

4.6 FISHERIES AND AQUATIC RESOURCES

4.6.1 Summary of Environmental Consequences

The No Action Alternative for both current inflow and reduced inflow conditions would result in significant and unmitigable fisheries and aquatic resource impacts. Alternatives 1-5 would provide long-term beneficial effects for fisheries and aquatic resources due to the decrease in salinity and the control of elevation, compared to the No Action Alternative conditions. Significant and mitigable short-term adverse impacts would occur under alternatives 1 through 5 as a result of changes in habitat and incompatibilities between restoration (construction) activities and existing fisheries and aquatic resources. Four common actions would be implemented under Action Alternatives 1-5, and would result in net benefits. Chapter 5 provides an analysis of these common actions.

4.6.2 Significance Criteria

Criteria used to evaluate the significance of impacts to fisheries and aquatic resources are derived from the legal (federal and state) requirements to protect special status species and sensitive habitats, as described in Chapter 3. Specific criteria also take into account issues identified during public scoping of the EIS/EIR, discussions with USFWS and CDFG, issues from other reports addressing potential impacts of various land uses at Salton Sea on fisheries and aquatic resources, federal and state laws on fisheries and aquatic resources, including the Endangered Species Act and Clean Water Act.

An alternative could have a significant fisheries and aquatic resources impact if its implementation would result in any of the following:

- Harm to, harassment of, or destruction of individuals of any fish or aquatic species listed as endangered, threatened, or rare under federal or California law. In addition, such impacts are considered significant to other fish species under the following conditions:
 - survival and reproduction of a species in the wild are in immediate jeopardy;
 - the species exists in such small numbers throughout all of or a significant portion of its range that it may become endangered if its environment worsens due to the project; or
 - the species is likely to become endangered in the foreseeable future and may be categorized as threatened under federal law.
- Modification or destruction of the habitat, migration use corridors, or breeding areas of endangered, threatened, rare, or other fish or aquatic species, as defined in the preceding paragraphs.
- Loss of a substantial number of any fish or aquatic species that could affect abundance or diversity of that species beyond normal variability.

- Impacts to sensitive species.

4.6.3 Assessment Methods

Potential impacts to fisheries and aquatic resources are assessed by comparing proposed changes in habitat use under each of the alternatives to current and planned uses of these same areas. Existing fisheries and aquatic resources status, as described in Chapter 3, form the basis for assessing the significance of changes to fisheries and aquatic resources under each of the alternatives.

Salinity and Sea elevation are recognized as the primary controlling factors determining which aquatic species can survive and thrive at a given point in time. Salinity concentration can directly impact the reproduction and survivability of aquatic species while salinity and elevation can indirectly affect species by altering the temperature and water chemistry of the Sea. Thus, thresholds of different species to salinity were compared to the forecasted changes in salinity for each alternative. Similarly, potential changes in elevation and salinity, on temperature and water chemistry were qualitatively assessed. The following provides the data used to assess impacts from salinity on aquatic species and data used to assess effects from changes in salinity and elevation on temperature and water chemistry.

Salinity Impact Assessment Method

Increasing salinity affects the physiology of organisms within the Sea. This effect can be both direct, as in when it affects the performance of specific metabolic processes, or indirect, as in when it affects the energetics of the living organism so that more energy is devoted to osmoregulation and less for fundamental processes, such as growth and reproduction. At higher salinities, species would become increasingly susceptible to other physical factors (i.e., lower oxygen levels and temperature extremes), to other biological factors (disease and predators), and to increased mortality and reduced reproduction. Eventually, an increase in salinity would cause a population to crash. The result of increasing salinity in the Salton Sea would most likely be a reduction in the Salton Sea biota diversity.

Changes in the water chemistry of the Salton Sea occur from changes in solubility as salinity increases, and from changes in the biological community, which cause secondary effects on the water chemistry. The amount of oxygen dissolved in water has important biological consequences and is inversely proportional to the salinity. At one atmosphere of pressure, water temperature of 10°C, and salinity of 41,600 mg/L, oxygen saturation is 8.84. Under the same temperature and pressure but a salinity of 63,600 mg/L, oxygen saturation is reduced to 7.77, and at a salinity of 110,000 mg/L it is 5.95 (Sherwood et al. 1992). Changes in the water chemistry and subsequent changes in biological communities of the Sea would have considerable effects on fisheries.

For all organisms, the tolerable salinity range is not a plateau that drops off precipitously but a slope where stress is gradually placed on the organism, and its response represents the cumulative stress not only of salinity but of changing food supplies, temperature, ionic composition, and toxins. The greater the cumulative stress,

the steeper the slope. It should be noted that the majority of Salton Sea salinity tolerance research was reported in units of parts per thousand (ppt). In order to be consistent with the other sections of this report and compare tolerances with modeled salinity level predictions, all ppt values were converted into mg/L.

Information on salinity tolerances of various types of organisms within the Salton Sea is reported below.

Phytoplankton and Phytobenthos

As water surface elevation declines and the Sea becomes shallower, it becomes progressively easier for wind energy to mix the water column. This could transport oxygen to deeper layers of the water column and in some areas to the bottom. During the summer, 60 to 100 percent of the Sea bottom is exposed to dissolved oxygen concentrations of <1 mg/L (Hurlbert 1999a). Increased ease in mixing could facilitate suspension of materials present in bottom sediment, which could result in increased oxygen demands for suspended organic material. Increased ease of wind mixing results in increases in local current velocities and the ability for plankton and suspended substances to be transported. This could increase the rate of movement of phytoplankton in the Salton Sea, speeding up the effects of blooms of toxic algae. Decreased water depth may allow greater suspension of bottom materials that would increase turbidity and could increase the rate of mobilization for sediment-derived nutrients, such as nitrogen and phosphorus, and further accelerate eutrophication.

Recently, several potentially toxic algae species have been found in the Salton Sea. Certain species have been documented recently that were not known to occur previously and that are potentially responsible for the fish die-offs (Hurlbert 1999b). As many of these are marine species, increases in salinity may allow them to expand their numbers. These include *Chatonella* cf. *marina*, a toxic marine alga now present in winter, *Heterocapsa niei*, a potentially toxic dinoflagellate that is often a dominant species, a Pfiesteria-like organism found in 1997, and *Gyrodinium uncatenum* and several species of *Gymnodinium* that may be capable of toxin production (Dexter et al. 1999). *Prymnesium*, a toxic alga was present in lab studies at a salinity of 50,300 to 60,200 mg/L and may become more common at higher salinities in the Salton Sea (Stephens 1999b). Continuing studies on algae are being conducted as part of the ongoing limnological studies being conducted at the Salton Sea (Hurlbert 1999c; Stephens 1999b).

Invertebrates

The literature on salinity tolerances of rotifer *Brachionus plicatilis* is inconclusive, but it has been noted that it requires acclimatization to tolerate salinities over 36,200 mg/L (Salton Sea Science Subcommittee 1998), and reproduction is generally higher at lower salinities, generally between 36,200 and 47,000 mg/L (Lubzens et al. 1985). High salinity and higher temperatures make the production of males less likely and inhibit the hatching of resting eggs (Hino and Hirano 1984; Lubzens et al. 1980, 1985, 1993).

The copepods *Apocyclops dengizicus* and *Cletocamptus dietersi* have been studied for salinity tolerances. *Apocyclops dengizicus* has been noted to survive in salinities up to 80,600 mg/L.

(Timms 1993). Dexter (1993) induced reproduction at up to 72,600 mg/L, and adults survived at salinities over 85,200 mg/L for up to 120 days, but population growth stopped at over 60,200 mg/L. *Cletocamptus dietersi* was cultured at salinities up to 86,400 mg/L. Larvae died at 92,200 mg/L though adults survived and copulated at 118,400 mg/L (Dexter 1995).

The pileworm *Neanthes succinea* has been reported to have a 50 percent reduced survivorship at 69,200 mg/L, a more substantial reduction at 74,900 mg/L, and no survival at 92,200 mg/L (Kuhl and Oglesby 1979). Reproduction is hampered at salinities over 52,500 mg/L. The barnacle *Balanus amphitrite saltonensis* has loss of larval survival at 86,400 mg/L and loss of 50 percent at 58,000 mg/L (Crisp and Costlow 1963; Perez 1994). Survivorship over four weeks was not significantly affected at salinities up to 74,900 mg/L (Perez 1994). However, detrimental physiological changes were noted to occur at salinities over 50,300 mg/L (Simpson 1994). The amphipod *Gammarus mucronatus* has been noted to occur in salinities up to 52,500 mg/L (Hedgpeth 1967) and in culture at 85,200 mg/L (Salton Sea Science Subcommittee 1998). The corixid *Trichocorixa reticulata* has an extremely high tolerance for hypersaline conditions, as noted by Jang and Tullis (1980) and Euliss et al. (1991). It has been noted to occur at salinities up to 110,000 mg/L or more.

Brine shrimp are present in saline water from about 30,000 mg/L to near saturation (Hammer 1986). However, in the Great Salt Lake, shrimp cysts have been found to lose buoyancy and their populations decline at salinities of less than about 60,000 mg/L (Stephens 1990 and 1998). Conte et al. (1972, 1973) found *nauplii* did poorly at salinities of greater than 175,000 mg/L. Brine shrimp are not tolerant of high concentrations of potassium salts (Hammer and Parker 1984), and toxicity depends on the molar ratios of sodium to potassium being less than about 12 (Bowen and Carl 1992). Some of the Brinefly larvae are highly tolerant of high salinity. Brinefly larvae occur and reproduce in the north arm of Great Salt Lake at a salinity of 330,000 mg/L, but numbers are fewer than in the less saline south arm of the lake (Post 1977).

Fish Species

In general, adult fish are capable of tolerating higher salinity levels than the egg and larval life stages. Consequently, some aspects of fish life cycle may require habitats with lower salinities than are required for adult survival. Salinity measurements and predictions within the Sea have been based on the average salinity level. Although the average salinity may rise to levels exceeding fish tolerances, lower salinity areas may still be available (i.e. near drainage inflows). As a result, instances where salinity levels exceed fish tolerances the amount of suitable habitat would be severely limited, but may not preclude the species from survival within the Sea. Rather, it may concentrate populations and spawning activities to within these lower salinity areas. For the purposes of this section impacts have been determined based on the premise that when average salinity levels exceed the tolerance for species life cycle completion the species will be severely impacted. Information from the literature on the salinity tolerances of fish (and invertebrates) within the Salton Sea are provided below and are summarized in Table 4.6-1.

Tilapia. The Salton Sea tilapia population is basically a strain of *Oreochromis mossambicus* (Costa-Pierce and Doyle 1997). Tilapia have been observed to adapt successfully to gradually increasing salinity levels (pers. com. Costa-Pierce 1999). Whitfield and Blaber (1979) stated that tilapia had been collected within salinities up to 134,400 mg/L. Potts et al. (1967) established that five to ten week old fish can tolerate 74,900 mg/L indefinitely. Popper and Lichatowich (1975) reported that at salinities up to 51,400 mg/L, it was necessary to introduce predators for population control. Other research suggests the salinity range of tilapia does not exceed 74,900 mg/L, and their reproductive capabilities may be lost at 63,600 mg/L (Pullin et al. 1982). Frequent spawning activity in the Salton Sea have been observed for salinities of 43,000 – 55,000 mg/L (Costa-Pierce in prep). Research conducted in support of the CEQA/NEPA process (1998) suggests that by 63,600 mg/L the salinity tolerance of tilapia has probably been exceeded. For the purposes this report the upper salinity tolerance level for tilapia life cycle completion was established at approximately 63,600 mg/L.

There is a small amount of information on the interaction for tilapia between salinity and organic chemicals. Dange (1986) found that *O. mossambicus* is more susceptible to disruption of gill osmoregulatory mechanisms by toluene and naphthalene at 36,200 mg/L than at 20,400 mg/L. It could be inferred that higher salinities would make this species even more vulnerable to organic pollutants.

Bairdiella. Bairdiella in the Sea have a high level of developmental deformities (Whitney 1961; Matsui et al. 1992). It is thought that the deformities are, in fact, a result of a genetic founder effect. If this is so, then the ability of the bairdiella population to adapt to rising salinity may be genetically limited.

Several studies have been conducted on the effects of salinity on bairdiella. Hanson (1970) reported that juvenile bairdiella tolerated 55,300 mg/L, although there was 60 percent mortality at 58,000 mg/L. He found that mortality of yearling bairdiella began at 55,300 mg/L (40 percent) and increased to 60 percent at 58,000 mg/L and 93.3 percent at 66,400 mg/L, until no fish survived at 80,600 mg/L. Lasker et al. (1972) detected a marked increase in egg and larval mortality at salinities over 47,000 mg/L. May (1975a, 1975b, 1976) found that no larvae survived longer than two days in artificial Salton Sea water of 36,200 and 47,000 mg/L. Salinity and temperature effects on bairdiella reproduction studied by May (1975a, 1976) indicate diminished reproductive success at 41,600 mg/L and above.

Table 4.6-1
Summary of Salinity (mg/L) Occurrence and Tolerance Data for Species Inhabiting the Salton Sea

Species	Collection	Life Stage Survival	Life Cycle Completion	Population Maintenance
<i>Brachionus plicatilis</i> (rotifer)	81,800	52,500	50,300–52,500	41,600
<i>Apocyclops dengizicus</i> (copepod)	80,600	85,200	72,600	53,600
<i>Cletocamptus dietersi</i> (copepod)	44,000 ¹	118,400	86,400	86,400
<i>Balanus amphitrite saltonensis</i> (barnacle)	44,000 ¹	74,900	74,900	52,500

<i>Neanthes succinea</i> (pileworm)	44,000 ¹	72,100	52,500	86,400
<i>Gammarus mucronatus</i> (amphipod)	52,500	85,200	--	--
<i>Trichocorixa reticulata</i> (water boatman)	240,000	110,00	--	--
<i>Cynoscion xanthulus</i> (orange-mouth corvina)	44,000 ¹	60,800	41,600 ²	--
<i>Bairdiella icistia</i> (gulf croaker)	44,000 ¹	58,000	58,000	--
<i>Anisotremus davidsonii</i> (sargo)	44,000 ¹	58,000	47,000	--
<i>Oreochromis mossambicus</i> (tilapia)	134,400	74,900	63,600 ³	--
<i>Cyprinodon macularius</i> (desert pupfish)	98,100	74,900	74,900	--
<i>Poecilia latipinna</i> (sailfin molly)	94,600	92,200	-- ⁴	--
<i>Gillichthys mirabilis</i> (longjaw mudsucker)	89,300	--	80,600	--

Source: Adapted from Salton Sea Science Subcommittee 1998 DRAFT

Explanation of columns:

- **Collection.** Refers to the salinity at a site where an organism was collected in nature.
- **Life Stage Survival.** The maximum salinity, in experimental work, at which one or more life stages of a species can survive for an extended time, but where completion of the entire life cycle has not been established.
- **Life Cycle Completion.** The maximum salinity, in experimental work, at which completion of a species' entire life cycle has been demonstrated. This salinity theoretically should always be lower than the life stage survival salinity.
- **Population Maintenance.** The maximum salinity, in experimental work, at which population growth has been demonstrated and theoretically should be lower than the life cycle and life stage salinity values.

Notes:

¹ = Based on current conditions of Salton Sea

² = Juvenile Corvina have been observed under current conditions 44,000 mg/L. This may indicate either a higher salinity tolerance than previously recorded or successful reproduction is occurring in areas with lower salinity levels.

³ = This is a conservative estimate. Tilapia have been found to successfully adapt to gradually increasing salinity levels and may be able to complete their life cycles at salinities higher than 63,600 (pers. comm. Costa-Pierce 1999).

⁴ = Data not available

Ichthyoplankton field data collected between 1987 and 1989, with salinities ranging from 39,400 to 45,900 mg/L, respectively, showed a significant increase in the number of late larval stages but a decrease in the number of eggs and early larvae with each progressive year (Matsui et al. 1991b).

Sargo. Several studies were conducted to determine the effects of salinity on sargo. Lasker et al. (1972) showed a clear increase in larval mortality at 41,600 mg/L and higher. Hanson (1970) showed that survivorship of juvenile sargo appeared to decline markedly at salinities between 44,300 to 49,800 mg/L, reaching zero at 66,400 mg/L.

Matsui et al. (1991a) concentrated Salton Sea water by reverse osmosis and were able to acclimate adult sargo to 58,000 mg/L over a five month period. However, no spawning occurred in tanks at 52,500 or 58,000 mg/L. Brocksen and Cole (1972) reported “rather severe stress” at 47,000 mg/L.

Results of laboratory salinity tolerance tests indicated that although sargo acclimated to treatment salinities of 47,000 mg/L, significant larval mortality occurred in salinities above 41,600 mg/L, and 100 percent mortality occurred at 58,000 mg/L (Matsui et al. 1991a).

Field data collected between 1987 and 1989 with salinities of 39,400 and 45,900 mg/L, respectively, showed a decrease in both the number of late egg and early larval stages for sargo (Matsui et al. 1991a).

Orange-mouth Corvina. Although corvina is the most sought after game fish in the Salton Sea, its large size makes it a more difficult experimental organism, and it has therefore received the least amount of study. Hanson (1970) reported that corvina survived at 55,300 mg/L but that mortality was complete at 65,800 mg/L.

Brocksen and Cole (1972) found that assimilation efficiency was higher at 38,400 mg/L than at 47,000 mg/L and that oxygen consumption increased as salinity increased.

Matsui, Lattin et al. (1991a) found that corvina were able to grow in Salton Sea water concentrated by reverse osmosis at salinities up to 58,000 mg/L. However, spawning could only be induced (with the aid of hormone injections) at 36,200 and 41,600 mg/L; spawning did not occur at 47,000 mg/L under their experimental conditions. The salinity level currently in the sea (44,000 mg/L) may be within the life cycle completion tolerance level for corvina, however, studies have not confirmed this.

Desert Pupfish. Desert pupfish have a high tolerance for extreme environmental conditions, including temperature, dissolved oxygen, and salinity. Barlow (1958) reported that the desert pupfish survived salinity as high as 98,100 mg/L in the laboratory and reported finding them in pools near the Salton Sea with salinities of up to 69,200 mg/L. Schoenherr (1992) reports adult pupfish tolerating water up to 74,900 mg/L. Pupfish growth is faster at 36,200 and 15,200 mg/L than in 58,000 mg/L ocean water concentrated by evaporation (Kinne 1960). Desert pupfish eggs successfully

developed in salinities of 74,900 mg/L at temperatures below 33°C, with longer development times and higher mortality than at lower salinities. Development was not successful at 92,200 mg/L.

The critical thermal maximum of 44°C for this species is the highest ever recorded for a species of fish. This ability to tolerate hot water also enables them to live in hot springs. In such a habitat, the desert pupfish may feed on blue-green algae that live in water hotter than its critical thermal maximum. The pupfish does this by hovering in water as hot as it can tolerate and then darting into the hotter water for a quick bite of food. The desert pupfish also has recorded the lowest tolerated minimum for dissolved oxygen, at 0.13 mg/L.

Sailfin Molly. In general this species is considered extremely tolerant of salinity ranges (Herbert et al. 1987). Adults are reported to withstand salinities greater than 86,400 mg/L (Nordlie et al. 1992; Herre 1929). The sailfin molly has been found to occur at 94,600 mg/L but is absent from ponds at 102,800 mg/L (Herre 1929). By acclimating mollies very gradually to ocean water supplemented with salts, Nordlie et al. (1992) obtained 95.7 percent survivorship (over two weeks) at 86,400 mg/L and 43.1 percent at 92,200 mg/L.

Longjaw Mudsucker. The longjaw mudsucker has been collected from sites with salinities as high as 82,500 mg/L (Barlow 1963). Lonzarich and Smith (1997) have seen reproduction at salinities up to 80,600 mg/L.

Water Chemistry and Elevation Impact Assessment Method

A matrix was developed to qualitatively assess changes in the water chemistry, biology, and use of the Salton Sea resulting from increased salinity and decreased depth (Table 4.6-2). Forecasted changes from each alternative were compared to the matrix to determine the likely impacts.

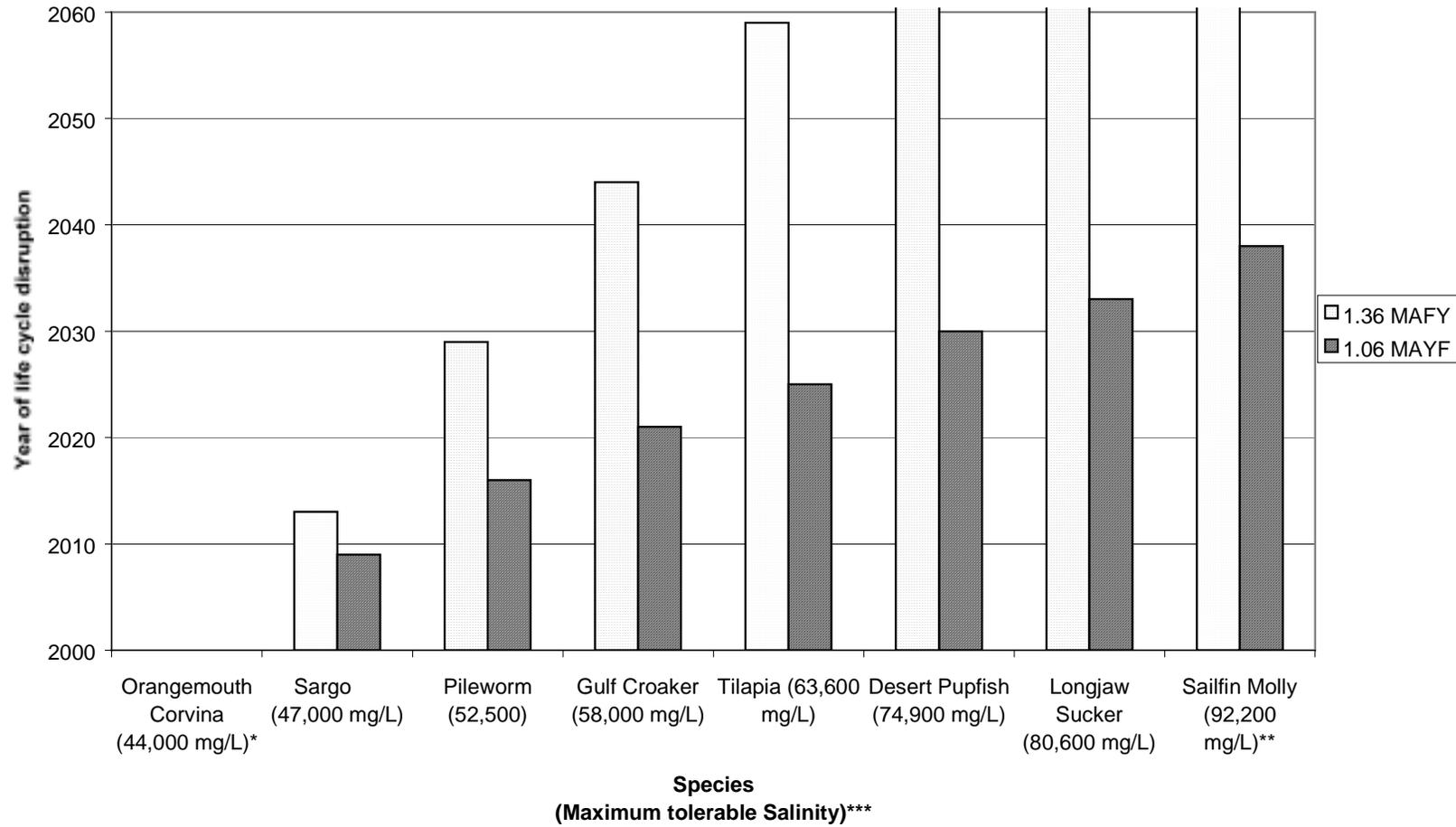
4.6.4 No Action Alternative

Under the No Action Alternative, significant direct or indirect impacts to fisheries and aquatic resources would result from increases in salinity and changes in elevation of the Sea. Under both the current (1.36 maf/yr) and reduced (1.06 maf/yr) inflow regimes the Sea would become significantly more saline. As the salinity level continues to rise under the No Action Alternative, the habitat would be impaired, and impacts to fisheries and aquatic resources would result. Table 4.6-3 and Figure 4.6-1 compare the impacts, from changing salinity, to aquatic resources over time from the two different flow regimes.

Table 4.6-2
Changes in the Water Chemistry, Biology, and Use of the Salton Sea Resulting from Increased Salinity and Decreased Depth

Water Constituent or Characteristic	Increased Salinity	Decreased Depth	Biological Effect	Use of Salton Sea
Temperature	Increased thermal capacity: water slower to warm in summer and slower to cool in winter	Potential increase in summer temperatures, decrease in winter minimum temperature	Wide temperature fluctuation may be restrictive to some species	May restrict sport fisheries
Dissolved oxygen	Decreased solubility	Increased mixing of atmospheric oxygen in near-surface water and suspension of oxygen-demanding materials from bottom	Reduces numbers of oxygen-breathing organisms. May increase number of sulfate-reducing bacteria and organisms that can utilize atmospheric oxygen	Restrict fisheries, possibly increase odor due to sulfides, would decrease fish abundance
PH	Decreased buffer ability as calcium carbonate solubility is reduced, causing pH to rise	Not known	Wide pH fluctuation may be restrictive to some species. Photosynthesis may cause wide variation in pH due to lack of buffering	Wide pH fluctuation may be restrictive to some species and subsequently may affect sport fisheries.
Turbidity	May decrease solubility of some organic substances, increasing the turbidity	Increased turbidity due to suspension of bottom material	Reduced light penetration for photosynthesis, particularly for benthic algae	Adverse effect to sport fisheries, could cause surface scum as algal blooms more surface dominated
Nutrients (nitrogen, phosphorus)	Causes changes in biological community and may greatly change the interaction of nutrients in algal and animal groups	Greater rate of mobilization of nutrients released from bottom sediment	Algal blooms increased; greater oxygen demands from decaying algae; greater secondary production by zooplankton	Adverse effect to fish populations at lower salinity; zooplankton may become dominated by artemia and ephydra
Trace elements	Generally reduced toxicity of some due to common ion interaction	Increased mobilization from sediment to water column may increase availability, particularly for selenium	Effect on biota uncertain. While toxicity may be reduced due to salt effects, oxidation may make some elements more available	At lower salinities, increase trace element availability could decrease abundance of fish

Figure 4.6-1 Year which Species Cannot Complete Lifecycle (based on average Sea salinity)



Notes:

* Juvenile corvina have been observed under current conditions 44,000 mg/L, this exceeds previously recorded salinity tolerances.

** based on life stage survival, lifecycle completion data not available

*** based on life cycle completion

Table 4.6-3
Estimated Year the Average Sea Salinity Level Exceeds the Maximum Salinity at which
Species Can Complete their Lifecycle

Species	Year of Impact at 1.06 maf/yr Inflow Conditions	Year of Impact at 1.36 maf/yr Inflow Conditions
Orangemouth Corvina	2000	2000
Sargo	2009	2013
Pileworm	2016	2029
Gulf Croaker	2021	2044
Tilapia	2025	2059
Desert Pupfish	2030	2088
Longjaw Mudsucker	2033	Beyond 2100
Sailfin Molly	2038	Beyond 2100

Under the current flow regime the Sea level would increase slightly, while under the reduced flow regime the Sea would become smaller. Consequently, the No Action Alternative with reduced flows, in addition to more rapid increases in salinity, may affect fisheries and aquatic resources in the sea by reducing available habitat. The rates at which elevation and salinity changes depend on the average annual inflow into the Salton Sea. Specific impacts are discussed below.

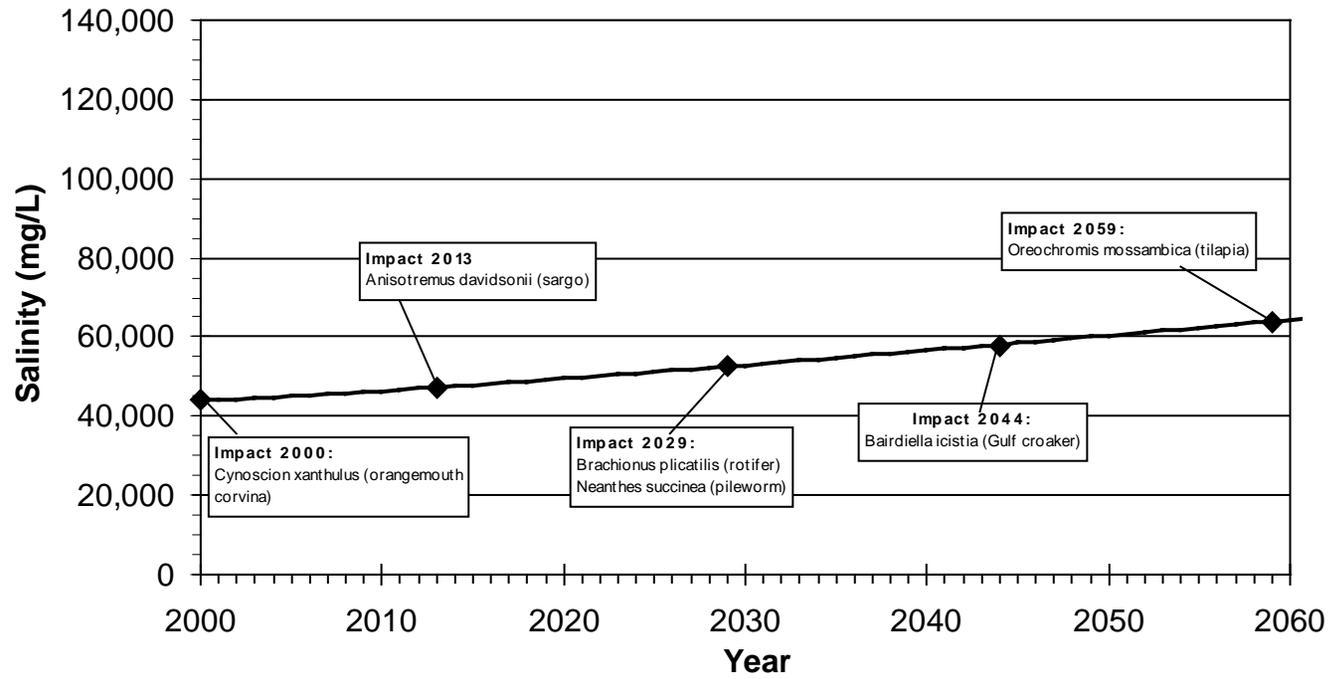
Effect of No Action with Continuation of Current Inflow Conditions

The No Action Alternative, under current inflow conditions, would result in significant and unmitigable fisheries and aquatic resource impacts. Both salinity and elevation level would not be expected to remain constant under these conditions. As discussed above, direct and indirect impacts to habitat would occur as a result of these changes in the salinity level and elevation. This in turn would have an affect on fish and other species living within the Sea. Figure 4.6-2 shows the effect of salinity changes on population dynamics under the No Action Alternative with current flow conditions.

Under the No Action Alternative with current inflow conditions, there would be little change in sediment depositional patterns, although there may be an increase in precipitation of CaCO₃ and CaSO₄.

The current dominant invertebrates (*Neonthes*) are predicted to stop reproducing at 52,000 mg/L salinity, which could occur within the next 30 years. This would result in a major loss of food for fish and in turn fish-eating birds. Remnant populations may survive within areas of lower salinities, such as at the mouths of rivers.

Figure 4.6-2 Predicted Year of Significant Impact Due to Salinity Increase for No Action with Current Inflow Conditions



Note:
Impact = species cannot complete lifecycle

The pileworm, *Neanthes succinea*, which is the basis of the Salton Sea food chain, has a significant reduction in reproduction when the salinity reaches 52,500 mg/L (expected to occur by the year 2029). *Brachionus plicatilis* (rotifer) will also not be able to complete its life cycle at this salinity. This may allow amphipods, such as *Gammarus mucronatus*, to become the dominant benthic invertebrate.

The overall outcome of the No Action Alternative would be the loss of the sport fishery. While the demise of corvina, croaker, and sargo has been predicted for many years, they continue to reproduce. The available evidence indicates that corvina reproduction might fail at any time above the current salinity of 44,000 mg/L. Sargo will likely fail at approximately 47,000 mg/L (2013). By the year 2041 the salinity will reach 58,000 mg/L which exceeds the croakers ability to complete its lifecycle. This will leave tilapia as the only species large enough for sport fishing in the Sea.

Tilapia may still be present for several years beyond the other sportfish. At 63,600 mg/L (2025), tilapia's salinity tolerance for reproduction would probably be exceeded, and it is likely to disappear or experience substantial population reduction. This would leave desert pupfish, longjaw mudsuckers and possibly sailfin molly as the only fish in the Sea capable of utilizing the majority of aquatic habitats. These species probably would be able to expand their populations at this point but because these fish are small, they may not fully replace the tilapia as food for fish-eating birds, thus the fish-eating bird population would decline.

Effect of No Action Alternative with Reduced Inflows (1.06 maf/yr)

Significant and unmitigable impacts would be expected under the No Action Alternative with reduced inflows. Under these conditions, salinity levels are expected to increase, and the Sea's elevation level is expected to drop. A substantial increase in salinity levels would degrade the remaining available habitat (a level of 75,050 mg/L is expected in 30 years). Elevation is expected to drop approximately 7 feet in the first 30 years. This would cause a significant reduction in available aquatic habitat.

Due to the reduced surface elevation, rocky substrates along the shoreline in some areas would be exposed. Barnacle shell substrate would be dry. In this scenario, there would be a reduction in delta formation, but more shoreline sediments would be exposed.

In the first 30 years, polychaete density in the sea sediments probably would increase due to greater availability of oxygen. However, after 30 years the polychaete population would be greatly depressed if not absent. Egg fertilization of the pileworm (*Neanthes succinea*) has been reported to be substantially reduced at a salinity of 52,5000 mg/L and completely unsuccessful over 58,000 mg/L (Kohl and Oglesby 1979).

Salinity would dictate population dynamics similar to that described above in the No Action Alternative current inflow scenario, except the timing of change would be accelerated as indicated below:

<u>Salinity</u>	<u>1.06 maf/yr</u>	<u>1.36 maf/yr</u>
50,000 mg/L	13 years	22 years
60,000 mg/L	22 years	49 years
70,000 mg/L	29 years	75 years

With reduced inflows, salinity levels would increase to levels significantly greater than predicted for the No Action Alternative with current inflow conditions resulting in some additional population impacts.

At about 72,600 mg/L, the copepod *Apocyclops dengizicus* could disappear (most likely the rotifers and pileworms would have died off some time before this). The copepod (*Cletocamptus dietersi*) would likely disappear at 86,400 mg/L, leaving no true zooplankton, only protozoans, to graze the phytoplankton. This could have significant effects on the species composition of the phytoplankton, with possible implications for nutrient cycling and the overall productivity of the Sea.

There is some evidence that the desert pupfish can complete their lifecycle in salinity conditions up to 74,900 mg/L (Barlow 1958). Salinity is predicted to increase beyond this level by the year 2030. Additionally, Sea elevation decreases may impede migration between the agricultural drains. Based on this prediction, impacts to desert pupfish under the No Action Alternative with reduced flows, would be significant.

Figure 4.6-3 shows the effect of salinity changes on population dynamics under the No Action Alternative with reduced flow conditions. In general, the Sea's sport fishery will likely fail by the year 2025 with the loss of corvina, sargo, croaker, and tilapia. All fish species will likely disappear from the Sea by the year 2038, leaving only water boatman, brine shrimp and brine flies.

4.6.5 Alternative 1

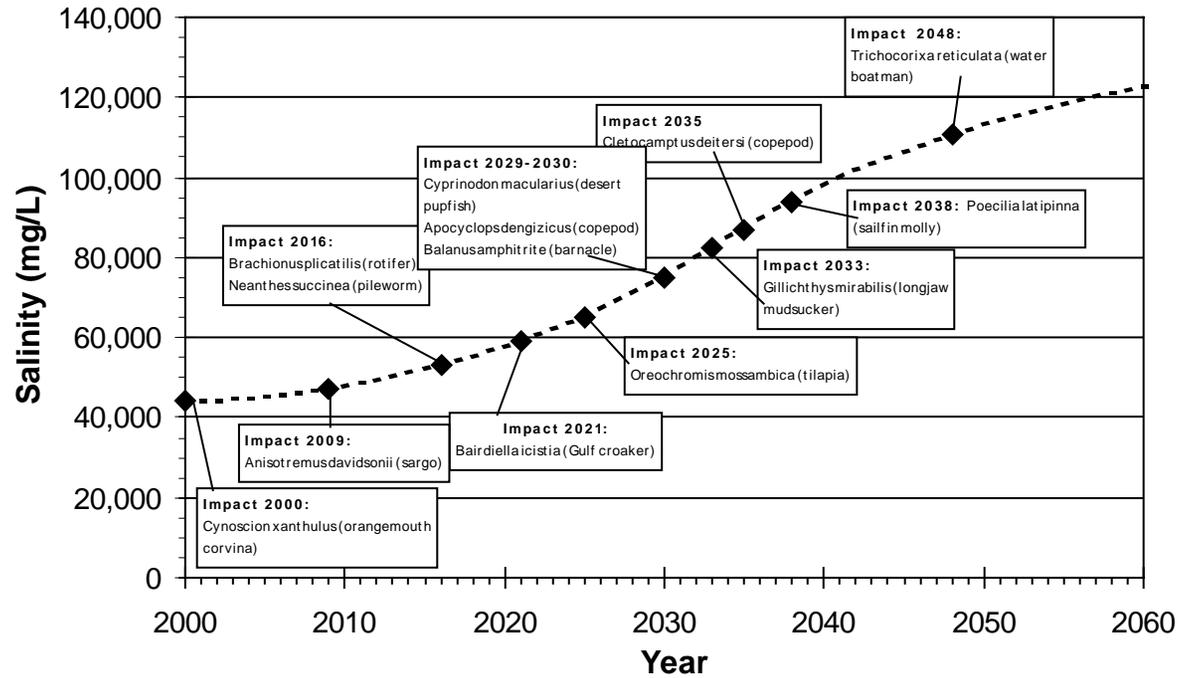
In addition to implementing the four common actions described in Chapter 5, Alternative 1 proposes to control salinity and elevation by using two evaporation ponds.

Effect of Alternative 1 with Continuation of Current Inflow Conditions

North and South Evaporation ponds (98 kaf/year)

Both the North and South evaporation ponds would be located in areas which are currently within the main body of the Sea. Construction activities would take place within aquatic habitats, resulting in a number of temporary adverse effects to aquatic habitat and resources. These impacts are primarily the result of dredge and fill operations and the removal of existing habitat from the Sea.

Figure 4.6-3 Predicted Year of Significant Impact Due to Salinity Increase for No Action with Reduced Inflow Conditions



Note:
Impact = species cannot complete lifecycle

Organic-rich sediment covers about 735 acres of the Sea bottom where the dike footing would be placed. The organic-rich sediment is not structurally stable and would be removed to a depth of five feet using a suction dredge. Approximately seven million cubic yards of sediment would be removed. The material would be returned to the Sea between parallel silt curtains suspended by floats from the water surface. The silt curtain would allow water to pass but would contain the solids in a path of unknown width on the Sea bottom. The dredging and disposal activities would have the following localized effects to the aquatic environment:

- Increase in turbidity may negatively impact fish and invertebrates in localized areas.
- Release of nutrients from disturbance of Sea bottom sediments, which could accelerate local eutrophication. This may result in localized anoxic conditions precluding areas from use as fish habitat.
- Oxygen depletion from hydrogen sulfide in sediment. The high organic material content of the sediment contains a considerable amount of hydrogen sulfide. Release of the sediment would increase oxygen demand, causing localized oxygen depletion with potentially adverse effects on biota. The amount of hydrogen sulfide released from the sediment is not known, but it may cause localized odor problems and can be toxic to fish and invertebrate resources.
- Blanketing of polychaetes and fish habitat by solids, which could result in food chain impacts. Dikes would greatly reduce the local numbers of polychaetes (*Neanthes succinea*) as dike material is added on top of the soft-bottom sediment in which the polychaetes reside. Polychaetes are the principle food item for many fish and shorebirds in the Salton Sea, and densities average 1,000 individuals per square meter throughout much of the Sea (Dexter et al. 1999). Walker et al. (1961) estimated the spring standing crop of *Neanthes* at 300 pounds per acre. Replacement of soft bottom material with dike fill could result in loss of about three billion polychaetes in the footprint of the dikes. It is not known if polychaetes would colonize the seaward side of the dike surface, since it would be covered with riprap. An additional 34.3 square miles of Sea bottom converted to hypersaline pond also would be devoid of polychaetes. This would constitute a loss of about 8.8×10^{10} polychaetes (Stephens 1999a). The diminishment of this food source in less than 10% of the existing area of the Sea could lead to a reduction of the area's productivity.
- Introduction of trace elements potentially contained in bottom muck or associated with the dike fill material, which could be toxic to fish populations. For example, as the sediment may be aerated during dredging, there is some potential that reduced forms of selenium, such as selenides, may be oxidized and could become mobile in water when sediment is released back to the Salton Sea.

- Disturbance of seasonal patterns (e.g., spawning) if construction activities occurred during crucial periods in the breeding activities of Salton Sea fish resources.

Overall the construction activities and subsequent temporary impacts are estimated to occur for a duration of 48 months.

Alternative 1 with current inflow conditions is expected to reduce the salinity in the Sea to 36,824 mg/L by the year 2030. This would result in improved water quality likely capable of supporting the species which currently exist in the Sea. The elevation is expected to drop 2 feet by the year 2030. This will result in the loss of aquatic habitat and reduce the surface area of the Sea by 51 square miles compared with the No Action Alternative.

The north pond dike would intersect the shoreline at both ends and result in a loss of that section of shoreline. The north evaporation dikes would create a new western shoreline further into the Sea. The loss of fish habitat along the shoreline would be a minor impact, given that suitable habitat is available elsewhere in the Sea. River and stream deltas may also be affected due to the different circulation patterns likely to develop as a result of the altered shoreline. The south evaporation pond will be constructed entirely offshore. The construction of both evaporation ponds would decrease the amount of available habitat for fish. However there would be an overall beneficial impact to the remaining fish habitat, as the evaporation ponds would stabilize salinity levels and control the elevation of the Sea.

The creation of dikes could have a positive influence on barnacles (*Balanus amphitrite*), which would likely colonize these new substrates. The appearance of large numbers of barnacles on the seaward extent of the dikes would likely attract sargo, mudsuckers, and croaker. Another beneficial impact to fish would result from the creation of deeper water habitat at the toe of the dikes. Dike rip-rap could provide habitat for fish and other aquatic species.

Creation of hypersaline environments in the ponds could promote high primary productivity of the phytoplankton, accompanied by high secondary production of invertebrates, such as brine flies and brine shrimp, which flourish above 30,000 mg/L. These organisms serve as protein sources for many fish and waterbirds. However, this benefit is short term, as salinity would continue to rise within the ponds to levels above which these species cannot survive. In addition, given that pupfish are tolerant of temperature extremes and high salinities (up to 74,900), they could live and spawn in the early stage evaporation ponds. However, the upper limit for salt concentrations in the ponds could be as high as 300,000 mg/L, which is expected to be well beyond the limits of the pupfish.

Additionally, it will be necessary to pump water from the Sea into the evaporation ponds. The intake structures for this would be screened to minimize the potential for fish entrainment.

Pupfish Pond

Pupfish migrate through the project area along the shoreline between the mouth of San Felipe Creek, and other waterways. Little is known about the movements of pupfish between the Sea and San Felipe Creek, but unobstructed access between various drainages and shallow vegetated aquatic habitat within the Sea is required (Stephens 1999a). The purpose of placing the south evaporation pond offshore would be to allow the creation of a pupfish pond. This pond would exist between the current southwest shoreline and the southwest dike of the south evaporation pond. To maintain this habitat and connectivity between the drains in this area, additional dikes would be constructed from the north and south ends of the south evaporation pond extending to the shoreline. These dikes would allow a constant water depth to be maintained as the elevation of the Sea drops. Significant snag habitat on the west side of the new River and around the mouth of San Felipe Creek would also be protected.

The pond will be managed to maintain approximately three feet depth to provide pupfish movement. It is unknown how the ponds and dikes would change circulation patterns in the Sea and in particular in the proposed pupfish pond. The dikes and circulation changes would affect nutrient turnover in backwater and marshy areas and could cause waters to stagnate and habitat to degrade. The creation of shallow water habitat along the shoreline without direct interface to the main body of the Sea may result in a number of impacts.

- The ponds could affect the freshwater inflow to the Sea by intercepting some of that flow, resulting in increasing salinity to the main body of the Sea.
- The ponds would isolate the shoreline area from the rest of the Sea, losing the flushing action naturally found which assists in temperature moderation, DO control and exchange, sediment transport, dilution of constituents and potential contaminants entering the pond area from drains, and general cleansing action.
- Increased sedimentation would result in the need for additional dredging. This would cause similar impacts to fishery resources as discussed above for dredging and disposal activities.
- Increased concentration of birds may result in increased concentration of avian diseases.
- Increased concentration of birds may result in increased predation on fish and invertebrate species including desert pupfish.
- The difficulty in maintaining adequate flow through the area and increased concentration of avian fecal matter and general stagnation. This may increase eutrophic conditions and accelerate the decline in water quality within the protection pond.
- Degraded water quality may result in the loss of invertebrates in the shallow area

- The long duration of construction activities may result in significant disturbance.
- The dikes could provide nesting sites for predatory species (i.e. gulls).
- Wind driven circulation of the Sea would be altered by placement of these structures which would also alter delta formation. Impacts to fish and invertebrates is uncertain.
- The high level of evaporation likely to occur in shallow water habitat may make maintenance of salinity within the ponds would be difficult.
- The diversion of drainage flows into the ponds may result in increased food chain concentration of undesirable constituents (selenium)

North Wetland Habitat

Reduced annual inflows would also threaten the most important wetland habitat currently utilized by fish and wildlife in the northern portion of the Sea. These wetlands provide the largest expanse of snag habitat at the Sea. This action would include construction of dikes at the -230 foot contour on both sides of the Whitewater River Delta to protect existing nearshore and snag habitat by maintaining shallow wetland habitat at the northern end of the Sea. The habitat would have up to 3 feet of water depth and would ensure that the several small islands within the area would not become connected to the shoreline due to drops in water surface elevation. The location of the northern wetland habitat is shown on Figure 2.4-6.

The construction would isolate the wetland area from the main body of the Sea while still allowing the mouth of Whitewater River to flow directly into the Sea. The water levels within the wetland habitat would be maintained by pumping or diverting water from the Whitewater River and allowing it to gravity flow back into the Sea. Potential impacts are similar to those described for the pupfish pond. In addition, the gravity flow back into the Sea may allow pupfish and other species to migrate out of the shallow water areas and into the main body of the Sea. However, due to the flow of the Whitewater River they may not be capable of migrating in the reverse direction (from the sea into the North Wetland Habitat). The location of the North pond may conflict with current use of the area including private duck clubs.

Effect of Alternative 1 with Reduced Inflow Conditions (1.06 maf/yr)

Under Alternative 1 with reduced inflow conditions both evaporation ponds and the pupfish pond would be created as described above. As the reduction in inflow is predicted to result in accelerated salinity increases and reduced surface elevation, additional actions (displacement dike) would be implemented. With the incorporation of these additional actions, Alternative 1 with reduced flows is anticipated to result in a salinity level of 45,862 mg/L by the year 2030. This increase in salinity is small compared with the 75,050 mg/L salinity level predicted for the No Action Alternative. By controlling the salinity, Alternative 1 would result in an overall beneficial impact to aquatic resources.

The elevation of the Sea is expected to drop 10 feet by the year 2030. This elevation drop combined with the additional Alternative 1 construction would result in a loss of 95 square miles of aquatic habitat from current conditions. This is compared with a predicted loss of 37 square miles of aquatic habitat under the No Action Alternative with reduced flows. The potential impacts from the additional actions which would be triggered by the reduced inflows are presented below.

Displacement Dike

A displacement dike would be constructed in the southern portion of the Sea as shown on Figure 2.4-4. It is designed to reduce the total area of the Sea, effectively displacing enough water to maintain surface elevations if annual inflows are reduced to 1.06 maf per year. Construction activities for the displacement dike would temporarily disturb approximately 360 on-shore acres, would take approximately 48 months to complete, involving a maximum of 300 to 330 workers. These temporary impacts within the Sea will be similar to the construction impacts discussed for the evaporation pond construction. In-Sea area disturbed or occupied by new structures would total approximately 520 acres.

4.6.6 Alternative 2

Alternative 2 proposes to construct an EES North of Bombay Beach in order to reduce the salinity and control the elevation of the Sea. In addition, the four common actions described in Chapter 5 would be implemented.

Effect of Alternative 2 with Continuation of Current Inflow Conditions

EES Located North of Bombay Beach (150 kaf/year – showerline technology)

Construction of the EES east of Bombay Beach would have a minor short-term impact on fisheries and aquatic resources as the majority of construction activities would take place upland. Construction of the intake structure would create a temporary negative impact on the aquatic habitat in the area. The intake structure would include a screened pipe approximately 87 inches in diameter. The horizontal intake structure would contain a trash rack and fish screens in order to minimize its impact on aquatic resources.

Under this alternative, salinity is expected to be 45,510 by the year 2030. This is close to the current salinity level and significantly lower than the salinity level predicted for the No Action Alternative. This would result in a salinity level likely tolerable by the species which currently reside in the Sea.

Sea levels would be stabilized at -232 ft msl, eight feet lower than under the No Action Alternative conditions, resulting in a loss of 29 more square miles of aquatic habitat. This would have a short-term adverse effect on fish, but it is not expected to impair long-term foraging opportunities, reproduction, or migration.

Effect of Alternative 2 with Reduced Inflow Conditions

Under alternative 2 with reduced inflow conditions the EES north of Bombay Beach would be constructed as described above. The reduced inflows would result in a more rapid drop in elevation and increase in salinity than is predicted for current inflow conditions. In order to address these issues, several additional actions (displacement dike, and North wetland habitat, and import of floodflows) will be taken. The salinity is expected to rise to 53,726 by the year 2030. This salinity would likely negatively impact the populations of orange-mouth corvina and sargo.

The elevation of the Sea is expected to drop 10 feet to -237 by the year 2030. This elevation drop would result in a loss of 70 square miles of aquatic habitat compared with a predicted loss of 37 square miles under the No Action Alternative. The potential impacts from additional actions are described below.

Displacement Dike

A displacement dike would be constructed essentially reducing the size of the Sea in order to maintain the surface elevation. The impacts of this action are described in Alternative 1 with reduced flow conditions.

North Wetland Habitat

A protection pond will be constructed along the north shore as described in Alternative 1 with reduced inflow conditions. Temporary and long-term impacts are expected to be the same as those described for Alternative 1.

Import Flood Flows

Inflows to the Sea would be augmented with flood flows from the Colorado River. Colorado River flood flows would typically be available every three to seven years. The flows would be carried to the Sea by the All American Canal and the Alamo River and about 700 cfs would be diverted through the Coachella Canal through the evacuation channel located at Detention Channel #1. This would result in approximately 300,000 acre-feet being available over the four months during the years when flood flows occur.

By carrying flood flows through the existing channels there is the potential to significantly impact the aquatic resources occupying the Alamo River. Detention Channel #1 is dry the majority of the time and does not support aquatic resources. The flows also have the potential to remove submergent vegetation and erode channel banks. It may be necessary to regulate these flows to minimize these potential impacts.

4.6.7 Alternative 3

Alternative 3 proposes to construct an EES at the Salton Sea Test Base in order to reduce the salinity and control the elevation of the Sea. In addition, the four common actions described in Chapter 5 would also be implemented. The only difference between Alternative 2 and Alternative 3 is the location of the EES

Effect of Alternative 3 with Continuation of Current Inflow Conditions

The predicted salinity and elevation changes for Alternative 3 would be the same as those described above for Alternative 2. Short-term and long-term impacts to aquatic resources would also be similar.

Effect of Alternative 3 with Reduced Inflow Conditions

Construction of the EES on the former Salton Sea Test Base under reduced inflow conditions would have a minor short-term impact on fisheries and aquatic resources. Short-term and long-term impacts would be similar to those described under Alternative 2. Alternative 3 with reduced flows would include the construction of a displacement dike, Southwest and North wetland habitat, and imported flood flows similar to those described for Alternative 2.

4.6.8 Alternative 4

In addition to implementing the four common actions, Alternative 4 proposes to construct an EES at the Salton Sea Test Base and an evaporation pond in the south west section of the Sea.

*Effect of Alternative 4 with Continuation of Current Inflow Conditions**South Evaporation Pond (68 kaf/year) and an EES Located at the Salton Sea Test Base (100 kaf-year – showerline technology)*

Construction activities for the South evaporation pond would take place within the Sea, resulting in a number of temporary adverse effects to aquatic habitat and resources. These impacts are primarily the result of dredge and fill operations and the removal of existing habitat from the Sea. Impacts for the construction of the South evaporation pond were described in Alternative 1. However, Alternative 4 will not impact as much in-Sea aquatic habitat because only the South evaporation pond will be constructed.

Short-term and long-term impacts resulting from the construction of an EES at the Salton Sea Test Base are similar to those described in Alternative 3, the size of the EES for Alternative 4, would be reduced to a capacity of 100,000 acre-feet per year.

The combination of the South concentration pond and the EES would increase the effectiveness and speed at which salts are removed from the Sea compared with alternatives 2 and 3 with less aquatic habitat disturbance than Alternative 1. The Salinity of the Sea is expected to be reduced to 39,566 by the year 2030. This reduced salinity level would be a beneficial impact for all of the aquatic species currently occupying the sea.

The elevation of the Sea is anticipated to drop 2 feet from its current level by the year 2030. This would result in a loss of 40 square miles of aquatic habitat. This is compared with almost no change in aquatic habitat area with the No Action Alternative. Although this would be a significant loss of habitat the overall improvement in water quality conditions in the Sea would result in a net benefit for aquatic species compared with the No Action Alternative.

Pupfish Pond

Alternative 4 would also include the construction of a pupfish pond in the area between the existing Southwest shoreline and the proposed South evaporation pond as described in Alternative 1 with current inflow conditions.

North Wetland Habitat

A protection pond will be constructed along the north shore as described in Alternative 1 with reduced inflow conditions.

Effect of Alternative 4 with Reduced Inflow Conditions

Under Alternative 4 with reduced inflow conditions the South evaporation pond, EES at Salton Sea Test Base, and the pupfish ponds would be created as described above. As the reduction in inflow is predicted to result in accelerated salinity increases and elevation decreases, the additional actions (displacement dike, North wetland habitat, and Imported Flood Flows) would be implemented. With the incorporation of these additional actions, Alternative 4 with reduced inflows is anticipated to result in a salinity level of 47,467 mg/L by the year 2030. This is a significant beneficial impact compared with a predicted (year 2030) salinity of 75,050 mg/L for the No Action Alternative.

The elevation of the Sea is expected to drop 8 feet by the year 2030. This elevation drop combined with the additional Alternative 4 actions would result in a loss of 80 square miles of aquatic habitat. This is compared with a predicted loss of 37 square miles of aquatic habitat under the No Action Alternative with reduced flows. The potential impacts from the additional actions are presented below.

Displacement Dike

A displacement dike would be constructed essentially reducing the size of the Sea in order to maintain the surface elevation. The impacts of this action are described in Alternative 1 with reduced inflow conditions.

Import Flood Flows

Flood flows would be imported from the Colorado River as described in Alternative 2 with reduced inflow conditions.

4.6.9 Alternative 5

In addition to implementing the four common actions, Alternative 5 proposes to construct an EES (using portable ground based blower technology) within the North evaporation pond.

Effect of Alternative 5 with Current Inflow Conditions

EES Located within the North Evaporation Pond (150 kaf/year EES – Ground based blower technology)

Construction of the North evaporation pond would result in the same short-term and long-term impacts described in Alternative 1 minus the impacts from the construction of the South evaporation pond. The additional installation of portable ground based

blowers would result in minimal impacts to aquatic resources. The intake structures for the EES would be similar to that described in Alternative 2 with a fish screen and trash rack structure to minimize fish entrainment.

This alternative would extend the operational life of the North evaporation pond by 100 years compared to Alternative 1. The salinity is expected to be reduced to 40,841 mg/L by the year 2030. This reduced salinity level would be a beneficial impact to aquatic resources. Under current inflow conditions the elevation of the Sea is expected to drop 6 feet in the first 30 years. This would result in a loss of 40 square miles of aquatic habitat. This would be a significant reduction in available habitat, however the improved water quality conditions would result in a net beneficial impact for aquatic resources.

North Wetland Habitat

In order to protect the shallow water habitat which would be lost as the elevation of the Sea drops, the North wetland habitat would be developed. The impacts resulting from this wetland habitat are similar to those described in Alternative 1 with reduced inflow conditions.

Effect of Alternative 5 with Reduced Inflow Conditions (1.06 maf/yr)

Under Alternative 5 with reduced inflow conditions the EES within the North evaporation pond and the North wetland habitat would be created as described above. As the reduction in inflow is predicted to result in accelerated salinity increases and elevation decreases, the additional actions (displacement dike, and Imported Flood Flows) would be implemented. With the incorporation of these additional actions, Alternative 5 with reduced inflows is anticipated to result in a salinity level of 46,175 mg/L by the year 2030. This is a significant beneficial impact compared with a predicted (year 2030) salinity of 75,050 mg/L for the No Action Alternative.

The elevation of the Sea is expected to drop 10 feet by the year 2030. This elevation drop combined with the additional Alternative 5 actions would result in a loss of 75 square miles of aquatic habitat. This is compared with a predicted loss of 37 square miles of aquatic habitat under the No Action Alternative with reduced flows. The potential impacts from the additional actions which would be triggered by the reduced inflows are presented below.

Displacement Dike

A displacement dike would be constructed essentially reducing the size of the Sea in order to maintain the surface elevation. The impacts of this action are described in Alternative 1 with reduced flow conditions.

Import Flood Flows

Flood flows would be imported from the Colorado River as described in Alternative 2 with reduced inflow conditions.

4.6.10 Cumulative Effects

Implementation of restoration activities would not have any significant adverse cumulative impacts when assessed with other past, current, and future projects in the region. The Brawley wetlands project, the Heber wastewater treatment system project, and the drain water quality improvement plan would improve inflows into the Sea from the New River.

4.6.11 Mitigation Measures

The following measures are suggested as the minimum actions required to reduce impacts associated with restoration alternatives and actions to less than significant levels as they affect fisheries and aquatic resources:

Implement construction activities during nonspawning periods.

For any habitat lost to proposed actions, remaining habitat should be carefully monitored for salinity levels, turbidity levels, and other water quality effects. If any areas are specifically used for spawning, these should be avoided during construction wherever possible.

Water Quality (including temperature, dissolved oxygen, salinity, and chemical constituents) should be monitored in the pupfish pond and North Wetland Habitat.

4.6.12 Potentially Significant Unavoidable Impacts

Both the No Action Alternative and the five action alternatives result in a change in the Sea elevation. Consequently, regardless of which Action or No Action alternative is taken the shallow water habitat that currently exists and is utilized by a number of species will change.

Additionally, salinity levels will increase for a period of time regardless of which Action or No Action alternative is chosen. It is currently believed that the orange-mouth corvina is nearing its upper salinity tolerance level. As a result this species may be significantly impacted within the next few years.