sq mi)	15	11	5	0	0	0	0	0
	Average In-Sea Pond Area (sq mi)	18	15	8	2	0	0	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	53,955	43,778	23,927	7,131	0	0	0	0
	On-Land Evaporative Capacity needed (af/yr)	45,138	62,626	96,901	127,861	148,905	162,532	175,815	188,705
	On-land Pond Area (sq mi)	15	21	32	43	50	54	59	63
	PV In-Sea Ponds ($M)	401	319	168	48	0	0	0	0
	PV Additional Evap ($M)	70	99	158	214	254	281	307	334
	Total PV of Restoration ($M)	542	489	397	334	325	NA	NA	NA
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,846	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	12	9	2	0	0	0	0	0
	In-Sea Ponds after Restoration (sq mi)	12	9	2	0	0	0	0	0
	Average In-Sea Pond Area (sq mi)	12	9	2	0	0	0	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	36,597	26,609	7,131	0	0	0	0	0
	On-Land Evaporative Capacity needed (af/yr)	28,750	46,506	81,309	103,491	118,273	132,752	146,865	160,560
	On-land Pond Area (sq mi)	10	16	27	35	40	44	49	54
	PV In-Sea Ponds ($M)	263	188	48	0	0	0	0	0
	PV Additional Evap ($M)	44	72	131	170	197	224	250	277
	Total PV of Restoration ($M)	378	331	250	241	NA	NA	NA	NA
50	Salt Removal (million tons) [S_{30}]	68	84	115	146	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	4	1	0	0	0	0	0	0
	In-Sea Ponds after Restoration (sq mi)	10	7	1	0	0	0	0	0
	Average In-Sea Pond Area (sq mi)	7	4	0	0	0	0	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	21,387	11,568	859	0	0	0	0	0
	On-Land Evaporative Capacity needed (af/yr)	13,767	31,763	58,603	75,305	90,865	106,106	120,962	135,378
	On-land Pond Area (sq mi)	5	11	20	25	30	36	41	45
	PV In-Sea Ponds ($M)	149	79	6	0	0	0	0	0
	PV Additional Evap ($M)	21	49	92	120	147	174	202	229
	Total PV of Restoration ($M)	241	199	189	NA	NA	NA	NA	NA

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 50,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 1,290,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)									
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,LU}$] >>>	365.80	362.46	355.93	349.58	343.19	335.36	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.62	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	45	42	35	28	21	13	3	0
	In-Sea Ponds after Restoration (sq mi)	31	28	21	15	9	1	0	0
	Average In-Sea Pond Area (sq mi)	38	35	28	21	15	7	1	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	114,577	104,186	83,915	64,175	44,306	20,257	3,831	0
	On-Land Evaporative Capacity needed (af/yr)	22,480	39,667	73,347	106,257	139,060	175,778	204,553	220,367
	On-land Pond Area (sq mi)	8	13	25	36	47	59	69	74
	PV In-Sea Ponds ($M)	945	845	657	485	323	141	26	0
	PV Additional Evap ($M)	34	61	117	175	236	307	367	400
	Total PV of Restoration ($M)	1,050	977	845	731	630	520	463	471
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,726	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	35	31	25	18	11	3	0	0
	In-Sea Ponds after Restoration (sq mi)	28	25	19	12	6	0	0	0
	Average In-Sea Pond Area (sq mi)	32	28	22	15	9	2	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	94,505	84,328	64,477	45,149	25,685	5,060	0	0
	On-Land Evaporative Capacity needed (af/yr)	4,587	22,076	56,350	89,843	123,219	157,472	175,815	188,705
	On-land Pond Area (sq mi)	2	7	19	30	41	53	59	63
	PV In-Sea Ponds ($M)	754	661	488	330	181	34	0	0
	PV Additional Evap ($M)	7	34	88	146	206	271	307	334
	Total PV of Restoration ($M)	831	765	647	546	458	376	378	NA
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	26	22	16	9	3	0	0	0
	In-Sea Ponds after Restoration (sq mi)	26	23	16	10	4	0	0	0
	Average In-Sea Pond Area (sq mi)	26	22	16	10	3	0	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	77,148	67,159	47,682	28,721	9,617	0	0	0
	On-Land Evaporative Capacity needed (af/yr)	0	5,956	40,759	74,770	108,656	132,752	146,865	160,560
	On-land Pond Area (sq mi)	0	2	14	25	36	44	49	54
	PV In-Sea Ponds ($M)	597	511	350	203	66	0	0	0
	PV Additional Evap ($M)	0	9	63	119	179	224	250	277
	Total PV of Restoration ($M)	668	591	484	394	316	295	NA	NA
50	Salt Removal (million tons) [S_{30}]	68	84	115	148	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	17	14	8	2	0	0	0	0
	In-Sea Ponds after Restoration (sq mi)	24	21	14	8	2	0	0	0
	Average In-Sea Pond Area (sq mi)	21	17	11	5	1	0	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	61,937	52,119	32,975	14,342	2,534	0	0	0
	On-Land Evaporative Capacity needed (af/yr)	0	0	26,488	60,963	88,331	106,106	120,962	135,378
	On-land Pond Area (sq mi)	0	0	9	20	30	36	41	45
	PV In-Sea Ponds ($M)	467	386	235	99	17	0	0	0
	PV Additional Evap ($M)	0	0	40	96	143	174	202	229
	Total PV of Restoration ($M)	538	457	347	266	231	NA	NA	NA

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 100,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 1,240,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,LU}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.62	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,387
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	58	54	47	40	33	25	15	5
	In-Sea Ponds after Restoration (sq mi)	45	42	35	29	23	15	5	0
	Average In-Sea Pond Area (sq mi)	51	48	41	34	28	20	10	2
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	153,401	143,011	122,740	103,000	83,131	59,082	29,605	6,951
	On-Land Evaporative Capacity needed (af/yr)	0	842	34,522	67,432	100,235	136,954	178,779	213,416
	On-land Pond Area (sq mi)	0	0	12	23	34	46	60	71
	PV In-Sea Ponds ($M)	1,346	1,235	1,026	833	650	443	210	47
	PV Additional Evap ($M)	0	1	53	107	164	232	313	385
	Total PV of Restoration ($M)	1,417	1,307	1,150	1,011	885	745	594	503
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	47	44	37	30	24	16	6	0
	In-Sea Ponds after Restoration (sq mi)	42	39	32	26	20	12	2	0
	Average In-Sea Pond Area (sq mi)	45	41	35	28	22	14	4	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	133,330	123,153	103,302	83,974	64,510	40,858	11,768	0
	On-Land Evaporative Capacity needed (af/yr)	0	0	17,525	51,018	84,395	121,675	164,047	188,705
	On-land Pond Area (sq mi)	0	0	6	17	28	41	55	63
	PV In-Sea Ponds ($M)	1,134	1,030	836	658	488	296	81	0
	PV Additional Evap ($M)	0	0	26	80	136	203	284	334
	Total PV of Restoration ($M)	1,205	1,101	934	808	695	570	436	405
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	38	34	28	21	15	7	0	0
	In-Sea Ponds after Restoration (sq mi)	40	37	30	24	17	10	0	0
	Average In-Sea Pond Area (sq mi)	39	35	29	23	16	8	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	115,972	105,984	86,507	67,545	48,442	25,142	0	0
	On-Land Evaporative Capacity needed (af/yr)	0	0	1,934	35,945	69,831	107,610	146,865	160,560
	On-land Pond Area (sq mi)	0	0	1	12	23	36	49	54
	PV In-Sea Ponds ($M)	959	862	680	514	356	177	0	0
	PV Additional Evap ($M)	0	0	3	55	111	177	250	277
	Total PV of Restoration ($M)	1,030	933	754	640	538	425	321	NA
50	Salt Removal (million tons) [S_{30}]	68	84	115	146	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	29	26	20	14	7	0	0	0
	In-Sea Ponds after Restoration (sq mi)	38	35	28	22	16	8	0	0
	Average In-Sea Pond Area (sq mi)	34	30	24	18	12	4	0	0
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	100,762	90,943	71,800	53,167	34,385	11,590	0	0
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	22,138	56,480	94,516	120,962	135,378
	On-land Pond Area (sq mi)	0	0	0	7	19	32	41	45
	PV In-Sea Ponds ($M)	812	721	550	394	246	79	0	0
	PV Additional Evap ($M)	0	0	0	34	89	154	202	229
	Total PV of Restoration ($M)	883	792	621	499	406	304	NA	NA

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 150,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 1,190,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)									
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,LU}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.82	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	69	65	58	51	44	36	26	16
	In-Sea Ponds after Restoration (sq mi)	59	56	49	43	36	29	19	9
	Average In-Sea Pond Area (sq mi)	64	60	54	47	40	32	22	13
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	190,501	180,110	159,839	140,099	120,230	96,181	66,704	37,417
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	30,333	63,136	99,854	141,680	182,950
	On-land Pond Area (sq mi)	0	0	0	10	21	33	47	61
	PV In-Sea Ponds ($M)	1,767	1,646	1,416	1,204	1,001	769	507	269
	PV Additional Evap ($M)	0	0	0	46	100	163	241	322
	Total PV of Restoration ($M)	1,838	1,717	1,487	1,321	1,171	1,003	818	662
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	58	55	48	41	35	27	17	7
	In-Sea Ponds after Restoration (sq mi)	56	53	46	40	34	26	16	7
	Average In-Sea Pond Area (sq mi)	57	54	46	41	34	26	16	7
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	170,429	160,252	140,401	121,073	101,609	77,957	48,867	19,955
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	13,919	47,295	84,575	126,948	168,750
	On-land Pond Area (sq mi)	0	0	0	5	16	28	43	57
	PV In-Sea Ponds ($M)	1,535	1,421	1,175	1,009	820	604	359	139
	PV Additional Evap ($M)	0	0	0	21	74	136	213	293
	Total PV of Restoration ($M)	1,606	1,492	1,246	1,101	965	811	643	503
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	49	45	39	32	26	18	9	0
	In-Sea Ponds after Restoration (sq mi)	54	51	44	38	31	23	14	4
	Average In-Sea Pond Area (sq mi)	51	48	41	35	29	21	11	2
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	153,072	143,083	123,606	104,645	85,541	62,241	33,495	6,341
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	32,732	70,511	113,370	154,219
	On-land Pond Area (sq mi)	0	0	0	0	11	24	38	52
	PV In-Sea Ponds ($M)	1,342	1,235	1,035	849	672	469	239	43
	PV Additional Evap ($M)	0	0	0	0	50	112	188	265
	Total PV of Restoration ($M)	1,413	1,306	1,106	920	793	652	498	379
50	Salt Removal (million tons) [S_{30}]	68	84	115	146	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	40	37	31	25	18	11	1	0
	In-Sea Ponds after Restoration (sq mi)	52	49	42	36	29	22	12	2
	Average In-Sea Pond Area (sq mi)	46	43	36	30	24	16	7	1
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	137,861	128,043	108,899	90,266	71,484	48,500	20,062	3,635
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	19,381	57,606	100,900	131,744
	On-land Pond Area (sq mi)	0	0	0	0	6	19	34	44
	PV In-Sea Ponds ($M)	1,181	1,079	890	715	548	356	140	24
	PV Additional Evap ($M)	0	0	0	0	29	91	165	222
	Total PV of Restoration ($M)	1,252	1,150	961	786	648	518	376	317

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 200,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 1,140,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)									
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,LU}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.62	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	78	75	68	61	54	46	36	25
	In-Sea Ponds after Restoration (sq mi)	73	70	63	57	50	42	33	23
	Average In-Sea Pond Area (sq mi)	76	72	65	59	52	44	34	24
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	225,874	215,484	195,213	175,473	155,604	131,555	102,078	72,791
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	27,762	64,481	106,306	147,577
	On-land Pond Area (sq mi)	0	0	0	0	9	22	36	49
	PV In-Sea Ponds ($M)	2,204	2,072	1,824	1,592	1,370	1,115	824	559
	PV Additional Evap ($M)	0	0	0	0	42	102	175	252
	Total PV of Restoration ($M)	2,275	2,143	1,895	1,663	1,483	1,288	1,070	882
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	68	64	58	51	44	36	26	17
	In-Sea Ponds after Restoration (sq mi)	70	67	60	54	47	40	30	20
	Average In-Sea Pond Area (sq mi)	69	66	59	52	46	38	28	19
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	205,803	195,626	175,775	156,447	136,983	113,331	84,241	55,329
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	11,922	49,202	91,574	133,376
	On-land Pond Area (sq mi)	0	0	0	0	4	16	31	45
	PV In-Sea Ponds ($M)	1,952	1,829	1,596	1,379	1,171	933	660	412
	PV Additional Evap ($M)	0	0	0	0	18	77	149	225
	Total PV of Restoration ($M)	2,023	1,900	1,667	1,450	1,260	1,080	880	708
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	58	55	49	42	36	28	18	9
	In-Sea Ponds after Restoration (sq mi)	68	64	58	52	45	37	28	18
	Average In-Sea Pond Area (sq mi)	63	60	53	47	40	33	23	13
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	188,445	178,457	158,979	140,018	120,915	97,615	68,869	40,290
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	35,137	77,996	120,270
	On-land Pond Area (sq mi)	0	0	0	0	0	12	26	40
	PV In-Sea Ponds ($M)	1,743	1,627	1,407	1,203	1,008	783	525	292
	PV Additional Evap ($M)	0	0	0	0	0	54	125	200
	Total PV of Restoration ($M)	1,814	1,698	1,478	1,274	1,079	908	721	563
50	Salt Removal (million tons) [S_{30}]	68	84	115	146	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	50	47	41	34	28	21	11	2
	In-Sea Ponds after Restoration (sq mi)	66	63	56	50	43	35	26	16
	Average In-Sea Pond Area (sq mi)	58	55	48	42	36	28	19	9
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	173,235	163,416	144,273	125,639	106,858	83,874	55,436	27,156
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	22,232	65,527	108,223
	On-land Pond Area (sq mi)	0	0	0	0	0	7	22	36
	PV In-Sea Ponds ($M)	1,567	1,456	1,248	1,055	870	657	413	192
	PV Additional Evap ($M)	0	0	0	0	0	34	104	178
	Total PV of Restoration ($M)	1,638	1,527	1,319	1,126	941	761	587	441

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 340,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 1,000,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)									
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,LU}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.62	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	100	96	89	82	75	67	57	47
	In-Sea Ponds after Restoration (sq mi)	112	108	102	96	89	81	72	62
	Average In-Sea Pond Area (sq mi)	106	102	95	89	82	74	64	54
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	315,741	305,350	285,079	265,339	245,470	221,421	191,944	162,657
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	18,440	57,710
	On-land Pond Area (sq mi)	0	0	0	0	0	0	6	19
	PV In-Sea Ponds ($M)	3,466	3,309	3,011	2,731	2,461	2,147	1,785	1,448
	PV Additional Evap ($M)	0	0	0	0	0	0	25	91
	Total PV of Restoration ($M)	3,537	3,380	3,082	2,802	2,532	2,218	1,880	1,609
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	89	86	79	72	66	58	48	38
	In-Sea Ponds after Restoration (sq mi)	109	105	99	93	86	78	69	59
	Average In-Sea Pond Area (sq mi)	99	96	89	82	76	68	58	49
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	295,670	285,492	265,641	246,313	226,850	203,197	174,107	145,195
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	1,708	43,509
	On-land Pond Area (sq mi)	0	0	0	0	0	0	1	15
	PV In-Sea Ponds ($M)	3,166	3,017	2,736	2,472	2,217	1,920	1,577	1,258
	PV Additional Evap ($M)	0	0	0	0	0	0	3	67
	Total PV of Restoration ($M)	3,237	3,088	2,807	2,543	2,288	1,991	1,650	1,396
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	80	76	70	64	57	49	40	30
	In-Sea Ponds after Restoration (sq mi)	107	103	97	90	84	76	67	57
	Average In-Sea Pond Area (sq mi)	93	90	83	77	71	63	53	44
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	278,312	268,324	248,846	229,885	210,781	187,481	158,735	130,157
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	30,403
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	10
	PV In-Sea Ponds ($M)	2,914	2,773	2,506	2,256	2,014	1,732	1,404	1,101
	PV Additional Evap ($M)	0	0	0	0	0	0	0	47
	Total PV of Restoration ($M)	2,985	2,844	2,577	2,327	2,085	1,803	1,475	1,218
50	Salt Removal (million tons) [S_{30}]	68	84	115	148	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	71	68	62	56	50	42	33	23
	In-Sea Ponds after Restoration (sq mi)	105	101	95	89	82	74	65	55
	Average In-Sea Pond Area (sq mi)	88	85	78	72	66	58	49	39
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	263,102	253,283	234,139	215,506	196,724	173,740	145,302	117,022
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	18,356
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	6
	PV In-Sea Ponds ($M)	2,700	2,566	2,311	2,073	1,842	1,572	1,259	969
	PV Additional Evap ($M)	0	0	0	0	0	0	0	28
	Total PV of Restoration ($M)	2,771	2,637	2,382	2,144	1,913	1,643	1,330	1,068

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 440,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 900,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)									
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,t1}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.82	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	109	106	99	92	85	77	67	57
	In-Sea Ponds after Restoration (sq mi)	139	136	130	123	117	109	99	90
	Average In-Sea Pond Area (sq mi)	124	121	114	108	101	93	83	73
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	371,648	361,258	340,987	321,247	301,378	277,329	247,852	218,565
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	1,803
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	1
	PV In-Sea Ponds ($M)	4,362	4,189	3,861	3,551	3,250	2,900	2,493	2,111
	PV Additional Evap ($M)	0	0	0	0	0	0	0	3
	Total PV of Restoration ($M)	4,433	4,260	3,932	3,622	3,321	2,971	2,564	2,185
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	99	95	89	82	75	67	58	48
	In-Sea Ponds after Restoration (sq mi)	137	133	127	120	114	106	97	87
	Average In-Sea Pond Area (sq mi)	118	114	108	101	95	87	77	67
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	351,577	341,400	321,549	302,221	282,757	259,105	230,015	201,103
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	4,031	3,867	3,556	3,263	2,978	2,645	2,258	1,895
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	4,102	3,938	3,627	3,334	3,049	2,716	2,329	1,966
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	90	86	80	73	67	59	50	40
	In-Sea Ponds after Restoration (sq mi)	134	131	124	118	112	104	94	85
	Average In-Sea Pond Area (sq mi)	112	109	102	96	89	82	72	62
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	334,219	324,231	304,754	285,792	266,689	243,389	214,643	186,065
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	3,753	3,597	3,300	3,021	2,750	2,433	2,062	1,715
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	3,824	3,668	3,371	3,092	2,821	2,504	2,133	1,786
50	Salt Removal (million tons) [S_{30}]	68	84	115	146	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,853	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	81	78	72	66	59	52	42	33
	In-Sea Ponds after Restoration (sq mi)	132	129	123	116	110	102	92	83
	Average In-Sea Pond Area (sq mi)	107	104	97	91	85	77	67	58
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	319,009	309,190	290,047	271,414	252,632	229,648	201,210	172,930
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	3,517	3,367	3,083	2,816	2,557	2,253	1,896	1,563
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	3,588	3,438	3,154	2,887	2,628	2,324	1,967	1,634

Salt Removal Requirements for Varying Salinity and Elevation Targets

Inflow Reduction = 540,000 acft/yr

Inflow at end of 30 years (ac-ft/yr) 800,000 Rest. Period 30 yrs

Salton Sea Salinity Target (ppt)									
	Salton Sea Elevation Target (ft, msl) [E_{30}] >>>	-227	-228	-230	-232	-234	-236	-238	-240
	Surface Area without Displacement (sq mi) [$A_{30,LU}$] >>>	365.80	362.46	355.93	349.58	343.19	335.38	325.76	316.19
	Salton Sea Volume (maf) [V30] >>>	7.62	7.39	6.93	6.48	6.04	5.60	5.18	4.77
	Annual Volume Reduction (af/yr) >>>	0	7,768	23,093	38,143	52,925	67,405	81,518	95,213
35	Salt Removal (million tons) [S_{30}]	224	235	257	278	299	320	340	360
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	102,717	107,811	117,860	127,730	137,424	146,919	156,174	165,154
	Withdrawal for Restoration (ac-ft/yr) [W]	137,056	143,853	157,262	170,431	183,366	196,035	208,384	220,367
	Withdrawal Requirement after Restoration (ac-ft/yr)	84,018	84,018	84,018	84,018	84,018	84,018	84,018	84,018
	In-Sea Ponds for Restoration (sq mi)	115	111	104	97	90	82	72	62
	In-Sea Ponds after Restoration (sq mi)	167	164	157	151	145	137	127	118
	Average In-Sea Pond Area (sq mi)	141	137	131	124	117	109	99	90
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	420,654	410,263	389,993	370,252	350,383	326,334	296,858	267,570
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	5,218	5,031	4,675	4,339	4,012	3,630	3,183	2,763
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	5,289	5,102	4,746	4,410	4,083	3,701	3,254	2,834
40	Salt Removal (million tons) [S_{30}]	172	185	210	234	258	282	305	327
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	78,907	84,728	96,214	107,493	118,571	129,423	140,000	150,264
	Withdrawal for Restoration (ac-ft/yr) [W]	99,093	106,404	120,827	134,992	148,905	162,532	175,815	188,705
	Withdrawal Requirement after Restoration (ac-ft/yr)	73,516	73,516	73,516	73,516	73,516	73,516	73,516	73,516
	In-Sea Ponds for Restoration (sq mi)	104	101	94	87	81	72	63	53
	In-Sea Ponds after Restoration (sq mi)	164	161	154	148	142	134	124	115
	Average In-Sea Pond Area (sq mi)	134	131	124	118	111	103	93	84
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	400,583	390,405	370,554	351,226	331,763	308,110	279,021	250,108
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	4,859	4,682	4,344	4,025	3,715	3,351	2,924	2,523
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	4,930	4,753	4,415	4,096	3,786	3,422	2,995	2,594
45	Salt Removal (million tons) [S_{30}]	120	134	162	190	217	244	270	295
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	55,096	61,646	74,567	87,256	99,719	111,927	123,827	135,373
	Withdrawal for Restoration (ac-ft/yr) [W]	65,347	73,115	88,440	103,491	118,273	132,752	146,865	160,560
	Withdrawal Requirement after Restoration (ac-ft/yr)	65,347	65,347	65,347	65,347	65,347	65,347	65,347	65,347
	In-Sea Ponds for Restoration (sq mi)	95	91	85	78	72	64	55	45
	In-Sea Ponds after Restoration (sq mi)	162	159	152	146	139	132	122	112
	Average In-Sea Pond Area (sq mi)	128	125	118	112	106	98	88	79
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	383,225	373,237	353,759	334,798	315,694	292,395	263,649	235,070
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	4,559	4,389	4,067	3,762	3,466	3,117	2,708	2,323
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	4,630	4,460	4,138	3,833	3,537	3,188	2,779	2,394
50	Salt Removal (million tons) [S_{30}]	68	84	115	146	176	206	234	262
	Storage Requirement for Salt (af) [S_{30}/M_{30}]	31,286	38,563	52,920	67,019	80,867	94,432	107,653	120,483
	Withdrawal for Restoration (ac-ft/yr) [W]	35,154	43,331	59,463	75,305	90,865	106,106	120,962	135,378
	Withdrawal Requirement after Restoration (ac-ft/yr)	58,813	58,813	58,813	58,813	58,813	58,813	58,813	58,813
	In-Sea Ponds for Restoration (sq mi)	86	83	77	71	64	57	47	38
	In-Sea Ponds after Restoration (sq mi)	160	157	150	144	138	130	120	111
	Average In-Sea Pond Area (sq mi)	123	120	114	107	101	93	84	74
	Average Evaporative Capacity of In-Sea Ponds (af/yr)	368,015	358,196	339,052	320,419	301,638	278,654	250,215	221,935
	On-Land Evaporative Capacity needed (af/yr)	0	0	0	0	0	0	0	0
	On-land Pond Area (sq mi)	0	0	0	0	0	0	0	0
	PV In-Sea Ponds ($M)	4,302	4,139	3,830	3,538	3,254	2,919	2,524	2,154
	PV Additional Evap ($M)	0	0	0	0	0	0	0	0
	Total PV of Restoration ($M)	4,373	4,210	3,901	3,609	3,325	2,990	2,595	2,225