CHAPTER 8
BIOLOGICAL RESOURCES

This chapter describes the biological resources in the study area and potential changes that could occur due to implementation of the alternatives. Biological resources could be affected due to changes in surface water elevations in the Salton Sea or excavation activities during construction. This evaluation also includes a discussion of the performance of the alternatives relative to the historic fish and wildlife diversity and use of the Salton Sea.

STUDY AREA

The study area is defined as the geographical area within which the large majority of potential impacts are expected. The study area for biological resources is the Salton Sea ecosystem, which includes the Salton Sea, the agricultural lands surrounding that sea, and the tributaries and drains within the Imperial and Coachella valleys that deliver water to the Salton Sea. These areas include biological communities that could be directly affected by construction of the alternatives. While the agricultural lands and associated drains contribute substantially to the diversity and abundance of wildlife in the study area, impacts of the restoration are not anticipated to occur in these areas. Therefore, this analysis focuses on those areas most affected by restoration activities, i.e., the areas within and immediately adjacent to the area currently occupied by the Salton Sea. For the purpose of evaluating impacts on biological resources, the Salton Sea ecosystem study area is defined as the Salton Sea and adjacent land extending from the shoreline to a distance of about 0.5 miles.

REGULATORY REQUIREMENTS

The regulatory framework for biological resources includes the following federal, State, and local requirements. Restoration actions at the Salton Sea could be subject to some or all of these requirements.

The Rivers and Harbors Act of 1899 (33 U.S.C. 401 et seq.) protects the public right to free navigation in navigable waters of the United States as described by the U.S. Army Corps of Engineers (USACE) Section 10/404 implementing regulations at 33 CFR Part 329. The Act also prohibits unauthorized construction or work in navigable waters of the United States.

The Clean Water Act of 1972, as amended (33 U.S.C. 1251 et seq.) provides for the restoration and maintenance of the physical, chemical, and biological integrity of the nation's waters, as described in Chapters 5 and 6. Sections 401 and 404 of the Act prohibit discharges of dredged or fill materials into waters of the United States except as permitted under separate regulations by the USACE and the federal Environmental Protection Agency.

The Porter-Cologne Water Quality Control Act (Porter-Cologne) (California Water Code Title 23) protects California waters, as described in Chapter 6. Porter-Cologne gives the State Water Resources Control Board (SWRCB), through the Regional Water Quality Control Boards (RWQCBs), the authority to regulate discharges of waste, including dredged or fill material, to any waters of the State similar to authority of the USACE from the federal Clean Water Act. The Colorado River Basin Regional Water Quality Control Board (CRBRWQCB) has prepared (and amended) a basin-wide Water Quality Control Plan that serves as a guide to optimize the beneficial uses of the water within the Colorado River Basin region of California by preserving and protecting the quality of these waters.

The federal Endangered Species Act of 1973, as amended, (16 U.S.C. 1531 et seq.) protects listed threatened or endangered species (and any designated critical habitat) from unauthorized take. It also directs federal agencies to ensure that their actions do not jeopardize the continued existence of listed species. Section 7 of the Act defines federal agency responsibilities for consultation with the US Fish and Wildlife Service (Service), including the preparation of Biological Assessments and Biological Opinions. Section 10 of the Act describes how the Service may authorize take of a listed species by non-federal agencies, including preparation of Habitat Conservation Plans.

The Migratory Bird Treaty Act of 1918, as amended (16 USC 703-712) and Executive Order 13186 (2001) provides for the protection of migratory birds by making it illegal to possess, take, or kill any migratory bird species, unless specifically authorized by a regulation implemented by the Secretary of the Interior, such as designated seasonal hunting. The Executive Order requires federal agencies to obtain permits from the Department of the Interior, Service for the “taking” of any migratory birds.

Executive Orders 11988 (Floodplain Management) and 11990 (Protection of Wetlands) require federal agencies to provide leadership to protect the natural and beneficial values served by floodplains and wetlands. Federal agencies are directed to avoid development in floodplains where possible, and to minimize the destruction or degradation of wetlands.

California Lake and Streambed Alteration Program (Fish and Game Code Section 1600 et seq.) requires any person, State, or local government agency, or public utility proposing a project that could divert, obstruct, or change the natural flow of any bed, channel or bank of a river, stream, or lake to notify the California Department of Fish and Game (DFG) before beginning the project. If DFG determines that the project could adversely affect existing fish and wildlife resources, a Lake or Streambed Alteration Agreement is required.

California Endangered Species Act of 1984 (Fish and Game Code Section 2050 et seq.) provides for the protection of rare, threatened, or endangered plants and animals, and prohibits the taking of such species without authorization by DFG. Section 2081 defines the responsibilities of DFG and applicants with regard to authorized take.

California Fully Protected Birds, Mammals, Reptiles and Amphibians and Fish (Fish and Game Code Sections 3511, 4700, 5050 and 5515) prohibits the take or possession of any fully protected bird, mammal, reptile and amphibian, or fish. However, Section 20817 of the Fish and Game Code was amended to allow DFG to authorize the take of species resulting from impacts attributable to the implementation of the QSA. Take of fully protected species may be authorized if related to the QSA.

HISTORICAL PERSPECTIVE

The fish, invertebrate, and avian communities associated with the Salton Sea ecosystem have changed considerably over the relatively short life of the Salton Sea. These changes, which occurred primarily in response to water quality conditions in the Salton Sea, have strongly influenced the character of the Salton Sea ecosystem, the species composition, and current level of use by fish and wildlife. This section provides the historical context to better understand the avian and aquatic communities that depend on the Salton Sea and to frame potential impacts and benefits associated with the alternatives.

The development of Salton Sea aquatic communities has occurred gradually. However, it is possible to characterize three discrete biological phases based primarily on water chemistry and species abundance (Costa-Pierce and Riedel, 2000). The initial “Freshwater Phase” began when the lake first started filling in 1905 and continued until the salt concentration of the Salton Sea became similar to ocean water in the early 1940s. The “Marine Phase” was represented by the period during which the Salton Sea maintained a level of salinity near that of ocean water (about 34,000 mg/L) from the 1940s into the 1980s. The “Hypersaline Phase” began in the 1980s when salinity levels exceeded 40,000 mg/L, and continues into the present.

The response of aquatic and avian species varied with each of the phases. During the Freshwater Phase, the number of freshwater tolerant fish species was small, and their abundances were relatively low. Some bird species began to colonize the Salton Sea, but their abundances were also low. During the Marine Phase, especially the latter part, the numbers of fish species stayed small, while the abundance dramatically increased. Invertebrate species, such as pileworms, substantially increased as well. As a result, the Salton Sea took on greatly enhanced importance for migrating birds as a valued stopover location for resting and feeding along the Pacific Flyway. During the Hypersaline Phase, tilapia became the dominant fish as other fish species declined in abundance. Late in this Phase, significantly large fish die offs occurred, invertebrate populations declined, and the popular marine sport fish species disappeared.

Freshwater Phase – 1905 to 1940s

The Freshwater Phase of the Salton Sea began when it first filled and continued into the 1940s when the salinity approached that of sea water. The original members of the Salton Sea fish community were conveyed directly from the Colorado River into the Salton Sea as it was filling (Walker, 1961). In 1916, common carp, striped mullet, humpback sucker, rainbow trout, and bonytail chub were reported (Evermann, 1916).

While most of the early fish fauna were species native to the lower Colorado River region, the desert pupfish was the only fish native to the Salton Sea watershed. They were present in Figtree John Spring (Evermann, 1916) and abundant along the north shore of the Salton Sea (Walker, 1961). They also occurred in other areas of quiet water, including a few of the streams and agricultural drains that entered the Salton Sea. They were abundant in the hypersaline shore pools behind the wave-built sand bars where they tolerated extreme environmental conditions, including temperatures that often exceeded 99 degrees Fahrenheit (°F) in summer, and were below 35 °F in winter.

Starting in 1929, DFG attempted to introduce marine fish and invertebrate species to the Salton Sea that could survive, reproduce, and supply food and sport fishing opportunities (Dill and Cordone, 1997). Many species did not survive as the salinity continued to increase and the ecosystem changed. The stocking of longjaw mudsuckers and pileworms was apparently successful and provided the foundation of a new ecosystem that would mature later during the Marine Phase.

Limited ornithological expeditions occurred after the Salton Sea was formed and ornithologists slowly began collecting and identifying the avifauna of the relatively new Salton Sea between 1908 and 1929. American white pelicans and double-crested cormorants were breeding at the Salton Sea by 1908 (Garrett et al., 2004). Significant early records include colonies of double-crested cormorants in 1913, gull-billed terns in 1927, and laughing gulls in 1928 (Garrett et al., 2004).

After the early 1900s, extensive areas of desert scrub and mesquite thickets were converted to agriculture. These changes likely influenced the distribution and abundance of landbirds such as vermillion flycatcher, Le Conte's thrasher, and Lucy's warbler, which all exhibited declines in abundance by the 1930s (Patten et al., 2003). Changes in farming practices, construction of local communities and parks, and the invasion by non-native plants and trees created new habitats in the Salton Sea area that did not exist prior to the 1900s. These areas, especially habitat provided by agricultural lands, assumed greater value as they began providing foraging areas for birds.

The Salton Sea Migratory Waterfowl Refuge (recently renamed the Sonny Bono Salton Sea National Wildlife Refuge) was established in the southern portion of the Salton Sea in 1930. At that time, the Salton Sea water elevation was at -248 feet mean sea level (msl) and the majority of the refuge lands were located above the waterline. By 1947, most of these lands were submerged.

Marine Phase – 1950 to Early 1980s

In this period, the Salton Sea was characterized by marine salinity and continued change. The Salton Sea, tributary streams, and irrigation drains supported large numbers of desert pupfish until population declines attributed especially to introductions of exotic fish species began in the early 1960s (Black, 1980). Phytoplankton, invertebrates, and fish introduced from the Gulf of California that were tolerant of conditions in the Salton Sea dominated the open water. Three invertebrates (pileworm, a barnacle, and a copepod) became the dominant organisms that formed the simple food chain of the Salton Sea (Walker, 1961).

In the late 1940s to the mid-1950s, DFG stocked more than 30 species of marine fishes in the Salton Sea, including orangemouth corvina, sargo, and gulf croaker (Walker, 1961). Two kinds of tilapia unexpectedly invaded the Salton Sea during the 1960s and 1970s from irrigation drains in the Imperial and Coachella valleys where they had been introduced for weed control. Redbelly tilapia was the dominant species in the Salton Sea until it was replaced by the Mozambique tilapia in the late 1970s.

DFG analysis of available party boat logs from 1962 through 1972 showed that 6,845 anglers landed over 36,000 orangemouth corvina for an average of 5.3 corvina per angler/day (Black, 1974). This fishery continued through the early 1980s.

Anoxic conditions during this period adversely affected aquatic organisms. Walker (1961) reported observations made during 1956 that linked mixing of the surface and deeper, oxygen depleted waters of the Salton Sea to fish kills. Sometimes the oxygen concentrations at the surface would be lowered below the level required by many aquatic species. During such periods, fish kills would occur as evidenced by dead fish floating on the surface and washing ashore on the beaches. The depletion of oxygen was reflected also by the disappearance of pileworms from the mud at depths below about 30 feet during summer.

By 1970, the Salton Sea was used by large numbers of shorebirds every year as a stopping place to rest and feed (McCaskie, 1970). The Salton Sea was the last large body of water available to birds as they moved northward into the desert regions of eastern California. Many birds remained at the Salton Sea for up to two weeks feeding and building up their fat reserves before continuing their migration.

The north and south ends of the Salton Sea were the areas most attractive to shorebirds and other waterbirds (McCaskie, 1970). This was probably due to the large expanses of mudflats which were extremely rich in forage organisms for the shorebirds. From an observation point in the northern end of the Salton Sea, it was possible to observe between 15,000 and 20,000 shorebirds feeding along the shoreline.

In 1954, the State of California established the Imperial Wildlife Area to safeguard habitat for migratory birds and alleviate crop damage to adjacent farms (Moore, 2001). While both the Imperial Wildlife Area and the Salton Sea Migratory Waterfowl Refuge were established primarily to alleviate crop depredation from waterfowl, they provided valuable managed marsh habitats. Yuma clapper rails were observed at the Salton Sea Migratory Waterfowl Refuge beginning in 1939.

Avian botulism that affected waterfowl, shorebirds, and pheasants was reported during the 1950s, but outbreaks were not large. However, during the 1960s, thousands of birds died at the Salton Sea from botulism (Friend, 2002). A large outbreak of botulism in 1972 also killed thousands of waterfowl and other birds. Sporadic outbreaks occurred during the remainder of the 1970s. In 1979, avian cholera was first recorded at the Salton Sea with the loss of thousands of birds, primarily waterfowl (Friend, 2002). Several die-offs occurred during the 1980s with botulism and avian cholera identified as the causative agents.

Hypersaline Phase – 1990s through Present

As the salinity rose above 40,000 mg/L, the hypersaline ecosystem of the Salton Sea continued to undergo substantial change. The most noticeable change was a reduction in both the diversity and abundance of fish species. Starting in 2000, all sport fish populations at the Salton Sea underwent a dramatic decline, as deteriorating water quality apparently reached a threshold for their survival. Sargo, gulf croaker, and orangemouth corvina have been undetectable in DFG gill net sampling since mid-May, 2003. Tilapia populations have rebounded since their lowest levels in 2003, but currently persist in the Salton Sea at levels that are only 10 percent of those recorded in the 1990s.

Reidel et al. (2002) reported that large die offs of both fish and birds had occurred at the Salton Sea since 1992. A large fish kill occurred in January 1997 that resulted in a significant loss of tilapia (Costa-Pierce and Reidel, 2000). They also reported that all the fish in the Salton Sea were stressed due to high level of salinity, eutrophication, and poor water quality. They hypothesized that tilapia died because of deoxygenated water and toxic levels of ammonia from the infrequent mixing of the upper and lower levels of the Salton Sea, combined with high and low temperature stresses.

In 2000, important habitats for birds were not equally distributed around the Salton Sea and areas within the northern, southwestern, southern, and southeastern shorelines hosted the greatest numbers of birds (Shuford et al., 2000). The shoreline along the Wister Unit of the Imperial Wildlife Area held the highest densities of water birds in all seasons, but more so during August and September. The highest densities of waterbirds occurred year round along the southeastern shoreline and secondarily along the northern shoreline of the Salton Sea. Nesting habitat for colonial waterbirds included the area near the Whitewater River confluence and along the southeastern shoreline between and including the delta areas of the New and Alamo rivers (Shuford et al., 2000). Colonial breeding waterbirds using these areas include great blue herons, great egrets, snowy egrets, cattle egrets, black-crowned night herons, double-crested cormorants, white-faced ibis, brown pelicans, and little blue herons. Recent declines in fish populations could have reduced the abundances of pelicans and cormorants, and breeding success in black skimmers and Caspian terns (Molina and Sturm, 2004). Thirty-four species of shorebirds were observed between 1989 and 1995 and in 1999. Black-necked stilts, whimbrels, small sandpipers, dowitchers, willets, and long-billed curlews were the most abundant. The area is also important as a wintering area for western snowy plovers (Shuford et al, 2004) and continues as a major wintering ground for over 100,000 waterfowl including ruddy ducks, northern shovelers, northern pintails, and Ross and snow geese (Barnum and Johnson, 2004).

DATA SOURCES

Information regarding biological resources was obtained from published sources and previous planning documents. Specific data sources are cited in the text and the Bibliography is provided in Chapter 28.

DATA LIMITATIONS

Information on historic levels of bird use at the Salton Sea was limited to surveys conducted since 1978, most of which were of short duration and limited to a few species. Also, these surveys frequently applied different survey techniques or protocols, which complicate the ability to compare results. The work conducted in 1999 (Shuford et al., 2000) represents the most comprehensive bird survey at the Salton Sea in which the majority of the avifauna was seasonally surveyed over the course of the year. This survey was used in the modeling of habitat capacity for avian resources at the Salton Sea under the alternatives. For habitats not currently found at the Salton Sea (primarily Saline Habitat Complex) and existing areas that would have higher salinities in the future, data from salt ponds adjacent to San Francisco Bay were used to adjust the observed Salton Sea densities for increased salinities (see Appendix C).

EXISTING CONDITIONS

The aquatic and terrestrial habitats in the study area continue to support fish and wildlife. However, because of ongoing changes in the ecosystem, particularly the aquatic component, the diversity and level of use of the Salton Sea by fish and wildlife has changed considerably over the past several years (e.g., loss of the marine sport fish). For the purpose of this chapter, Existing Conditions are based on information collected in the late 1990s to present. The following describes the existing environment at the Salton Sea and the resources most likely affected by restoration activities.

Special Status Species

The study area supports many plants and animals with various special status designations. Most of these species occur upslope of the Salton Sea in adjacent areas that would not likely be affected by restoration activities at the Salton Sea. Some special status species (Table 8-1), however, rely on the Salton Sea and areas immediately adjacent for meeting one or more of their life history requirements (e.g., breeding, foraging, roosting). The following provides a brief description of the special status species most likely to be affected by restoration (i.e., those using Salton Sea habitats). In addition to species with a special status designation, several colonial breeding waterbirds were assessed because of the importance of the nesting colonies at the Salton Sea and the potential for these areas to be affected by construction of the restoration facilities. The description of bird species is taken primarily from Patten et al. (2003) and Shuford et al. (2000).

Table 8-1
Special Status Species

Species	Federal Status	State Status
Desert Pupfish	Endangered	Endangered
Western Snowy Plover (interior population)	Species of Conservation Concern	Species of Special Concern
American White Pelican		Species of Special Concern
Brown Pelican	Endangered	Endangered
Double-crested Cormorant		Species of Special Concern
White-faced Ibis	Species of Conservation Concern	Species of Special Concern
Black Skimmer		Species of Special Concern
Van Rossem's Gull-billed Tern	Species of Conservation Concern	Species of Special Concern

Desert Pupfish

Desert pupfish are State and federally listed as endangered, primarily as a result of habitat loss (e.g., dewatering of springs), pollution, and introduction of exotic species that either prey upon desert pupfish or compete for available resources (Marsh and Sada, 1993). The desert pupfish is the only fish native to the Salton Sink, and existed in Salt and San Felipe creeks, and in several springs that were inundated by the flooding of the Salton Trough in 1905. Desert pupfish populations persist today in both creeks, and have become established in the terminal sections of agricultural drains that flow directly to the Salton Sea on the south and north shores, as well as in the shallow water margins of the Salton Sea itself. These populations are presumed connected because desert pupfish are present in the Salton Sea and in pools created along its margin. (See Appendix H-1 for additional information on issues related to desert pupfish habitat connectivity). Desert pupfish apparently are capable of moving freely between the relatively fresh water in the agricultural drains and the highly saline environment in the Salton Sea. This movement provides the opportunity for genetic exchange among desert pupfish and the opportunity to recolonize areas in the event a local population is extirpated.

Western Snowy Plover

The western snowy plover is a small shorebird that regularly winters and breeds along the shoreline of the Salton Sea. It nests during the spring and summer on open beaches with sand and barnacle substrates. The number of breeding pairs at the Salton Sea ranges from 200 to 225, with nesting distributed primarily along the west side from Desert Shores to the mouth of San Felipe Creek, and on the east side from Bombay Beach to the Wister Unit of the Imperial Wildlife Area (Patten et al., 2003).

American White Pelican

American white pelicans formerly bred at the Salton Sea, but occur now as migrants and winter residents. The Salton Sea is an important wintering site for American white pelicans and at times supports a substantial proportion of the species' world population (Patten et al., 2003). As recently as 1999, nearly 23,000 individuals were observed in aerial surveys at the Salton Sea (Shuford et al., 2000). Wintering birds congregate at the river mouths, loaf on sand bars and mudflats, and forage (primarily on fish) in shallow, brackish water.

Brown Pelican

Newly fledged young and post-breeding adult brown pelicans disperse to the Salton Sea from nesting areas in Baja California. During summer, brown pelicans forage on fish around the margin of the Salton Sea. Since the mid 1990s, single day counts have reached 2,000 individuals (Shuford et al., 2000) and probably exceed 3,000 (Patten et al., 2003). Peak numbers of brown pelicans detected during surveys in 2005 and 2006 were over 5,000 birds (C. Schoneman, pers. comm.). In recent years, brown pelicans have nested in small numbers, especially at the south end of the Salton Sea at the mouth of the Alamo River.

Double-crested Cormorant

Double-crested cormorants are considered permanent residents and breeders at the Salton Sea, with the highest densities occurring in the winter when migrants are present. Like pelicans, they feed on fish at numerous locations around the Salton Sea. Large nesting colonies of double-crested cormorants have been recorded at the Salton Sea, especially at Mullet Island, the Red Hill vicinity, and the Whitewater River delta (Figure 8-1). In 1999, 5,425 nesting pairs were observed at the Salton Sea (Shuford et al., 2003). At the Salton Sea, double-crested cormorants roost on the snags, rock outcrops, submerged utility poles and pilings.

White-faced Ibis

This species is a perennial visitor to the Salton Sea (primarily in winter) and an irregular breeder. White-faced ibises forage on invertebrates in shallow water, primarily in marsh lands adjacent to the Salton Sea and in flooded agricultural fields in the Imperial Valley. In 1999, a comprehensive bird survey (Shuford et. al., 2000) recorded up to 37,500 white-faced ibises at roost sites in the Salton Sea area. However, surveys during the same year failed to record nesting white-faced ibises at the Salton Sea.

Black Skimmer

Black skimmers are relatively recent arrivals to California and first were observed at the Salton Sea in 1968. They are now a fairly common breeder at the Salton Sea, with the number of breeding pairs reaching nearly 500. They seldom overwinter. In 1999, 377 breeding pairs were recorded at Rock Hill at the Salton Sea (Shuford et al., 2000). They also nest at the Salton Sea near the Whitewater River delta, various locations on the southern shoreline, and near Salton City (see Figure 8-1). Black skimmers forage on small fish in calm, shallow waters around the Salton Sea.

Van Rossem's Gull-billed Tern

Gull-billed terns are fairly common breeders at the Salton Sea, which is considered the breeding stronghold for gull-billed terns in the western United States. They arrive at the Salton Sea in mid-March and remain until October. They nest on protected spits, berms, and islets composed of sand or barnacle shells (see Figure 8-1). In 1999, 101 nesting attempts were recorded, 57 on the north end of the Salton Sea near Johnson Street and 44 at Rock Hill on the south shore (Shuford et al., 2000). Gull-billed terns forage primarily in freshwater ponds and flooded agricultural fields.

Colonial Breeding Birds

In addition to colonial breeding species described above, the shoreline, islands, and river deltas at the Salton Sea support breeding colonies of great blue herons, great egrets, snowy egrets, cattle egrets, black-crowned night herons, and Caspian terns. These species use a variety of substrates for nesting including islands, riparian vegetation, snags and utility poles submerged at their base, and rock outcrops. These sites are generally located near the mouths of the New, Alamo, and Whitewater rivers and at various locations around the Salton Sea where suitable nesting structure occurs (see Figure 8-1). Nesting pairs of these species generally number in the hundreds, but some (e.g., cattle egret) nest in the thousands. In 1999, 6,660 pairs of cattle egrets were recorded nesting at the Salton Sea (Shuford et al., 2000). The availability of suitable nesting sites might be limiting for some of these species.

Suitable nesting sites for colonial breeders require a combination of physical characteristics. These, among others, include appropriate nesting structure (e.g., vegetation, snags, beaches), protection from predators (e.g., nesting sites surrounded by water), proximity to water, and a minimum size necessary to support a colony. For many colonial breeding birds, the size of the colony influences overall breeding success, and nesting sites that support all of the necessary characteristics might not be used if they are too small or distributed too broadly.

Salton Sea Habitats

The Salton Sea ecosystem provides fish and wildlife habitats that function at multiple scales to contribute to the overall biological diversity and use of the area. The important components of the existing Salton Sea study area include the shoreline of the Salton Sea and the associated shallow water areas, the open water, and the areas where the New, Alamo, and Whitewater rivers enter the Salton Sea. This section describes the existing conditions of Salton Sea habitats and how these areas function to support fish and wildlife. In addition to the Salton Sea, other habitats contribute to the overall diversity and level of use of the Salton Sea ecosystem. Important components include the adjacent refuge areas (and their associated freshwater marsh), the agricultural fields primarily located in the Imperial Valley, and riparian areas at the mouths of tributaries. Additional descriptions of the refuge areas and agricultural lands are provided in Appendix H-1.

Shoreline/Shallow Water

The shallow shoreline areas that extend around the perimeter of the Salton Sea support an invertebrate community that serves as the forage base for numerous migratory and breeding shorebirds. Shorebird use of these areas is generally concentrated along the shallow margins where invertebrate prey is accessible by wading and probing. The area occupied by this shallow water habitat is influenced by topography, with a relatively narrow band of habitat occurring on the steeper slopes (e.g., eastern and western shores) with considerably greater amounts of accessible resources in the habitat areas along the more gently sloping north and south shores. Along the southeastern edge of the Salton Sea, particularly near the Wister Unit of the Imperial Wildlife Area, relatively flat areas periodically form large mudflats that substantially increase the availability of habitat accessible to shorebirds. The existing area that receives the most bird use is about 6,000 acres. This area contains unvegetated mud flats and shoreline as well as a limited

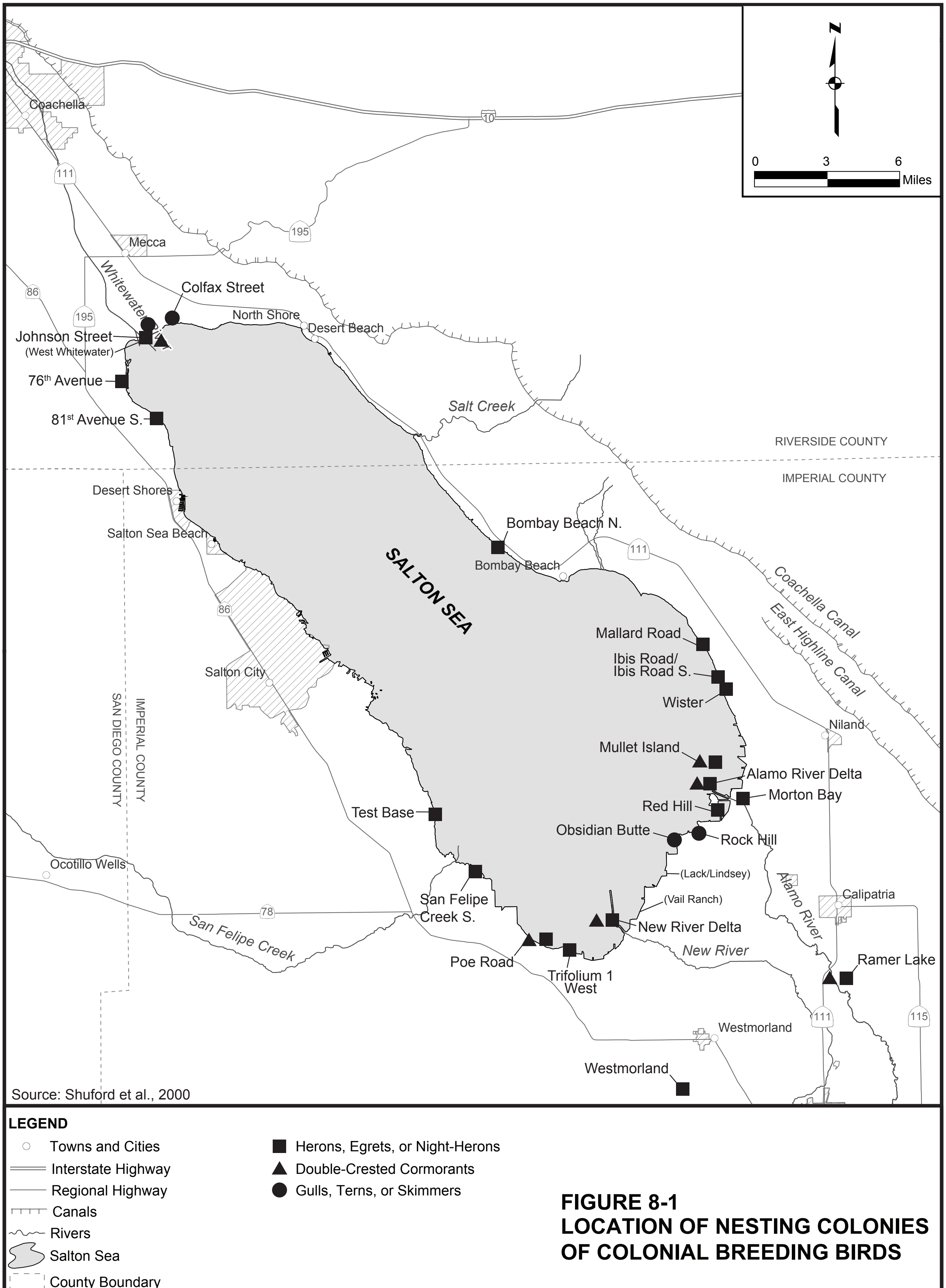

FIGURE 8-1
LOCATION OF NESTING COLONIES OF COLONIAL BREEDING BIRDS

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shoreline vegetation community dominated by tamarisk, with some iodine bush. About 293 acres of this cover type are identified in the University of Redlands (1999) database. The shore itself also functions as a resting area for many birds and as a nesting area for some (e.g., western snowy plover and black-necked stilt).

The substrate along the Salton Sea shoreline, especially at depths of less than 1 foot, is composed of intact and broken barnacle shells and unconsolidated sediments ranging from coarse sand to gravel (Detwiler et al., 2002). Pools along the shoreline formed by sand or barnacle shell bars parallel to shore and connected to the Salton Sea and/or drains vary in size over time due to changes in elevation and evaporation at the Salton Sea. The shoreline pools and shallow waters provide habitat for desert pupfish as well as for other fish and invertebrates. These areas also provide important spawning and nursery areas for tilapia. The smaller fish in shallow waters feed on invertebrates as well as algal material. Rocky shoreline habitats also provide valuable refugia for invertebrates during periods when hypoxic or anoxic conditions persist in the Salton Sea (Detwiler et al., 2002).

Wading birds, dabbling ducks, and shorebirds using the shoreline feed primarily on invertebrates, although some also feed on fish. Representative species that forage primarily on fish include black skimmer, Caspian tern, Forster's tern, and great blue heron. Some bird species that feed on invertebrates include black-necked stilt, American avocet, black-bellied plover, ruddy turnstone, and western sandpiper. Nesting/roosting colonies of gulls, terns, pelicans, and black skimmers occur along or near the shoreline on remnant levee sections and shallow boulder and barnacle bars. Shorebird abundance increases from lows in late May and early June to peak abundance from August to November.

At a surface elevation of -228 feet msl, the Salton Sea has about 120 miles of shoreline. Although the entire shoreline is generally available to birds, the level of use is not uniformly distributed. Of the 19 shoreline areas evaluated by Shuford et al. (2000), eight were identified as areas of particular importance to birds, most of which were located on the northern and southern portions (including southwest and southeast) of the Salton Sea. The shoreline adjacent to the Wister Unit of the Imperial Wildlife Area consistently exhibits the highest waterbird densities in each season.

Open Water

The vast majority of the Salton Sea (currently over 200,000 acres) is open water that is habitat for a variety of fish and wildlife. (See Appendix H-1 for additional information on open water at the Salton Sea.) The open water supports fish and invertebrate production and loafing and forage areas for birds. Until recently, these areas also provided important habitat for pelagic spawning fish such as orangemouth corvina. The distribution of fish and wildlife in the open water is concentrated along the near shore areas. This area is used primarily by waterbirds, including those that feed on fish. Some species, such as eared grebe, rely on open water almost exclusively during their stay at the Salton Sea, while others (e.g., waterfowl, gulls, and pelicans) use open water for a portion of their daily or seasonal activities. Birds use open water for foraging, rafting, and as a staging area prior to migration. Open water also provides birds with protection from most predators and human disturbance.

Open water areas of the Salton Sea are subject to periodic events that can make large portions of the Salton Sea lethal or uninhabitable to most aquatic life. During parts of the year, the Salton Sea becomes stratified with cooler water forming a distinct layer below the warmer surface water. This lower layer becomes anoxic (deprived of oxygen) because of its isolation from the surface and the photosynthetic activity that occurs in that portion of the water column where light can penetrate. The combination of high levels of organic material and biological activity in the sediments under anoxic conditions produce toxic compounds, such as hydrogen sulfide. These compounds are periodically released to the surface waters when thermal stratification breaks down during high winds and seasonal changes in air temperature. During these turnover events, aquatic life (including fish) can be killed over vast areas of the Salton Sea. The effect of these events is less pronounced in the near shore areas that remain oxygenated year round.

River Mouths and Deltas

The river mouths and deltas represent the interface between the saline waters of the Salton Sea and the relatively fresh inflows from the rivers, direct drains, and creeks. The primary inflows into the Salton Sea include the New and Alamo rivers and direct drains from the south, the Whitewater River from the north, San Felipe Creek from the west, and Salt Creek from the east. The size of these estuarine areas is influenced primarily by the amount of inflow, and the New and Alamo rivers, which constitute nearly 80 percent of the inflow to the Salton Sea, contribute to the largest of these areas. Factors such as depth, inflow quality, and wind conditions also influence the habitat at the river mouths/deltas. Sediment deposition in these areas form deltas that contribute to the complexity and diversity of the habitat. Similar conditions occur at the mouth of the Whitewater River and, to a lesser extent, the mouths of agricultural drains that discharge directly to the Salton Sea. These areas are relatively small, yet very productive. While these areas are not used exclusively by any one species, they routinely support higher concentrations of birds than surrounding areas.

The river mouths, particularly in the southern part of the Salton Sea, provide an area of reduced salinity and higher dissolved oxygen. The same species use these areas as use open water and shallow water near the shoreline. In low salinity to freshwater areas, tilapia, sailfin mollies, longjaw mudsucker, and other freshwater species are present. Desert pupfish inhabit the lower portions of drains that discharge directly to the Salton Sea, but they have not been observed in the rivers (Sutton, 1999). In the past, orangemouth corvina have been reported to congregate (possibly for spawning) where freshwater flows into the Salton Sea, possibly due to higher dissolved oxygen or better water quality (Costa-Pierce, 2001).

The size of the areas influenced by inflow varies on a daily to seasonal basis in relation to the volume of water discharged to the Salton Sea at each location. Brackish waters ranging from 10,000 to 30,000 mg/L extend about 1,600 to 3,300 feet offshore from the New and Alamo river mouths (Costa-Pierce, 2001), with the larger areas occurring during summer when irrigation runoff is high. The size of the area influenced by the brackish water inflow from the New and Alamo rivers was estimated to be about 100 to 250 acres (Costa-Pierce and Riedel, 2000).

Islands and Snags

Several islands along the margin of the Salton Sea provide important nesting and resting habitat for a variety of birds. With the exception of Mullet Island, these areas are generally very small (few acres or less), devoid of vegetation, and influenced by water surface elevation. Mullet Island, located in the southeastern part of the Salton Sea, has an area of about 4.5 hectares (about 11 acres) (Molina, 2004) and supports nesting black skimmers, double-crested cormorants, gull-billed terns, Caspian terns, great blue herons, and gulls. Partially submerged dikes also provide isolated land for bird resting and nesting. Molina (2004) observed that during 1991 through 2001, many gulls, terns, and black skimmers used small islands at the Salton Sea. Islands are critically important at the Salton Sea and their availability possibly limits reproduction by some bird species.

In some areas along the Salton Sea, trees killed by inundation from past increases in the water elevation remain in shallow water along the shoreline. These snags provide important roosting and nesting opportunities for herons, egrets, and other birds. These structures are not permanent, and they continue to degrade and collapse over time. Other structures situated in inundated areas also provide a similar function. Herons, egrets, white-faced ibises, and double-crested cormorants nest in snags, and some species use partially submerged utility poles surrounded by water (Patten et al., 2003). Most of the snags are located in the Whitewater River delta, near the Wister Unit of the Imperial Wildlife Area, and at Morton Bay (see Figure H1-1in Appendix H-1).

Riparian Habitat or Other Sensitive Natural Communities

Native plant communities in the Salton Sea area were profoundly affected by human activity, such as the conversion of the Imperial and Coachella valleys to agriculture and other uses. These activities not only eliminated vast areas of native vegetation, but also led to the introduction of non-native plant species that now dominate most of the disturbed areas around the Salton Sea. Native riparian vegetation that was once dominated by mesquite is now dominated by tamarisk and other non-native species.

The riparian vegetation that borders the New, Alamo, and Whitewater rivers, especially at and near the mouths, is composed primarily of non-native species such as tamarisk and common reed. Riparian vegetation is also supported at San Felipe and Salt creeks as well as some of the agricultural drains. While these do not represent native communities, they do provide habitat for wildlife.

Several rare natural communities are identified in the California Natural Diversity Database or otherwise identified by DFG as occurring in the vicinity of the Salton Sea. These include Active Desert Dunes, Desert Fan Palm Oasis, Transmontane Alkali Marsh, Sonoran Cottonwood Willow Riparian Forest, Mesquite Bosque, and Freshwater Marsh. All of these rare natural communities are located upslope of the Salton Sea and are not expected to be influenced by restoration activities at the Salton Sea.

Wetlands

Unmanaged vegetation occurs along the margins of the Salton Sea where water associated with irrigation runoff and other sources provide sufficient soil moisture. These areas are located above and along the shoreline, and include diked wetlands and areas dominated by tamarisk. These unmanaged areas are referred to as “adjacent wetlands” in the Salton Sea database (University of Redlands, 1999) and cover about 6,485 acres. Tamarisk and iodine bush are the most common species of adjacent wetlands (Table 8-2). Cattail and bulrush are identified as the primary vegetation on 217 acres of adjacent wetlands. With the exception of wetlands associated with river mouths, all of these areas are located above the shoreline of the Salton Sea and generally outside the influence of construction activities associated with restoration. Some of these areas could be jurisdictional wetlands.

Table 8-2
Primary Vegetation and Acreage of Adjacent Wetlands

Primary Vegetation	Total Acres
Iodine bush	1,577
Mixed halophytic shrubs	65
Arrowweed	597
Bulrush	17
Sea-blite	86
Tamarisk	2,349
Cattail	200
No primary wetland vegetation	1,595
Total	**6,485**

Ecological Risk in Salton Sea Habitats

For the purposes of the Draft Programmatic Environmental Impact Report (PEIR), ecological risks are related primarily to selenium, which was evaluated quantitatively because it was identified as a constituent of concern during scoping for the PEIR. Selenium is a naturally occurring element and an essential nutrient for fish and birds. However, when it is present at elevated concentrations in the food web, selenium can cause severe adverse effects, especially on reproduction of fish and birds. Current inflows to the Salton Sea contain low to moderate levels of selenium, averaging about 5 to 10 µg/L, as described in Appendix F. The existing biological and geochemical processes in the Salton Sea reduce the inflow concentration to below 2 µg/L. Phytoplankton and algae take up selenium, but the absence of higher aquatic plants in the Salton Sea tends to decrease selenium bioavailability. Bioaccumulation occurs through invertebrate and fish consumption of bacteria, phytoplankton, and algae in the water column or in shallow sediments, and through birds feeding on those invertebrates and fish. Deposition of biologically accumulated selenium (primarily in dead phytoplankton, algae, invertebrates, and fish) in bottom sediments in the deep portions of the Salton Sea is an important component in the removal of selenium from the water column. The resuspension of these bottom sediments appears to be a key factor in promoting and maintaining the highly eutrophic character of the Salton Sea (Anderson and Amrhein, 2002; Schladow, 2004), which in turn acts to maintain the anoxia of bottom waters and facilitate the conversion of sediment selenium to forms that are not biologically available or accessible. For additional information on selenium in the Salton Sea and ecological risks, see Appendix F.

ENVIRONMENTAL IMPACTS

Analysis Methodology

The following summarizes the general methodology and technical assumptions used to assess potential impacts of the alternatives. These impacts were assessed at a programmatic level, yet in sufficient detail to allow an understanding of the types, magnitude, timing, and significance of impacts that could result from implementation of an alternative. It was assumed that specific details and localized impacts associated with the construction and operations and maintenance of actions would be evaluated in subsequent project-level analysis.

In general, the evaluation assesses two elements of the potential impacts: 1) impacts of construction and operations and maintenance and 2) the overall benefit of the alternatives on fish and wildlife. Because the distribution of biological resources could change prior to construction, the timing, location, and magnitude of these construction related impacts were evaluated relative to the anticipated conditions at the time of construction. Construction and operations and maintenance impacts were evaluated collectively by the type of activity or restoration feature because of the uncertainty regarding the project-level specific details and the common impacts associated with construction of most alternatives. For example, construction of a Barrier would generate similar construction impacts regardless of the alternative; thus the impacts of Barrier construction were evaluated collectively and not repeated for each alternative that includes a Barrier. However, any construction related impacts unique to a particular alternative are described for that alternative. To evaluate the overall benefits that would result, the amount of habitat created or supported under each alternative was described relative to Existing Conditions and the No Action Alternative. To account for changes over time, the analysis was conducted for each of four phases (present through 2020, 2020 through 2030, 2030 through 2040, and 2040 through 2078). The quantity of available habitat was expressed as the acreage of a particular habitat type available during each of the four phases.

The evaluation of impacts focuses on fish and birds. Other wildlife (e.g., mammals and reptiles) use the area, but they occur primarily upslope of the Salton Sea and likely would not be impacted by activities occurring within the Salton Sea or on the exposed Sea Bed.

To evaluate the overall benefits to aquatic resources (primarily fish), the types of habitat created or supported under each alternative were assessed in terms of their ability to support recreational sport fish (e.g., gulf croaker) and forage fish (e.g., tilapia), two groups of fish historically or currently important at the Salton Sea. See Appendix H-1 for additional discussion of these fish groups and their habitats. Benefits (and impacts) to desert pupfish are described in the discussion of impacts on special-status species.

Expectations regarding the use of these habitats by selected bird species were based on habitat modeling as described in Appendix C. This analysis was based on a comprehensive shoreline survey of the Salton Sea (Shuford et al., 2000). Because of the comprehensive nature of the survey and its relative recent completion, the densities observed in 1999 served as the basis for characterizing bird use under Existing Conditions. However, because of changes at the Salton Sea since 1999, including the substantial reduction in fish resources, the Salton Sea might currently (2006) support lower densities of some birds than it did in 1999. Therefore, the model results might underestimate the benefits of the restoration alternatives relative to 2006 for some bird species.

Potential bird use was described as "habitat capacity," defined as an abundance that could be supported by a particular habitat type, based on a predicted bird density applied to the area of each habitat type in the modeled alternative. Densities in open water and low salinity habitats were based on data from the 1999 comprehensive shoreline survey of the Salton Sea (Shuford et al., 2000). Because most of the alternatives involve higher salinity habitats than have been surveyed at the Salton Sea, data from San Francisco Bay salt ponds was used to estimate densities in these habitats. Due to natural differences in the geography, and magnitude and phenology of waterbird use between San Francisco Bay and the Salton Sea, a conversion factor was used to obtain more Salton Sea-appropriate predictions for these habitats. Habitat capacity for each of the alternatives was compared to Existing Conditions and the No Action Alternative-Variability Conditions.

Wintering and migrating waterfowl, primarily ducks and geese are supported in large numbers in the Salton Sea area and collectively contribute to the diversity of the Salton Sea ecosystem. Several species, including snow goose, northern pintail, American wigeon, green-winged teal, northern shoveler, and ruddy duck, occur or have historically occurred in numbers exceeding 10,000 (Patten et al., 2003). With the exception of diving ducks (e.g., ruddy duck), waterfowl in the Salton Sea area are associated primarily with the croplands, freshwater reservoirs associated with the agricultural areas, and the managed freshwater marshes on the refuges. Geese and dabbling ducks (particularly northern shovelers) occasionally use the Salton Sea shoreline and the brackish areas at the river mouths. For the purpose of the analysis, it was assumed that restoration activities would not affect the primary habitats for these species and thus would not result in adverse impacts. For all alternatives, the continued availability of freshwater habitat along the southern shoreline of the Salton Sea would support the function that the Salton Sea currently provides to waterfowl. The reduced salinity of the water bordering the southern shoreline under each of the restoration alternatives could increase available habitat at the Salton Sea itself. Impacts on diving ducks that currently use the Salton Sea and that could be affected by restoration activities are represented by ruddy duck in the evaluation of alternatives.

To assess the performance of the alternatives relative to the goals of the legislation, predicted habitat capacity was compared to the historic levels of use by these species at the Salton Sea (see Appendix H-1 for additional discussion of historic levels of bird use). However, because these predicted habitat capacities were derived from models based on 1999 data, they cannot be compared directly with historical abundance levels. For example, habitat-specific densities are likely to experience large interannual fluctuations, so all predictions should be considered relative to 1999, the year upon which they were based, rather than absolute predictions of habitat capacity. Unlike many of the historic estimates, model predictions represent mean numbers, rather than maximum total counts across a season. For the purpose of the evaluation of habitat benefits, each of the created habitats (e.g., Marine Sea and Saline Habitat Complex) was assumed to support the habitat characteristics and functions described in Appendix H-1. The Brine Sink was assumed to retain habitat value up to a salinity of about 200,000 mg/L, although it is acknowledged that factors other than salinity (e.g., eutrophication) or in combination could reduce the value of the Brine Sink prior to reaching this salinity.

The results of both the evaluation of habitat capacity for birds and the comparison to historic conditions must be considered in light of the risks posed by selenium. As previously described, selenium is a naturally occurring element that currently affects fish and birds at the Salton Sea and would continue to affect fish and birds under all of the alternatives, including the No Action Alternative. The effects on birds are typically expressed as reductions in egg hatchability or growth and survival of young. To assess the risks associated with selenium, the analysis relied on results of the Ecological Risk Assessment for aquatic and terrestrial receptors potentially exposed to selenium in the vicinity of the Salton Sea (Appendix F). The Ecological Risk Assessment describes the likelihood and nature of potential exposures of fish (in freshwater marshes and Salton Sea) and of birds (in aquatic and terrestrial habitats of the Assessment Area) to selenium and the possible severity of adverse effects to those animals resulting from exposure to selenium. For purposes of the analysis in this chapter, only fish and birds occupying aquatic and wetted shoreline habitats and affected through the sediment and dietary (food web) exposure pathways were included. Both the overall risk to fish and birds and the risk to special status species were evaluated. For alternatives that include Saline Habitat Complex, it was assumed that individual cells would be managed to achieve a salinity level greater than 20,000 mg/L. Maintaining salinity above this level would prevent or inhibit the growth of rooted aquatic plants, thereby reducing the need for vegetation management to maintain water flow and circulation, remove excess accumulations of biomass, and minimize the contribution of rooted plants to the remobilization and cycling of selenium from sediment into the water column and food web. If not restricted from the Saline Habitat Complex, rooted plants would produce a substantial amount of organic detritus that would contain elevated concentrations of selenium and serve as substrate for the microbes that are important in cycling selenium aquatic systems. In addition, plant roots would contribute to remobilization of selenium from the sediment in the water column and food web by oxidation and methylation of the chemically reduced forms of selenium that are found in sediment. Elevated salinity also reduces the potential for Saline Habitat Complex to support mosquito populations and avian disease organisms such as botulism.

To evaluate the overall risk to fish and birds at the population level, the hazard quotients (which compare an estimated exposure to an effect concentration or dose) based on the high toxicity reference value (TRV) for each species were used (see Appendix F, Table F-45 for summary and Tables F-33, F-35, F-38, and F-39 for more details). These hazard quotients were averaged within the habitats present under each alternative and weighted by the area of each habitat; they were then summed across habitats to derive an "overall hazard index" for the alternative. To evaluate the risk to special status species at the individual level, the hazard quotients based on the low TRV (which provides a more conservative assessment of risk) were used for each special status species. The hazard quotient for each habitat present under each alternative was weighted by the area of that habitat and then hazard quotients were summed across habitats to derive an "overall hazard index." An area-weighted average hazard quotient (or a hazard index [HI]) less than 1 indicates a relatively low risk to fish and wildlife from selenium; values between 1 and 5 suggest a moderate risk, and values greater than 5 suggest a relatively higher level of overall risk. (It should be recognized, however, that risks to particular species would be higher or lower than the average, as indicated below and in Appendix F.)

Projected selenium levels would not be expected to result in direct mortality of adults or significant incidence of teratogenic effects in developing bird embryos. The most likely effects would be in reduced hatching success of eggs of more highly exposed or sensitive species. Overall, the benefits of restoration (ability to support fish and birds at the Salton Sea) would outweigh the potential risks posed by exposure to selenium. However, actions that would have lower overall levels of ecological risk due to selenium would be preferable to actions resulting in higher levels of risk. The effects of selenium on fish and birds are described for each alternative under the evaluation of overall benefits of restoration and impacts on special status species.

Significance Criteria

The following significance criteria were based on CEQA and used to determine if changes as compared to Existing Conditions and the No Action Alternative would:

- Have a substantial reduction in the value of the Salton Sea for fish and wildlife;
- Have a substantial adverse effect, either directly or through habitat modifications on colonial breeding birds and any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the DFG or Service;
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, and regulations or by the DFG or the Service;
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filing, hydrological interruption, or other means;
- Interfere substantially with the movement of any resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; or
- Conflict with the provisions of an adopted Habitat Conservation Plan (HCP), Natural Community Conservation Plan (NCCP), or other approved, local, regional, or State habitat conservation plan.

Application of Significance Criteria on the Alternatives

Significance criteria have been applied to the alternatives considered in the PEIR. The following list summarizes the overall methodology in the application of the criteria to the alternatives:

- **Substantial Reduction in the Value of the Salton Sea for Fish and Wildlife** – The alternatives are intended, among other objectives, to retain the value of the Salton Sea for fish and wildlife. While implementation of the alternatives has the potential for long term adverse impacts (e.g., effects of eutrophication and selenium), they also have the potential to provide long term benefits for fish and wildlife. This criterion is applied broadly to encompass the overall Salton Sea ecosystem, rather than individual components of the system (e.g., special status species), for the purpose of evaluating the overall effects of the alternatives on fish and wildlife relative to the No Action Alternative and Existing Conditions. Conclusions regarding overall benefits are based on the capacity of the habitat associated with each of the alternatives to support birds (as indicated by the habitat-based bird modeling) considered within the context of the anticipated negative effects of eutrophication and selenium. The bird modeling and projection of selenium effects is based on 2078 conditions;
- **Substantial Adverse Effect on Candidate, Sensitive, or Special Status Species** – This criterion was applied to construction and to operations and maintenance activities that could directly or indirectly affect species listed in Table 8-1. This criterion was also applied to the potential risks associated with selenium in the sediments of the Salton Sea and in the water that would be supplied to each of the habitat components of the restoration;
- **Substantial Adverse Effect on any Riparian Habitat or Other Sensitive Natural Community** – This criterion was applied to the riparian vegetation at the mouths of the New, Alamo, and Whitewater rivers; and creeks and agricultural drains;
- **Substantial Adverse Effect on Federally Protected Wetlands** – areas identified as adjacent wetlands, some of which could be jurisdictional, are located in various areas above the shoreline around the margin of the Salton Sea. These are generally outside the influence of the restoration activities, and site-specific delineation and evaluation of individual wetland areas potentially

affected by restoration activities would be conducted at the project-level. This significance criterion was applied primarily to potential wetlands associated with the river mouths where facilities associated with the restoration could occur;

- **Interfere Substantially with the Movement of Any Resident or Migratory Fish or Wildlife Species** – The desert pupfish that occupy many of the drains and creeks that discharge directly to the Salton Sea move among the drains and creeks via the Salton Sea. If the alternatives prevent or inhibit this movement, a substantial impact would occur. In addition, striped mullet are believed to move between the Salton Sea and the rivers, but it is unknown if this movement is necessary for their continued survival. This criterion was applied primarily to movement of desert pupfish (along the Salton Sea shoreline) among the creeks and drains they inhabit;
- **Conflict with Any Local Policies or Ordinances Protecting Biological Resources** – The Imperial County General Plan includes provisions to preserve the integrity, function, productivity, and long term viability of environmentally sensitive habitats, and plant and animal species. The general plan also includes a provision to maintain salinity levels in the Salton Sea, which enable it to remain a viable fish and wildlife habitat. Compliance with the local policies and ordinances is discussed in Chapter 11 and not considered in this chapter; and,
- **Conflict with the Provisions of an Adopted HCP or NCCP** – The Coachella Valley Multiple Species HCP/NCCP, which covers land use activities in the Coachella Valley, is near completion, but not yet approved. The IID is in the process of developing an HCP and NCCP covering water conservation activities and delivery and drainage of irrigation water within portions of its service area in the Imperial Valley. This plan also is not approved. Because there are no approved plans in place, this criterion was not applied.

Summary of Assumptions

The assumptions related to the descriptions of the alternatives are described in Chapter 3. The specific assumptions related to the analysis of biological resources are summarized in Table 8-3.

Table 8-3
Summary of Assumptions for Biological Resources

Assumptions Common to All Alternatives	
1. Water quality characteristics of the water bodies would respond as described in Appendices D and F	
2. Biological conditions and species use of water bodies as described in Appendix H-1	
3. Pupfish Channels would be designed to effectively support desert pupfish and their movement	
4. Fish and invertebrates could be introduced as conditions change in the future in response to restoration actions	
5. Habitat is limiting for birds and creation of additional habitat would increase the habitat capacity	
6. Selected bird species used to model habitat capacity provide a reasonable representation for other bird species with similar habitat requirements	
7. Constructed islands and nesting structures would be effective in replacing lost habitat values	
8. Areas adjacent to the Salton Sea that provide habitat for wildlife, such as agricultural fields and refuges, would continue to provide similar habitat value in the future	
9. Detailed design and site-specific analysis would be conducted in the project-level analyses	
10. Adaptive Management would be used to modify future restoration actions	
11. Vegetation (e.g., common reed) would establish along river channels in the Sea Bed.	
Assumptions Specific to the Alternatives	
No Action Alternative and Alternatives 1, 2, 3, 4, 5, 6, 7, and 8	No additional assumptions were made.

General Impacts of Implementation of Common Facilities

This section provides an analysis of the general impacts associated with the construction and operations and maintenance of features and facilities associated with restoration that are included in more than one of the restoration alternatives. These impacts generally would occur in association with the construction of a particular feature or facility regardless of the alternative. Impacts unique to individual alternatives are addressed in subsequent sections.

Berms and Saline Habitat Complex Features

Under all alternatives, Berms would be constructed to create habitat cells for the Early Start Habitat. Early Start Habitat would be a temporary feature with the characteristics of Saline Habitat Complex. Up to 2,000 acres would be constructed along the southern shoreline early in the implementation. Early Start Habitat would be constructed to hasten the development of habitat in an attempt to retain habitat values as habitat values in the Brine Sink decrease and to provide information that would assist in the design of Saline Habitat Complex. The Early Start Habitat also will be designed in consideration of the results of the pilot study currently being conducted by USGS along the southeastern shore of the Salton Sea. This pilot study is intended to evaluate various aspects of the performance of construction methods and habitat value of constructed shallow saline ponds.

Berms also would be used to form Saline Habitat Complex, including Shoreline Waterways. These Berms would be constructed of material dredged or excavated from the Sea Bed. In addition to constructing the Berms, earthwork would be conducted to create excavated areas that would serve to increase water depth and the complexity of these water bodies. Islands and other dry features would also be constructed. Maintenance activities associated with these facilities would include periodic dredging to remove accumulations of sediment and possible temporary dewatering used as a tool to improve the performance of the areas as habitat. These structures would not be designed to withstand severe ground shaking and it is presumed that they would require major repair or reconstruction after a substantial earthquake event.

Avian Resources

Construction of Berms parallel and perpendicular to the shore to form habitat cells, as well as earthwork associated with development of deeper water and islands, could cause a temporary disturbance that could adversely disturb nesting birds, particularly colonial nesting birds near the river deltas. The habitat associated with Early Start Habitat would likely be located along the southern shore of the Salton Sea between the New and Alamo river deltas, and possibly along the shoreline northeast of the Alamo River. This area was selected because there would be minimal impact to desert pupfish because drains in this area have no direct connection to the Salton Sea. These areas, including the river deltas and islands (e.g., Mullet Island) contain some of the most important habitat for colonial breeding birds (see Figure 8-1). Construction in these areas could be significant if the activities coincided with the breeding season and resulted in a level of disturbance that caused the failure of these birds to nest successfully. These impacts would only extend over the duration of the construction activity (one or two years) and might be avoided or minimized by performing construction activities nearest the breeding sites outside the nesting season.

Similarly, construction of Berms and habitat features associated with subsequent phases of development of Saline Habitat Complex could result in disturbance of nesting birds using habitat features constructed under the previous phase. This disturbance could represent a significant impact if nesting occurred in proximity to the construction area. This potential impact might be avoided or minimized by scheduling construction activities outside of the breeding season or designing the features that are intended to support nesting within constructed habitats (e.g., islands) in areas that would reduce the likelihood of disturbance of future construction.

Aquatic Resources

Construction of the Berms and habitat features would occur on exposed Sea Bed as the water recedes. As a result, aquatic resources (fish and invertebrates) likely would not be affected. Operations and maintenance activities, such as Berm/road condition monitoring and repair, water management, and biological monitoring would not likely result in significant impacts on aquatic resources. Periodic dredging or maintenance activities that require draining a particular cell, however, would result in a loss of fish and invertebrates. Dredging to remove sediment buildup in the cells likely would be an infrequent activity. Fish could be collected and transported to adjacent cells. The impact of dredging on aquatic resources would be less than significant.

Operations and maintenance activities on the Berms and habitat features could result in disturbance or mortality of desert pupfish if this species became established in the Saline Habitat Complex. Impacts on desert pupfish from the dredging and operations and maintenance activities would be considered significant due to its special status.

Sedimentation/Distribution Basins

The Sedimentation/Distribution Basins could be constructed on the New, Alamo, and/or Whitewater rivers near the existing shoreline. The basins would collect, settle, and remove sediment and regulate the flow of water into the conveyance structures including Air Quality Management canals, Shoreline Waterways, or other facilities. Most of the basin would be located on land exposed as the water recedes. Each Sedimentation/Distribution Basin would cover about 200 acres with an average water depth of less than 6 feet. This depth would facilitate settling of sediment and minimize vegetation in basins, although rooted aquatic vegetation likely would colonize portions of the basins. The basins would include an outlet structure that would connect to the extensions of the rivers to allow flushing of accumulated sediment and debris into the Brine Sink. Operations and maintenance activities on the Sedimentation/Distribution Basins would include dredging and flushing about once every two years to remove vegetation, accumulated sediment, and debris. The material would be flushed into the Brine Sink.

Avian Resources

Construction of the facilities would occur in or near some of the most important bird nesting areas at the Salton Sea and result in removal of any nesting habitat that occurs within the footprint of the facility. Direct impacts to breeding birds could be avoided or minimized by initiating construction in the non-breeding season. However, the permanent loss of colonial nesting areas would be a significant impact. This impact would occur in Phase I under all alternatives, including the No Action Alternative. Nesting sites constructed as part of Saline Habitat Complex and possibly sites that naturally develop along the margins of the inflow to the Brine Sink would reduce the significance of this impact in subsequent phases.

Terrestrial birds and waterbirds in or near the work area likely would avoid the construction activities. The distance from the area of active construction to the Salton Sea shoreline and river deltas would depend on the elevation of the Salton Sea at the time of construction. This distance would determine the potential for disturbance of shorebirds. Impacts to terrestrial birds would be less than significant due to the small area and short duration of the disturbance. Construction activities also would have the potential to disturb water associated species that nest, forage, and loaf on the shoreline, in snags near the shore, or river deltas. If construction were to occur near these nesting sites during the breeding season, impacts would have the potential to be significant.

Aquatic Resources

The Sedimentation/Distribution Basins would be constructed in non-inundated areas and would not directly affect Salton Sea aquatic resources. Construction and operations and maintenance of the basins, however, would preclude movement by aquatic organisms in the Brine Sink or created habitats back into the river. This is not expected to result in a significant impact.

Conveyance Facilities

Conveyance facilities include the structures needed to move water for various purposes from its source to the location of the habitat components or the Brine Sink. The full range of conveyance facilities is described in Chapter 3. These facilities include canals, pipelines, and pumping plants.

Avian Resources

During construction activities, noise and human disturbance would occur in a small area of active construction along the various canal corridors. Both terrestrial birds and shorebirds in or near the work area would likely avoid the disturbance area. The distance from the work area to the shoreline along the Brine Sink would depend on the level of the Brine Sink at the time of canal construction, and this distance would determine the potential for disturbance of shorebirds. Impacts to terrestrial birds could be significant.

Construction activities also have the potential to disturb water associated species that nest on the shore or in snags near the shore, assuming that the Salton Sea has receded very little when the canal is built. If construction were to occur near these nesting sites during the breeding season, impacts could be significant, particularly for species such as the western snowy plover.

Aquatic Resources

The Air Quality Management Canal and other water conveyance facilities would be constructed on exposed land as the water recedes. Crossings of drains and natural streams would be via siphons under those waterways. Construction of the siphons would have the potential to temporarily dewater the waterway at that location, or the surface flow would need to be temporarily diverted around the work area. In either case, aquatic resources could be disturbed or lost. Impacts could be significant.

Barriers and Perimeter Dikes

As described in Chapter 3, the construction of Barriers and Perimeter Dikes would be required under several alternatives. Barriers would be used to create a Marine Sea, and Perimeter Dikes would be used to a create a Marine Sea Mixing Zone, Concentric Rings, a Recreation Estuary Lake, and the IID Reservoir. In addition to the construction of the Barriers and Perimeter Dikes, harbors and upland staging facilities would also be required. The characteristics of these structures are described in Chapter 3.

Construction of a Barrier requires the conveyance of a substantial amount of rock and other materials within and immediately adjacent to the Salton Sea. The alternatives do not include any new or expanded roadways or railroads. It is assumed that most of the materials would be delivered by truck to the facilities. During project-level analysis, the use of railroads could be considered and evaluated based upon specific details. Therefore, analysis was based upon the projected construction conditions and was focused on the transport of rock and gravel from either a quarry or railroad siding located near the Salton Sea using the roadways. Other truck traffic would be incidental in comparison. Specific quarry locations and transportation routes are not known, nor is the method of transporting quarried rock. However, it is assumed that all rock and gravel, even if delivered to the area by rail, would need to be transported on roadways for at least part of the route. Roadways and electrical distribution lines would need to be extended to the shoreline during Phase I. Although the locations of these facilities are not known at this time, the construction and operations and maintenance of these facilities could result in substantial impacts to the environment depending on a variety of factors including the location and design of the facilities.

Avian Resources

Noise from heavy machinery and other human activities would occur during the construction of the staging areas. Birds, including terrestrial birds, shorebirds, and waterfowl in or near the work area would likely avoid the disturbance area. The distance from the area of disturbance and the location of these birds would depend on the location of these facilities and elevation of the Brine Sink at the time of construction. If the staging areas were developed in areas frequented by terrestrial birds, impacts could be significant.

Construction activities also have the potential to disturb water associated species that nest on the shore or in snags near the shore, and terrestrial birds nesting in or near the on-shore location of these facilities. If construction were to occur near these nesting sites during the breeding season, impacts could be significant, particularly for species such as the western snowy plover.

During Barrier and Perimeter Dike construction activities, noise and human disturbance would occur in the area of active construction along the alignment of the facility. Birds, including terrestrial birds and shorebirds in or near the work area, would likely avoid the disturbance area. The distance from the work area to the shoreline along the Brine Sink would depend on the level of the Brine Sink at the time of construction, and this distance would determine the potential for disturbance of shorebirds. Impacts on birds could be significant. If new access roads were constructed upslope of the shoreline in the study area, project-level analysis would be required to evaluate impacts on wildlife.

Construction activities in inundated areas (including excavation, foundation treatment and fill placement) would increase turbidity, with the secondary effects of increased turbidity on dissolved oxygen, light penetration, and sediment suspension that could adversely affect the forage base for birds.

Aquatic Resources

Dredging and other construction activities for the harbor facilities would have the potential to disturb or kill desert pupfish in or near the location of these facilities. Construction activities would also impede movement of desert pupfish along the shore. These impacts would be significant.

Construction of the harbor facilities would have the potential to temporarily disturb or kill fish and invertebrates that provide forage for avian wildlife. Fish would generally avoid the areas of disturbance. For all but desert pupfish, impacts would be less than significant because the area affected would be small relative the total habitat available within the study area.

In-water construction activities (including excavation, foundation treatment, and barrier/dike fill placement) would adversely impact aquatic species due to sediment disturbance and increased turbidity. This impact would have several secondary effects, including a reduction in dissolved oxygen and light penetration, physical clogging of gills of fish and invertebrates, and the burial of organisms.

Barrier and Perimeter Dike construction activities (including excavation, foundation treatment, and barrier fill placement) would have the potential to disturb or kill desert pupfish where construction activities occur near the shore. Construction activities would also impede movement of desert pupfish along the shore. These impacts would be significant.

Air Quality Management

A number of methods could be used for management of dust from the exposed Sea Bed: use of water efficient vegetation, brine stabilization, and temporary use of chemical soil stabilization as described in Chapter 3.

Avian Resources

Construction and use of roads, and installation, operations, and maintenance of the irrigation system would cause disturbance in localized areas within the exposed Sea Bed. Such activities could cause birds using the Brine Sink or its shoreline to avoid the area near the work. Air Quality Management activities would require daily operations and maintenance visits, which would result in daily disturbance of avian resources. Impacts of construction and operations and maintenance could be significant.

Air Quality Management activities around the margin of the Brine Sink would disturb birds using the entire shoreline and adjacent shallow waters through noise (tractors, pumps, and spray guns) and brine spray. The frequency of this disturbance would depend on the rate at which the shoreline fluctuates, which would vary among alternatives and with climatic conditions. Large numbers of birds could be affected for as long as the Brine Sink provides an invertebrate forage base. Impacts could be significant because the entire margin of the Brine Sink would be affected at intervals. Once the invertebrate production ceases due to high salinities, the impacts would be less than significant because few, if any, birds would use the area.

Aquatic Resources

Air Quality Management activities would occur in dry areas of the Sea Bed and thus would not have any direct effects on aquatic habitats.

Summary of Impact Assessment

The impacts shown in Table 8-4 assume implementation of the Next Steps to reduce the adverse impacts.

No Action Alternative

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins, Air Quality Management, Pupfish Channels, and Salton Sea. The construction activities would be identical under the No Action Alternative-CEQA Conditions and the No Action Alternative-Variability Conditions. Therefore, impacts related to disturbance would be the same for both conditions.

Under the No Action Alternative, the surface elevation and area of the Salton Sea would decline while the salinity would increase, as shown in Tables 8-5 and 8-6. Circulation and mixing would continue to be driven primarily by winds, but as the water becomes shallower, the effects of thermal stratification would become somewhat weaker, allowing more frequent mixing of surface and bottom waters. This would gradually result in a slightly less stratified vertical temperature profile and greater dissolved oxygen in deeper water in Phase IV. The frequency and magnitude of mixing events that bring anoxic water with high concentrations of hydrogen sulfide, ammonia, and phosphorus to the surface would decrease over time. The Salton Sea would continue to be a sink for selenium, with concentrations in the sediments orders of magnitude higher than in the water. The amount of exposed Sea Bed in which Air Quality Management activities could occur would increase by phase from 4,000 acres in Phase I to 47,000 acres in Phase IV under the No Action Alternative.

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Criterion: Overall effects of implementation on fish and wildlife.							
No Action Alternative	Existing Conditions	S	S	S	S	Under the No Action Alternative – CEQA Conditions, the biota of the Salton Sea would undergo substantial changes during Phase I and II, with additional changes in the succeeding phases. As the surface elevation falls, important roosting and nesting areas would be lost. With increased salinity, the aquatic food web would shorten because of the loss of fish and some invertebrate species, and bird populations dependent on an aquatic food base would decline. Impacts relative to Existing Conditions would be significant. With the loss of bird species dependent on fish as a food base, the overall risk from selenium to birds would be less than under Existing Conditions. Under the No Action Alternative-Variability Conditions, biological resources at the Salton Sea would be affected in a manner similar to the No Action Alternative-CEQA Conditions, although these changes would occur sooner and be more pronounced.	Implement measures to avoid disturbance of fish and wildlife resources during construction and operations and maintenance.
	No Action Alternative	NA	NA	NA	NA		
Alternative 1	Existing Conditions	S	L	L	L	Constructed Saline Habitat Complex would stabilize salinity within cells and support invertebrates and forage fish. For most of the evaluated bird species, constructed Saline Habitat Complex would increase habitat capacity relative to the No Action Alternative and to Existing Conditions. Fish would no longer be supported in the Brine Sink beginning in Phase I, and invertebrates would be lost from most of the Brine Sink by Phase III. The overall risk from selenium (low) would be similar to Existing Conditions and the No Action Alternative, and would be below the threshold for population-level effects in most species.	Conduct pilot studies to evaluate the effectiveness of Saline Habitat Complex in supporting fish and wildlife. Implement monitoring program to assist in project-level design and development of an adaptive management program. Implement measures to avoid disturbance of fish and wildlife during construction, including potential impacts resulting from increased light and glare. Prior to project-level design, evaluate the distribution of selenium in the sediments, especially in the interior portion of Salton Sea, and collect additional co-located biota, sediment, and water samples to refine predictions of selenium risk and reduce uncertainty. Modify design to minimize selenium uptake in food web.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 2	Existing Conditions	S	B	B	B	Constructed Saline Habitat Complex would stabilize salinity within cells and support invertebrates and forage fish. For all of the evaluated bird species, this alternative would increase habitat capacity relative to the No Action Alternative and Existing Conditions. The overall risk from selenium would be somewhat greater than under the No Action Alternative and Existing Conditions, and would be at the threshold for effects (Hazard Index [HI] of 1.0).	Same as Alternative 1.
	No Action Alternative	B	B	B	B		
Alternative 3	Existing Conditions	S	L	L	L	Constructed Saline Habitat Complex (Early Start) would support invertebrates and forage fish. The First Ring also would support forage fish. Water quality in the Second Ring would be anticipated to provide conditions that could support recreational sport fish species if introduced. For most of the evaluated bird species, this alternative would likely result in little change in habitat capacity relative to Existing Conditions and an increase relative to the No Action Alternative. The overall risk from selenium would be greater than under the No Action Alternative and Existing Conditions, and would be at the threshold for effects (HI of 1.0).	Same as Alternative 1. Evaluate the effectiveness of constructing and closing the southern portion of the First Ring to create functioning habitat while the northern portion of the First Ring is constructed.
	No Action Alternative	B	B	B	B		
Alternative 4	Existing Conditions	S	L	L	L	Salinity in the First, Second, and Third lakes would be less than about 40,000 mg/L and would provide habitat for fish and invertebrates. The Fourth Lake would provide habitat for invertebrates and fish with high salinity tolerance. For most of the evaluated bird species, habitat capacity would be expected to increase by at least 50 percent relative to Existing Conditions. Habitat capacity relative to the No Action Alternative would increase for all species. The overall risk from selenium would be greater than under the No Action Alternative and Existing Conditions, and would be just above the threshold for effects (HI of 1.0).	Same as Alternative 1.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase I	II	III	IV	Comments	Next Steps
Alternative 5	Existing Conditions	S	L	L	L	Constructed Saline Habitat Complex would support invertebrates and forage fish. Salinity in the Marine Sea would be above the tolerance levels for most fish species until late Phase II when it would begin to provide habitat for tilapia and other forage fish. Once salinity was stabilized by late Phase II, the Marine Sea could provide conditions that support recreational sport fish species. For most of the evaluated bird species, habitat capacity would be expected to increase by at least 50 percent compared to Existing Conditions. Habitat capacity relative to the No Action Alternative would increase for all species. The overall risk from selenium would be greater than under the No Action Alternative and Existing Conditions, and would be at the threshold for effects (HI of 1.0).	Same as Alternative 1.
	No Action Alternative	B	B	B	B		
Alternative 6	Existing Conditions	S	L	L	L	Constructed Saline Habitat Complex would support invertebrates and forage fish. Salinity in the Marine Sea would be above the tolerance levels for most fish species in Phase I, but could provide habitat for tilapia and other salt-tolerant forage fish beginning in Phase II. Compared to Existing Conditions, habitat capacity for most of the evaluated bird species would be expected to increase. Habitat capacity relative to the No Action Alternative would increase for all species. The overall risk from selenium would be greater than under the No Action Alternative and Existing Conditions, and would be just below the threshold for effects (HI of 0.9), which would be considered low.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 7	Existing Conditions	S	L	L	L	Constructed Saline Habitat Complex would support tilapia and other forage fish. The Recreational Saltwater Lake would have salinity levels above the tolerance levels for most fish species in Phase I, but could provide habitat for tilapia and other salt-tolerant forage fish beginning in Phase III, and possibly Phase II, depending on inflows. The Recreational Saltwater Lake could support introduction of marine sport fish species if salinity could be reduced to less than 40,000 mg/L. Compared to Existing Conditions, habitat capacity would be expected to increase substantially (more than 75 percent) for about half of the bird species evaluated. Habitat capacity for the other species would be expected to decline by up to 50 percent. Habitat capacity relative to the No Action Alternative would increase for all species. The overall risk from selenium would be greater than under the No Action Alternative and Existing Conditions, and would be just below the threshold for effects (HI of 0.9), which would be considered low.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		
Alternative 8	Existing Conditions	S	L	L	L	The Marine Sea could provide habitat for tilapia and other salt-tolerant forage fish beginning in Phase II. The Marine Sea is anticipated to provide conditions that could support recreational sport fish species once salinity is stabilized at the end of Phase II. Compared to Existing Conditions, habitat capacity would decline by up to 50 percent for about half of the bird species evaluated. Habitat capacity for the other bird species evaluated would be expected to increase relative to Existing Conditions. Habitat capacity relative to the No Action Alternative would increase for all species. The overall risk from selenium would be greater than under the No Action Alternative and Existing Conditions, and would be at the threshold for effects (HI of 1.0).	Same as Alternative 1.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Criterion: Substantial adverse effect on Candidate, Sensitive, or Special Status Species.							
No Action Alternative	Existing Conditions	S	S	S	S	Construction of the Sedimentation/Distribution Basins could result in loss of nesting and roosting habitat for special status birds at the river deltas during Phase I. By the end of Phase I, the Salton Sea would no longer provide sufficient prey (fish) to support the current populations of fish-eating birds. During Phase II, Pupfish Channel construction activities could kill or injure individual desert pupfish during connection of the drains to the channels. As the water recedes, the suitability of the beaches used by western snowy plovers for nesting could change as Sea Bed sediments are exposed. Operations and maintenance would result in disturbance impacts in all phases. Selenium risk to desert pupfish based directly on the sediment concentrations generally would be less than under Existing Conditions because they would be found only in the limited estuary areas under this alternative. Selenium risk to special status bird species based directly on the sediment concentrations would be moderate and slightly less than under Existing Conditions. For black skimmer (and other fish-eating birds), risk associated with the food web (diet) pathway would be less than under Existing Conditions. because their prey (fish) would be absent except in estuaries under No Action Alternative conditions, so there would be no exposure to fish-eating birds. For western snowy plover, the moderate risk associated with the food web (diet) pathway would be slightly less than under Existing Conditions. Impacts associated with the No Action Alternative-Variability Conditions would be similar, except that the Salton Sea would not support a forage base (fish or invertebrates) for special status birds during Phases III and IV. Selenium risk to special status species would be slightly greater than under the No Action Alternative-CEQA Conditions.	Implement measures to avoid or minimize impacts on breeding or roosting special status birds and desert pupfish during construction or maintenance activities.
	No Action Alternative	NA	NA	NA	NA		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase I	II	III	IV	Comments	Next Steps
Alternative 1	Existing Conditions	S	L	L	L	The impact of construction of the Sedimentation/Distribution Basins (loss of nesting habitat) would be the same as the No Action Alternative. Construction and operations and maintenance of the Pupfish Channels, and Air Quality Management facilities would be similar to those described for the No Action Alternative. There could be a loss of western snowy plover nesting habitat on the beach and snag habitat in the northern part of the Salton Sea. The Saline Habitat Complex would provide foraging and nesting opportunities for special status birds during Phase I and represent a benefit relative to the No Action Alternative. Selenium risk to desert pupfish based directly on the sediment concentrations would be low and less than under Existing Conditions because they would not be found in the large area of Brine Sink under this alternative. Risks to desert pupfish through the sediment pathway would be comparable to those under the No Action Alternative. Selenium risk to special status bird species based directly on the sediment concentrations would be moderate and less than under Existing Conditions and the No Action Alternative. For black skimmer (and similar fish-eating birds), risk associated with the food web (diet) pathway would be moderate and less than under Existing Conditions, but greater than under the No Action Alternative (when their prey [fish] would be absent except in estuaries, and there would be no exposure to fish-eating birds in the Salton Sea). For western snowy plover, the moderate risk associated with the food web (diet) pathway would be lower than under Existing Conditions and under the No Action Alternative.	Implement measures to avoid or minimize impacts on breeding or roosting special status birds and desert pupfish during construction or operations and maintenance activities. Evaluate the need and methods for incorporating areas of freshwater within Saline Habitat Complex to accommodate the requirements of breeding birds and their young. Determine the appropriate ratio of wetted to dry areas within the Saline Habitat Complex necessary to maximize the habitat value. Prior to project-level design, implement studies to further characterize the distribution of selenium in the sediments, especially in the interior portion of the Salton Sea, and collect additional co-located biota, sediment, and water samples to refine predictions of selenium risk and reduce uncertainty. Modify design to minimize selenium uptake in the food web.
	No Action Alternative	O	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase I	II	III	IV	Comments	Next Steps
Alternative 2	Existing Conditions	S	L	L	L	The impact of construction, operations and maintenance would be the same as Alternative 1, but over a larger area and longer duration. Selenium risk to desert pupfish based directly on the sediment concentrations would generally be moderate and less than under Existing Conditions because they would not be found in the large area of Brine Sink under this alternative. Risks to desert pupfish through the sediment pathway would be slightly greater than under the No Action Alternative. Selenium risk to special status bird species based directly on the sediment concentrations would be moderate and less than under Existing Conditions and under the No Action Alternative. For black skimmer (and similar species), risk associated with the food web (diet) pathway would be moderate and less than under Existing Conditions, but greater than under the No Action Alternative (when fish would be largely absent from the Salton Sea). For western snowy plover, the moderate risk associated with the food web (diet) pathway would be similar to or less than risks under Existing Conditions and under the No Action Alternative.	Same as Alternative 1.
	No Action Alternative	O	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase I	II	III	IV	Comments	Next Steps
Alternative 3	Existing Conditions	S	L	L	L	Construction of the Sedimentation/Distribution Basins would have a significant impact on special status species relative to Existing Conditions and a benefit relative to the No Action Alternative because fewer Sedimentation/ Distribution Basins would be constructed. The First Ring would support movement of desert pupfish populations, although some individuals could be injured or killed by passage through the circulation pumps. Operations and maintenance activities could result in disturbance impacts in all phases. The First and Second rings would provide conditions that support foraging opportunities for special status birds and create a benefit during all phases. Selenium risk to desert pupfish based directly on the sediment concentrations would generally be moderate and less than under Existing Conditions because there would be less habitat in high selenium areas for this species under this alternative. Risks to desert pupfish through the sediment pathway would be greater than under the No Action Alternative. Selenium risk to special status bird species based directly on the sediment concentrations would be moderate and less than under Existing Conditions and under the No Action Alternative. For black skimmer (and similar species), risk associated with the food web (diet) pathway would be moderate and less than under Existing Conditions, but greater than under the No Action Alternative (when fish would be absent from the Salton Sea). For western snowy plover, the moderate risk associated with the food web (diet) pathway would be similar to the level of risk under Existing Conditions and under the No Action Alternative.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 4	Existing Conditions	S	L	L	L	Construction of the Sedimentation/Distribution Basins would have impacts similar to those described for Alternative 3. The Concentric Lakes would support foraging and nesting opportunities for special status birds during all phases and create a benefit during all phases Selenium risk to desert pupfish based directly on the sediment concentrations would generally be moderate and less than under Existing Conditions because there would be less habitat in high selenium areas for this species under this alternative. Risks to desert pupfish through the sediment pathway would be greater than under the No Action Alternative. Selenium risk to special status bird species based directly on the sediment concentrations would be moderate and slightly less than under Existing Conditions and under the No Action Alternative. For black skimmer (and similar species), risk associated with the food web (diet) pathway would be moderate and less than under Existing Conditions, but greater than under the No Action Alternative (when fish would be absent from the Salton Sea). For western snowy plover, the moderate risk associated with the food web (diet) pathway would be similar to the level of risk under Existing Conditions and under the No Action Alternative.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 5	Existing Conditions	S	L	L	L	Construction of the Sedimentation/Distribution Basins would have impacts similar to those described for Alternative 3. The Concentric Lakes would support foraging and nesting opportunities for special status birds during all phases and create a benefit during all phases Selenium risk to desert pupfish based directly on the sediment concentrations would generally be moderate and less than under Existing Conditions because there would be less habitat in high selenium areas for this species under this alternative. Risks to desert pupfish through the sediment pathway would be greater than under the No Action Alternative. Selenium risk to special status bird species based directly on the sediment concentrations would be moderate and slightly less than under Existing Conditions and under the No Action Alternative. For black skimmer (and similar species), risk associated with the food web (diet) pathway would be moderate and less than under Existing Conditions, but greater than under the No Action Alternative (when fish would be absent from the Salton Sea). For western snowy plover, the moderate risk associated with the food web (diet) pathway would be similar to the level of risk under Existing Conditions and under the No Action Alternative.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		
Alternative 6	Existing Conditions	S	L	L	L	The impact of construction and operations and maintenance would be the same as Alternative 5 except that this alternative would maintain western snowy plover nesting habitat around much of the Marine Sea and Marine Sea Mixing Zone. Selenium risk to special status species would be similar to Alternative 5 based directly on sediment selenium concentrations and the food web (diet) pathway.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 7	Existing Conditions	S	L	L	L	The impact of construction and operations and maintenance would be the same as Alternative 6 except that the salinity of the Recreational Saltwater Lake and Saline Habitat Complex would be higher and might not support fish during Phase II. The IID water storage reservoir also could provide foraging opportunities for special status birds. Selenium risk to special status species would be similar to Alternative 5 based directly on sediment selenium concentrations and the food web (diet) pathway.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		
Alternative 8	Existing Conditions	S	L	L	L	The impact of construction, operations and maintenance would be the same as Alternative 6. Selenium risk to special status species would be similar to Alternative 5 based directly on sediment selenium concentrations and the food web (diet) pathway.	Same as Alternative 1.
	No Action Alternative	B	B	B	B		
Criterion: Substantial adverse effect on any riparian habitat, other sensitive natural community, or wetlands.							
No Action Alternative	Existing Conditions	S	O	O	O	Construction of Sedimentation/Distribution Basins along the margin of the Salton Sea and bordering the rivers and creeks would result in a reduction or loss of non-native riparian vegetation and wetlands in Phase I relative to Existing Conditions.	Implement measures to reduce losses of riparian vegetation and wetland values during construction and encourage development of native riparian vegetation and wetland values along channels that route water over the exposed Sea Bed to the Salton Sea.
	No Action Alternative	NA	NA	NA	NA		
Alternatives 1 and 2	Existing Conditions	S	O	O	O	Impacts associated with construction of the Sedimentation/Distribution Basins would be significant relative to Existing Conditions during Phase I and less than significant relative to the No Action Alternative.	Implement measures to reduce losses of riparian vegetation during construction and encourage development of native riparian vegetation and wetland values along channels that route water over the exposed Sea Bed to the Brine Sink.
	No Action Alternative	L	L	L	L		
Alternatives 3, 5, and 8	Existing Conditions	S	O	O	O	Same as Alternative 1, but impacts would be less relative to No Action Alternative because only two basins would be built.	Same as Alternative 1.
	No Action Alternative	L	L	L	L		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 4	Existing Conditions	S	S	S	S	Same as Alternative 3; however, impacts on riparian vegetation would remain significant relative to Existing Conditions in subsequent phases because water routed to the Brine Sink would be piped rather than contained in open channels where riparian vegetation and wetland values could become established.	Implement measures to reduce losses of riparian vegetation and wetland values during construction.
	No Action Alternative	L	L	L	L		
Alternatives 6 and 7	Existing Conditions	S	O	O	O	Same as Alternative 1, but impacts would be less relative to No Action Alternative because only one basin would be built.	Same as Alternative 1.
	No Action Alternative	L	L	L	L		
Criterion: Interfere substantially with the movement of any resident or migratory fish or wildlife species.							
No Action Alternative	Existing Conditions	S	S	S	S	Construction of the Pupfish Channels in Phase II would provide for continued connectivity for desert pupfish, although the level of connectivity would be significantly reduced relative to Existing Conditions. Desert Pupfish using drains along the northern shoreline of the Salton Sea would be divided by the Whitewater River and desert pupfish along the southern shoreline would be divided by the New and Alamo rivers. These segments would be isolated from one another and from desert pupfish using San Felipe and Salt creeks.	Develop genetic exchange program for desert pupfish.
	No Action Alternative	NA	NA	NA	NA		
Alternative 1	Existing Conditions	S	S	S	S	The effects would be similar to those described for the No Action Alternative, except the Pupfish Channels would be constructed in Phase I instead of Phase II.	Same as the No Action Alternative.
	No Action Alternative	S	O	O	O		
Alternative 2	Existing Conditions	S	S	S	S	The effects would be similar to those described for the Alternative 1, except that connectivity would be achieved through Shoreline Waterways instead of Pupfish Channels.	Same as the No Action Alternative.
	No Action Alternative	S	O	O	O		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 3	Existing Conditions	S	O	O	O	Harbor, if necessary, and Perimeter Dike construction as well as operations and maintenance during Phase I could interfere with movement of desert pupfish along the shoreline and result in significant impacts relative to both Existing Conditions and the No Action Alternative. Upon completion, the First Ring would provide connectivity for all desert pupfish populations and provide a benefit relative to the No Action Alternative in subsequent phases. However, the circulation pumps could limit local movement in the vicinity of the pumps.	During project-level analyses, evaluate methods to eliminate pumping plant in First Ring.
	No Action Alternative	S	B	B	B		
Alternative 4	Existing Conditions	S	S	S	S	The effects would be similar, but not identical, to those described for Alternative 3.	Same as the No Action Alternative.
	No Action Alternative	S	B	B	B		
Alternative 5	Existing Conditions	S	S	S	S	Desert pupfish movement would be accommodated by the Marine Sea, which would connect the drains along the northern shoreline and Salt Creek. The drains on the southern shoreline and San Felipe Creek would be connected by the Shoreline Waterway in three segments as described for Alternative 2. Impacts relative to Existing Conditions would be significant in all phases; impacts would be beneficial relative to the No Action Alternative in Phases II – IV.	Same as the No Action Alternative.
	No Action Alternative	S	B	B	B		
Alternative 6	Existing Conditions	S	S	S	S	All desert pupfish populations would be connected except those along the southeastern shoreline north of the Alamo River that would be connected by a Pupfish Channel. Impacts relative to Existing Conditions would be significant in all phases; impacts would be beneficial relative to the No Action Alternative in Phases II – IV.	Same as the No Action Alternative.
	No Action Alternative	S	B	B	B		
Alternative 7	Existing Conditions	S	S	S	S	The effects on desert pupfish movement would be similar to those described for Alternative 6., except that drains south of Salt Creek and northeast of the Alamo River would flow directly into Saline Habitat Complex instead of a Pupfish Channel.	Same as the No Action Alternative.
	No Action Alternative	S	B	B	B		

Table 8-4
Summary of Benefit and Impact Assessments to Biological Resources

Alternative	Basis of Comparison	Changes by Phase				Comments	Next Steps
		I	II	III	IV		
Alternative 8	Existing Conditions	S	S	S	S	The Marine Sea would allow desert pupfish to move around the perimeter except along the eastern shoreline. Desert pupfish using Salt Creek would become isolated from the other populations. Impacts relative to Existing Conditions would be significant in all phases; impacts would be beneficial relative to the No Action Alternative in Phases II – IV.	Same as the No Action Alternative.
	No Action Alternative	S	B	B	B		

Legend for Types of Benefits or Impacts in Each Phase:
S = Significant Impact
O = No Impact
L = Less Than Significant
B = Beneficial Impact
NA = Not Analyzed

Table 8-5
Salton Sea Changes Under the No Action Alternative-CEQA Conditions

End of Phase	Salinity (mg/L)	Surface Elevation (feet msl)	Surface Area (acres)
Existing Conditions	48,000	-228	230,000
Phase I (2020)	65,000	-236	217,000
Phase II (2030)	103,000	-246	186,000
Phase III (2040)	129,000	-248	172,000
Phase IV (2078)	138,000	-248	172,000

Table 8-6
Salton Sea Changes Under the No Action Alternative-Variability Conditions

End of Phase	Salinity (mg/L)	Surface Elevation (feet msl)	Surface Area (Acres)
Existing Conditions	48,000	-228	230,000
Phase I (2020)	76,000	-240	208,000
Phase II (2030)	164,000	-254	159,000
Phase III (2040)	249,000	-259	143,000
Phase IV (2078)	308,000	-260	140,000

The amount of open water and shoreline habitat would gradually decrease in Phase I. Water temperatures and dissolved oxygen levels would remain about the same as under Existing Conditions. The Sedimentation/Distribution Basins and Air Quality Management Canal would be constructed, thereby altering existing habitats. Operation of the Sedimentation/Distribution Basins and Air Quality Management canal would reduce the amount of water and sediment entering the river deltas, thus reducing their size as the Salton Sea recedes. By the end of Phase I, water level would have dropped below the level of rocky habitat, and Mullet Island and other islands and snags would no longer be surrounded by water. Air Quality Management activities on the exposed Sea Bed would begin. This would alter the habitat as described under common impacts.

As the surface of the Salton Sea recedes, the agricultural drains that support desert pupfish would continue to flow across the exposed Sea Bed to the Salton Sea. Under the terms of the IID Water Conservation and Transfer Project, IID would manage these channels to support desert pupfish and would provide connection of the channels once conditions in the Salton Sea became unsuitable for desert pupfish. This would provide connectivity among drains along the southern shoreline and connectivity of drains along the northern shoreline. At both locations, desert pupfish would not be able to pass into the river channels of the New, Alamo, and Whitewater rivers.

The amounts of open water and shoreline habitat would decrease more rapidly during Phase I. Stratification with periodic mixing events that bring anoxic water to the surface would continue but the frequency and intensity of such events would change slightly as water depth decreases. Air Quality Management activities and their effects on habitat would continue to expand over the exposed Sea Bed.

The only construction activities during Phases III and IV would be continued expansion of the Air Quality Management facilities. Maintenance of the Pupfish Channels and Air Quality Management facilities would continue. The surface elevation would continue to decrease while salinity would continue to increase into Phase IV, and then both would become nearly stable. Small deltas at the confluence of the river outflows would continue to be present. The reduced water depth would facilitate more frequent mixing to the bottom which would further reduce the magnitude of anoxic events.

Effects on Fish and Wildlife

The biota of the Salton Sea would undergo drastic changes during Phase I and II, with additional changes in the succeeding phases. As the surface elevation falls, important roosting and nesting areas would be lost. With increased salinity, the aquatic food web would shorten with the loss of top predators and prey species, and bird populations dependent on an aquatic food base, particularly fish, would decline. The food web would continue to shift toward a simpler and shorter system in response to increasing salinity.

Invertebrates

As the salinity of Salton Sea increases, the invertebrate community would change and simplify. The pileworm, which has been a primary component of the Salton Sea food chain, provides food for several fish and bird species. Reproduction of pileworms is substantially reduced when the salinity reaches about 50,000 mg/L. Another dominant invertebrate, a rotifer, would not be able to complete its life cycle at 48,000 mg/L. As the abundance of these species is reduced, the benthic invertebrate community would become dominated by amphipods, such as *Gammarus*. As the salinity thresholds of these invertebrates are exceeded, the abundance of more salt tolerant species would increase. These species likely would increasingly dominate the invertebrate community as the salinity of the Salton Sea increases. However, the health and persistence of this future invertebrate community would continue to be adversely influenced by complications resulting from eutrophication.

Rocky shoreline habitats also provide valuable refugia for invertebrates during periods when hypoxic or anoxic conditions persist in the Salton Sea (Detwiler et al., 2002). The rocky substrates have a high invertebrate (pileworm and amphipod) production rate through summer (Detwiler et al., 2002). In addition to salinity effects on invertebrate populations, the decline in surface elevation would likely expose the rocky shoreline habitats that are important for invertebrates such as barnacles and copepods.

Some of the microorganisms in the Salton Sea, such as cyanobacteria, produce toxins that can impair other organisms (Wood et al., 2002). Through 2020, populations of several species of toxin producing algae could increase. Sulfate reducing bacteria would likely persist in the sediments and anoxic water within and near the bottom (porewater) until the salinity exceeded their tolerances.

The salinity level under the No Action Alternative-Variability Conditions in Phase IV would be at the upper tolerance limit for invertebrates and, therefore, would not provide forage for some bird species, especially wading birds and shorebirds. Brine flies and brine shrimp would likely be present in 2078 under the No Action Alternative-CEQA Conditions and through a portion of Phase III under the No Action Alternative-Variability Conditions. It is likely that bacteria and some algae would survive in the Salton Sea through 2078.

Fish

Tilapia tolerate high salinity levels, particularly if the increase in salinity is gradual (Phillipart and Ruwet, 1982). Costa-Pierce and Riedel (2000) suggested that tilapia in the Salton Sea could acclimate to and reproduce at a salinity level of 60,000 mg/L. As evidenced by the apparent recent loss of the three marine sportfish species, factors other than salinity alone might hasten the inability of tilapia to inhabit the Salton Sea. Although reduced in number, tilapia continue to be the most abundant fish species in the Salton Sea and serve as the primary forage species for piscivorous (fish-eating) birds at the Salton Sea. Under the No Action Alternative, the abundance of tilapia would decline substantially as a result of increased salinity and the synergistic effects of eutrophication. Despite their eventual inability to survive in the Salton Sea proper, tilapia likely would continue to persist at the Salton Sea in lower salinity areas around the deltas and potentially near drain outlets. Although tilapia could persist in some areas, the total population supported in the Salton Sea would be reduced substantially relative to Existing Conditions.

When salinity reaches about 60,000 mg/L in Phase I, no tilapia would be expected to be present in open waters of the Salton Sea. Some fish could persist in areas where drain and river water not used for Air Quality Management enters the Salton Sea, resulting in small areas with lower salinity. The length of time that fish would persist in these areas would depend on the size of the areas and the extent to which they retain salinity at levels that could support fish. Freshwater fish would continue to inhabit the drains, Pupfish Channels, and Sedimentation/Distribution Basins.

Currently, sailfin mollies and desert pupfish can move easily to and from the drains into the Salton Sea. The reduction of larger, predatory fish in the Salton Sea could explain the recent presence of sailfin mollies and desert pupfish in near shore sampling conducted by DFG (DFG, 2005). If the present trend were to continue, sailfin molly and desert pupfish populations in the Salton Sea could increase until the salinity and other water quality factors reach the tolerance for their survival. Connection of drains that support desert pupfish would be provided as described above, but the level of connection could result in separation of the desert pupfish population at the Salton Sea into up to seven isolated units. In the absence of these connections, desert pupfish in each of the individual drains would become isolated.

Birds

The decline and ultimate loss of open water fish populations would reduce and possibly eliminate use of the Salton Sea by fish-eating birds such as pelicans, double-crested cormorants, and black skimmers by the end of Phase I or in early Phase II. Some of these birds, however, might use the Sedimentation/Distribution Basins and areas where fresher water flows into the Salton Sea, if fish continue to persist in these locations. Increased salinity alone, however, would not necessarily result in a substantial decline in bird diversity or abundance at the Salton Sea, although the water quality conditions are unlikely to support the stable invertebrate populations found at other saline lakes (e.g., Mono Lake) and some decrease in bird use would be likely. The relative abundance of bird species that forage on invertebrates likely would change over time with increases in salinity and resultant changes in the invertebrate community.

Many bird species use snags distributed around the Salton Sea for roosting and nesting. These habitat features would disappear in Phase I as the Salton Sea recedes and as the snags break and collapse due to degradation by wind, brine, and time. The loss of snags could limit nesting opportunities for several species of colonial nesting birds, including herons and egrets. Loss of nesting or communal roosting areas (snags and islands) for special status birds would be a significant impact.

As the Salton Sea recedes in future years, the distance between the shoreline and the freshwater wetlands (refuges and duck clubs) and agricultural lands adjacent to the present Salton Sea would increase, possibly changing the level of use at the Salton Sea. Air Quality Management activities would increase human presence in areas where vegetation is planted and maintained. This could disturb shorebirds adjacent to the work areas. Use of equipment for Air Quality Management could startle birds using the shoreline and open water, resulting in stress and expenditure of energy.

Selenium Risk

The No Action Alternative-CEQA Conditions and No Action Alternative-Variability Conditions would present similar overall risk (HI = 0.7 and 0.8, respectively) of adverse effects due to selenium, based on the Ecological Risk Assessment (Table 8-7). On an area-weighted basis, the No Action Alternative presents a level of risk associated with selenium similar to that under Existing Conditions (HI = 0.8). This similarity is partly because fish would be absent under the No Action Alternative, except in estuaries (with absence of fish being unrelated to the risk posed by selenium), thus there would be very little selenium related risk to fish or fish-eating birds. The comparison of the overall risk ranking between alternatives on the basis of selenium risk does not take into account the changes in species composition, diversity, or abundance that would result from the substantial increases in salinity.

Effects on Special Status Species

Construction and operations and maintenance of the Sedimentation/Distribution Basins, Pupfish Channels, and Air Quality Management facilities all have the potential to adversely affect special status species, depending on the timing and location of the activities. During Phase I, construction of the Sedimentation/Distribution Basins could adversely affect roosting, foraging, and nesting of colonial nesting birds at the rivers, as well as desert pupfish movement along the shoreline. Impacts on special status bird species from construction and operations and maintenance of the Sedimentation/Distribution Basins would be significant.

Pupfish Channel construction activities could result in mortality of desert pupfish during connection of the drains to the channels (Phase II). Extension of the drains and construction of five Pupfish Channels would provide connectivity of desert pupfish populations within the affected drains (a benefit) but not between those groups of drains or San Felipe Creek and Salt Creek populations. Drain extension and construction of the Pupfish Channels would have significant impacts to desert pupfish. Activities needed to maintain the Pupfish Channels would result in significant impacts.

As the water recedes, the beach habitat used by western snowy plovers for nesting would move and its characteristics could change as Sea Bed sediments are exposed. In addition, Air Quality Management activities would be implemented on emissive soils to the water edge. The changes in "beach" sediment characteristics and Air Quality Management activities could affect western snowy plover nesting. Construction of the Air Quality Management canal could disrupt breeding western snowy plovers (Phase I), and Air Quality Management activities could permanently remove breeding habitat along the receding Salton Sea (Phases II-IV). Impacts of these activities would be significant.

By the end of Phase I, the Salton Sea would no longer provide sufficient prey species (fish) to support the current American white pelican population, essentially eliminating one of their most important wintering and stopover destinations. Some American white pelicans and double-crested cormorants would likely continue to forage in the shallow estuarine areas, but the limited availability of forage fish likely would not support historic population levels. This impact would be significant.

Based on the Ecological Risk Assessment, selenium risk to desert pupfish based directly on the sediment concentrations would be less than under Existing Conditions (Table 8-8) because their use under this alternative would be limited to estuary areas where salinity would remain suitable. The selenium risk to special status bird species based directly on sediment selenium concentrations (HI = 2.5 and 2.6 for CEQA and Variability Conditions, respectively, [see Table 8-8]) would be slightly lower than under Existing Conditions (HI = 2.9). The risk associated with the food web (diet) pathway for black skimmer (and similar fish-eating birds represented by black skimmer) would be moderate, and less than under Existing Conditions because the habitat for their prey (fish) would be found only in the lower-salinity estuaries. For western snowy plover, the risk associated with the food web (diet) pathway (HI = 3.2 and 4.0 for CEQA and Variability Conditions, respectively; Table 8-8) would be less than under Existing Conditions (HI = 4.4), and would be considered moderate.

Table 8-7
Summary of Selenium Risk (Hazard Quotient [HQ]) based on High Toxicity Reference Values (from Appendix F)

	Fish Sediment	Fish Diet	Birds Sediment	Black-Necked Stilt	Eared Grebe	Mallard	Black Skimmer	Snowy Plover	Avg. HQ	Acres of Habitat	Proportion of Area	Area-Weighted Avg. HQ
Existing Conditions												
Salton Sea Open Water	0.7	0.6	0.7		0.2		1.9		0.77	233,044	0.98	0.8
Salton Sea Shoreline	0.4	2.3	0.4	0.9	0.8	0.4	1.3	2.2	1.14	5,461	0.02	0.0
Estuary Alamo	0.2	2.6	0.2	0.9	0.9	0.4	2.3		1.14	167	0.00	0.0
Estuary New	0.1	0.8	0.1	0.4	0.3	0.1	2		0.52	167	0.00	0.0
Estuary Whitewater	0.5	1.3	0.5	0.7	0.7	0.3	0.8		0.73	167	0.00	0.0
Total (acres and Hazard Index)										239,006		**0.8**
No Action Alternative-CEQA Conditions												
Salton Sea Open Water			0.6	0.8	0.8				0.73	165,910	0.94	0.7
Salton Sea Shoreline			0.4	0.6	0.6	0.3		1.7	0.72	9,702	0.06	0.0
Estuary Alamo	0.1	0.4	0.1	0.2	0.2	0.3	0.2	0.4	0.24	247	0.00	0.0
Estuary New	0.2	0.7	0.2	0.3	0.3	0.1	0.5	0.7	0.39	170	0.00	0.0
Estuary Whitewater	0.6	2.5	0.6	0.8	0.9	0.4	2.1	2.5	1.35	38	0.00	0.0
Total (acres and Hazard Index)										176,067		**0.7**
No Action Alternative-Variability Conditions												
Salton Sea Open Water			0.7	0.9	0.9				0.83	127,437	0.92	0.8
Salton Sea Shoreline			0.5	0.7	0.7	0.3		2	0.84	10,617	0.08	0.1
Estuary Alamo	0.1	0.5	0.1	0.3	0.2	0.1	0.3	0.4	0.26	276	0.00	0.0
Estuary New	0.2	0.97	0.2	0.4	0.3	0.2	0.7	0.9	0.50	146	0.00	0.0
Estuary Whitewater	1.1	4.1	1.1	1.2	1.4	0.6	3.5	4.1	2.23	45	0.00	0.0
Total (acres and Hazard Index)										138,521		**0.8**
Alternative 1												
Brine Sink			0.7	0.8				2.5	1.33	5,959	0.13	0.2
Saline Habitat Complex - South (drains)	0.3	1.2	0.3	0.5	0.4	0.2	0.9	1.2	0.65	7,781	0.17	0.1

Table 8-7
Summary of Selenium Risk (Hazard Quotient [HQ]) based on High Toxicity Reference Values (from Appendix F)

	Fish Sediment	Fish Diet	Birds Sediment	Black-Necked Stilt	Eared Grebe	Mallard	Black Skimmer	Snowy Plover	Avg. HQ	Acres of Habitat	Proportion of Area	Area-Weighted Avg. HQ
Saline Habitat Complex - South (rivers)	0.2	1.04	0.2	0.4	0.4	0.2	0.7	0.99	0.54	32,113	0.70	0.4
Total (acres and Hazard Index)										45,853		0.7
Alternative 2												
Brine Sink			0.8	0.98				3.1	1.63	34,568	0.31	0.5
Saline Habitat Complex - North	0.6	2.5	0.6	0.8	0.9	0.4	2	2.5	1.34	11,108	0.10	0.1
Saline Habitat Complex - South	0.2	1.1	0.2	0.4	0.4	0.2	0.8	1.1	0.57	55,059	0.50	0.3
Saline Habitat Complex - West	0.4	1.7	0.4	0.6	0.6	0.3	1.3	1.6	0.90	9,585	0.09	0.1
Total (acres and Hazard Index)										110,320		1.0
Alternative 3												
Brine Sink			0.9	1.1				3.4	1.80	2,850	0.04	0.1
First Ring	0.4	1.7	0.4	0.6	0.6	0.3	1.3	1.7	0.91	25,426	0.40	0.4
Second Ring	0.4	1.8	0.4	0.6	0.6	0.3	1.4	1.8	0.95	36,042	0.56	0.5
Total (acres and Hazard Index)										64,318		1.0
Alternative 4												
Brine Sink			1.4	1.5				5.3	2.73	1,113	0.02	0.0
First Lake	0.4	1.7	0.4	0.6	0.6	0.3	1.3	1.7	0.91	5,615	0.08	0.1
Second Lake	0.3	1.5	0.3	0.5	0.5	0.2	1.1	1.4	0.76	22,046	0.31	0.2
Third Lake	0.5	2.1	0.5	0.7	0.7	0.3	1.7	2.1	1.12	20,099	0.28	0.3
Fourth Lake	0.6	2.5	0.6	0.8	0.9	0.4	2.1	2.5	1.35	22,259	0.31	0.4
Total (acres and Hazard Index)										71,132		1.1
Alternative 5												
Brine Sink			0.96	1.1				3.6	1.89	526	0.01	0.0
Marine Sea	0.98	3.7	0.98	1.1	1.3	0.6	3.2	3.7	2.02	13,322	0.22	0.5

Table 8-7
Summary of Selenium Risk (Hazard Quotient [HQ]) based on High Toxicity Reference Values (from Appendix F)

	Fish Sediment	Fish Diet	Birds Sediment	Black-Necked Stilt	Eared Grebe	Mallard	Black Skimmer	Snowy Plover	Avg. HQ	Acres of Habitat	Proportion of Area	Area-Weighted Avg. HQ
Saline Habitat Complex	0.3	1.1	0.5	0.5	0.4	0.2	0.8	1.1	0.63	45,844	0.77	0.5
Total (acres and Hazard Index)										59,692		1.0
Alternative 6												
Brine Sink			1.2	1.3				4.6	2.37	530	0.01	0.0
Marine Sea	0.8	3	0.8	0.9	1.02	0.5	2.5	3	1.63	12,960	0.31	0.5
Saline Habitat Complex	0.2	1.1	0.2	0.4	0.4	0.2	0.8	1.005	0.56	28,036	0.68	0.4
Total (acres and Hazard Index)										41,526		0.9
Alternative 7												
Brine Sink			0.7	0.9				2.9	1.50	626	0.02	0.0
Marine Sea	0.8	3.1	0.8	0.97	1.1	0.5	2.6	3.1	1.69	12,427	0.34	0.6
Saline Habitat Complex - East	0.1	0.7	0.1	0.3	0.2	0.1	0.5	0.7	0.35	10,726	0.30	0.1
Saline Habitat Complex - North	0.5	2	0.5	0.7	0.7	0.3	1.6	2	1.08	1,681	0.05	0.1
IID Freshwater Res	0.1	0.7	0.1	0.3		0.1	0.5		0.33	10,830	0.30	0.1
Total (acres and Hazard Index)										36,290		0.9
Alternative 8												
Brine Sink			0.9	1.1				3.5	1.83	2,587	0.08	0.1
Marine Sea	0.4	1.5	0.4	0.6	0.5	0.2	1.1	1.4	0.80	14,724	0.44	0.4
Saline Habitat Complex	0.5	1.9	0.5	0.7	0.6	0.3	1.5	1.8	1.02	16,242	0.48	0.5
Total (acres and Hazard Index)										33,553		1.0

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Although the specific locations of the Sedimentation/Distribution Basins have not yet been identified, it is likely that they would be located partially within riparian areas along the rivers. The lands along the margin of the Salton Sea that could be affected by construction activities or operations and maintenance of Air Quality Management facilities are dominated by non-native vegetation. Non-native vegetation also borders the rivers, creeks, and agricultural drains that discharge to the Salton Sea. This riparian vegetation (composed primarily of common reed and tamarisk) along the rivers does not represent a natural vegetation community; however, it does provide habitat value to the wildlife using the area, particularly nesting and roosting birds. Construction in these areas would result in a reduction or loss of riparian vegetation, which would be a significant impact in Phase I. Assuming similar riparian vegetation becomes established along the channels that route river water over the exposed Sea Bed to the Salton Sea after Phase I, the lost riparian values would be restored in subsequent phases.

Table 8-8
Summary of Selenium Risk as Area-Weighted Hazard Index (HI) and Risk Categories based on Low Toxicity Reference Values (from Appendix F)

Alternative	Sediment				Diet			
	Pupfish		Birds		Black Skimmer		Snowy Plover	
	HI	Risk	HI	Risk	HI	Risk	HI	Risk
Existing Conditions	2.9	Moderate	2.9	2.9 (moderate)	3.9	Moderate	4.4	Moderate
No Action Alternative-CEQA Conditions	0.6	Low	2.5	Moderate	1.0	Low	3.2	moderate
No Action Alternative-Variability Conditions	0.9	Low	2.6	Moderate	1.5	Moderate	4.0	Moderate
Alternative 1	0.9	Low	1.2	Moderate	1.6	Moderate	2.4	Moderate
Alternative 2	1.3	Moderate	1.9	Moderate	2.1	Moderate	3.8	Moderate
Alternative 3	1.8	Moderate	1.8	Moderate	2.8	Moderate	3.6	Moderate
Alternative 4	2.0	Moderate	2.1	Moderate	3.2	Moderate	4.0	Moderate
Alternative 5	1.7	Moderate	1.7	Moderate	2.7	Moderate	3.4	Moderate
Alternative 6	1.6	Moderate	1.6	Moderate	2.6	Moderate	3.3	Moderate
Alternative 7	1.6	Moderate	1.6	Moderate	2.5	Moderate	2.8	Moderate
Alternative 8	1.6	Moderate	1.8	Moderate	2.6	Moderate	3.5	Moderate

Wetlands associated with river mouths also could be removed or adversely affected by construction of the Sedimentation/Distribution Basins, resulting in a significant impact. The loss of wetlands at the rivers would occur in Phase I.

Effects on Fish and Wildlife Movement

Impacts of construction on desert pupfish movement could be significant in Phase I because the construction of the Sedimentation/Distribution Basins could interfere with movement of desert pupfish along the shoreline. In Phase II, salinity in the Salton Sea would increase to levels that would prevent use of the Salton Sea by desert pupfish and movement among the tributary drains and creeks. The Pupfish Channels constructed in Phase II would provide for movement between the agricultural drains, but the level of connectivity would be reduced relative to Existing Conditions. The drains on the southern shoreline would be connected in three areas: the shoreline north of the Alamo River, the shoreline between the New and Alamo rivers, and the shoreline west and north of the New River. A Pupfish Channel also would connect the desert pupfish using drains along the northern shoreline of the Salton Sea. This Pupfish Channel would be divided by the Whitewater River. Isolation of these populations, including those at San Felipe and Salt creeks, would significantly impact movement of desert pupfish relative to Existing Conditions.

Alternative 1 – Saline Habitat Complex I

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins, Air Quality Management, Pupfish Channels, Saline Habitat Complex, and Brine Sink.

All water facilities, roads, Berms, and other structures would need to be maintained on a regular basis. Habitats provided under Alternative 1 are summarized in Table 8-9. The descriptions of Saline Habitat Complex in this chapter refer to “wet” and “total” areas that represent the open water and the combination of open water and Berms/island areas, respectively.

Table 8-9
Summary of Habitats/Components for Alternative 1 – Saline Habitat Complex I

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Pupfish Channels (number)	5	Same as Phase I	Same as Phase I	Same as Phase I
Saline Habitat Complex	6,000 acres (total) 2,000 acres (wet)	38,000 acres (total) 26,000 acres (wet)	Same as Phase II	Same as Phase II
Sedimentation/Distribution Basins	3 Basins 200 acres each	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	207,000 acres 78,000 mg/L	149,000 acres 210,000 mg/L	127,000 acres >350,000 mg/L	123,000 acres >350,000 mg/L
Exposed Sea Bed	30,000 acres	57,000 acres	72,000 acres	77,000 acres

Effects of Implementation on Fish and Wildlife

Under Alternative 1, a total of 38,000 acres (26,000 acres wet) of Saline Habitat Complex would be constructed. The cells with salinities less than about 60,000 mg/L would be expected to provide habitat for fish and invertebrates, while cells with higher salinities (but less than about 200,000 mg/L) would support only invertebrates. All of these cells would provide forage for a variety of birds. The increase in shoreline associated with the cell containment Berms and other habitat features would provide shorebird habitat where slopes are gradual. The value of the cells would be enhanced by construction of islands and structure to support roosting, loafing, and nesting habitat protected from mammalian predators.

The lower salinity Saline Habitat Complex cells would provide habitat and suitable water quality conditions for tilapia and possibly other forage fish. However, because of the highly eutrophic nature of these cells and the relatively low volume of flow-through, frequent periods of low dissolved oxygen that would occur when the photosynthetic activity of algae ceases at night could limit the fish species that could be supported. Although tilapia are very tolerant of low oxygen conditions, these periodic conditions could result in occasional fish kills. It is unlikely that the constructed habitat would provide the conditions necessary to support the recreational sport fish species that were historically supported in the Salton Sea. If future nutrient (primarily phosphorus) loads are reduced, the magnitude and frequency of periods of low dissolved oxygen levels would likely decrease.

Under Alternative 1, the Brine Sink would rapidly increase in salinity and become incapable of supporting fish by the end of Phase I. During this period, the Brine Sink would continue to stratify and develop anoxic conditions near the bottom with high levels of hydrogen sulfide and ammonia as found under existing conditions. Periodic mixing events, caused primarily by wind, that release hydrogen sulfide into the water column would continue to result in adverse effects on aquatic life (primarily invertebrates) as under the No Action Alternative in Phase I and as long as the Brine Sink supports aquatic life. The Saline Habitat Complex would be frequently mixed because of the shallow depths, and stratification and development of an anoxic layer near the bottom would not be expected.

Based on the results of the modeling of potential bird use (Appendix C), construction of Saline Habitat Complex cells would partially offset the loss of avian habitat anticipated under the No Action Alternative. Table 8-10 presents the change in habitat capacity relative to Existing Conditions and the No Action Alternative for Alternative 1 in 2078. Results are presented as numeric index values from -4 to +5 representing "quartiles" of change from a 75 to 100 percent decrease (-4) to a greater than 100 percent increase (+5) by 25 percent increments. Seasonal values for habitat capacity were combined into an average value across all seasons for comparison (Appendix H-1).

Table 8-10
Change in Projected Habitat Capacity (2078) under Alternative 1 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	3	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	-2	5[a]
American Avocet	-1	5[a]
Black-necked Stilt	5	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	1	5[a]
American White Pelican	-3	5[a]
Double-crested Cormorant	2	5[a]
Dowitcher spp.[c]	5	5[a]
Dunlin	2	5[a]
Snowy Plover	-2	5[a]
Western Sandpiper	5	5[a]
Western Snowy Egret	-1	5[a]

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of "5" was used to reflect the large benefit of restoration.
[b] Includes both western grebes and Clark's grebes, which were not differentiated in the field.
[c] Includes both long-billed and short-billed dowitchers.

For most of the evaluated bird species, construction of 38,000 acres of Saline Habitat Complex (26,000 acres wet) would increase habitat capacity relative to Existing Conditions (positive index values). The exceptions would be American avocet and snowy egret, where habitat capacity could decline slightly (0 to 25 percent), and ruddy duck, American white pelican, and western snowy plover, where habitat capacity could decline by up to 75 percent relative to Existing Conditions. Habitat capacity for eared grebe, black-necked stilt, long-billed curlew, dowitcher, and western sandpiper could increase by more than 100 percent.

The evaluation of selenium risk suggests that overall risks to fish and birds associated with Alternative 1 would be similar to those under Existing Conditions and the No Action Alternative. The area-weighted Hazard Index (HI) for Alternative 1 was 0.7, suggesting that selenium would be below the threshold for population-level effects in Phase IV (see Table 8-7). Therefore, overall risks due to selenium under this alternative would be considered low.

Overall, Alternative 1 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases. The Brine Sink would also provide habitat for invertebrates and birds until salinity passes the threshold for invertebrate survival during Phase II.

Effects on Special Status Species

The impacts of construction and operations and maintenance of the Sedimentation/Distribution Basins, Pupfish Channels, and Air Quality Management facilities in Alternative 1 would be essentially the same as those described for the No Action Alternative. Pupfish Channel construction activities, however, would occur in Phase I rather than Phase II. Construction of the Saline Habitat Complex would have the potential to adversely affect special status species if the noise and disturbance associated with construction activities interfered with nesting activities, especially near the river deltas. The level of potential impact would depend on the timing and location of the activities.

Alternative 1 would result in several impacts to biological resources that are not specifically related to the facilities or time phases for construction and operations and maintenance. These include potential loss of western snowy plover nesting habitat on the beach, loss of snag habitat, and loss of connectivity for desert pupfish populations except in the groups of drains connected by Pupfish Channels.

As the water recedes, snags used by birds along the northern shoreline would no longer be surrounded by water, making them less suitable for bird roosting and nesting. As the water recedes, the beach habitat used by western snowy plovers for nesting would move and its characteristics could change as Sea Bed sediments are exposed. In addition, Air Quality Management activities would be implemented in emissive soils to the Brine Sink. The changes in “beach” sediment characteristics and Air Quality Management activities could affect western snowy plover nesting. Construction of the Air Quality Management Canal could disrupt breeding western snowy plovers (Phase I), and the receding Brine Sink with Air Quality Management activities could permanently remove breeding habitat (Phases II-IV).

Snags and islands along the southern shoreline above elevation -230 feet msl would become less suitable for nesting and roosting special status birds as the water recedes. Nesting and roosting by special status birds in existing or newly constructed habitats adjacent to construction activities for the Saline Habitat Complex could be affected by those construction activities in Phases I and II. Loss of snag habitat in the northern part of the Salton Sea in Phases I or II would be a significant impact similar to that under the No Action Alternative. The temporary loss of islands and snags along the southern shoreline also would be a significant impact. Construction of the Saline Habitat Complex could have significant impacts on special status birds during Phases I and II if the noise and disturbance associated with the construction interfered with nesting activities. This habitat could isolate desert pupfish entering the cells from the Pupfish Channels. Once completed and colonized by aquatic organisms, the Saline Habitat Complex would provide foraging, roosting, and breeding habitat for special status birds (Phases II-IV), a benefit. Operations and maintenance activities, disturbance caused by dredging, human presence, and noise from equipment could result in periodic disturbance to the habitats and special status species.

Construction of the Pupfish Channel would require physical connection of the channel to the individual drains. Work activities in the drains supporting desert pupfish could result in the death or physical injury of desert pupfish at those locations. Therefore, constructing the Pupfish Channels would have the potential for significant impacts to desert pupfish. Upon completion, connectivity would be provided for desert pupfish within five groups of drains but not between these groups of drains or for San Felipe Creek and Salt Creek populations. Impacts of maintenance dredging on desert pupfish also would have the potential to be significant similar to the No Action Alternative. Temporary pumping of water from the Brine Sink to mix with the low salinity water from the drains and rivers to maintain salinity within the cells above 20,000 mg/L would have a low probability of affecting desert pupfish in the vicinity of the pump intake during Phase I. In addition to construction related impacts, desert pupfish could become established in portions of the Saline Habitat Complex. This use of the Saline Habitat Complex could increase the numbers of desert pupfish in the area; however, any populations established in the Saline Habitat Complex would be isolated from the populations in the drains.

The evaluation of selenium risk suggests that risks to desert pupfish based directly on the sediment concentrations would be low and less than under Existing Conditions (see Table 8-8) because high salinity would prevent their use of the Brine Sink under this alternative by 2078. Risks to desert pupfish through the sediment pathway would be comparable to risks under the No Action Alternative. Similarly, risks to special status bird species based directly on sediment selenium concentrations under Alternative 1 would be less than under Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway to special status species under Alternative 1 was 1.2, suggesting that selenium would be just above the predicted effect level in Phase IV. For black skimmer (and similar fish-eating birds represented by black skimmer), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 1.6). This risk would be less than under Existing Conditions (HI = 3.9), but slightly greater than under the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 2.4) would be lower than under Existing Conditions (HI = 4.4) and the No Action Alternative (HI = 3.2 and 4.0 for CEQA and Variability Conditions, respectively).

Effects on Riparian, Sensitive Natural Communities, and Wetlands

The effects of Alternative 1 on riparian, sensitive natural communities, and wetlands would be similar to the No Action Alternative.

Effects on Fish and Wildlife Movement

The effects of Alternative 1 on the movement of desert pupfish would be significant relative to Existing Conditions in all phases as described for the No Action Alternative. Under Alternative 1, the Pupfish Channels would be constructed in Phase I, which would preclude desert pupfish movement along the perimeter of the Brine Sink and result in the isolation of desert pupfish as described for the No Action Alternative. This impact, however, would occur in Phase I rather than Phase II. Therefore, the impact of Alternative 1 relative to the No Action Alternative would be significant in Phase I and the same as the No Action Alternative in the subsequent phases.

Alternative 2 – Saline Habitat Complex II

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins, Air Quality Management, Saline Habitat Complex, Shoreline Waterway, Saltwater Conveyance, and Brine Sink. Desert pupfish connectivity would be provided on the east and west sides of the Whitewater River, between San Felipe Creek and the New River, between the New and Alamo rivers, and northeast of the Alamo River. Salt Creek would remain isolated. All conveyance facilities, roads, Berms/dikes, and other structures would need to be maintained on a regular basis.

The Sedimentation/Distribution Basins and Air Quality Management locations would be similar to those described under the No Action Alternative. The Saline Habitat Complex would be similar to that described under Alternative 1. However, water would be retained in each cell for a shorter period of time, as described in Chapter 3. The Saline Habitat Complex in this alternative includes a Shoreline Waterway that blends and distributes water to the cells. The habitats provided in Alternative 2 are summarized in Table 8-11.

Table 8-11
Summary of Habitats/Components for Alternative 2

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Pupfish Channels	Not needed; connectivity achieved through Shoreline Waterway.			
Saline Habitat Complex	10,000 acres (total) 10,000 acres (wet)	61,000 acres (total) 42,000 acres (wet)	75,000 (total) 54,000 (wet)	Same as Phase III
Sedimentation/Distribution Basins	3 Basins 200 acres each	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	207,000 acres 78,000 mg/L	144,000 acres 249,000 mg/L	105,000 acres >350,000 mg/L	85,000 acres >350,000 mg/L
Exposed Sea Bed	30,000 acres	34,000 acres	63,000 acres	91,000 acres

Effects of Implementation on Fish and Wildlife

The effects of Alternative 2 would be similar to those of Alternative 1, except that more Saline Habitat Complex would be constructed. In addition, the residence time of the water in each of the cells would be shorter relative to Alternative 1 and the nutrient levels and productivity would be lower, which could reduce the magnitude of periods of low dissolved oxygen and the frequency of fish kills.

Based on the results of the modeling of potential bird use (Appendix C), construction of Saline Habitat Complex cells would offset the loss of habitat anticipated as the water recedes. Table 8-12 presents the change in habitat capacity relative to Existing Conditions and the No Action Alternative for Alternative 2 at the end point of restoration (2078). In general, construction of 75,000 acres of Saline Habitat Complex (54,000 acres wet) would benefit all of the evaluated bird species relative to Existing Conditions (positive index values). Increases in habitat capacity for most species would be expected to be greater than 100 percent relative to Existing Conditions. This would result primarily from the overall increase in available habitat and the broad range of salinity conditions that would promote habitat and bird diversity.

Table 8-12
Change in Projected Habitat Capacity (2078) under Alternative 2 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	5	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	2	5[a]
American Avocet	5	5[a]
Black-necked Stilt	5	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	5	5[a]
American White Pelican	1	5[a]
Double-crested Cormorant	5	5[a]
Dowitcher spp.[c]	5	5[a]
Dunlin	5	5[a]
Western Snowy Plover	4	5[a]
Western Sandpiper	5	5[a]
Snowy Egret	5	5[a]

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of "5" was used to reflect the large benefit of restoration.
[b] Includes both western grebes and Clark's grebes, which were not differentiated in the field.
[c] Includes both long-billed and short-billed dowitchers.

Selenium risks to fish and birds under Alternative 2 would be somewhat greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 2 was 1.0(see Table 8-7), suggesting that selenium would be at the predicted effect level in Phase IV. Therefore, overall risks due to selenium under this alternative would still be considered low for most birds.

Overall, Alternative 2 would benefit aquatic and avian resources relative to Existing Conditions in Phases II through IV and the No Action Alternative in all phases. The Brine Sink would also provide habitat for invertebrates and birds until salinity exceeded the threshold for invertebrate survival during Phase II. The Brine Sink would continue to stratify and develop anoxic conditions near the bottom that would produce hydrogen sulfide and ammonia as found under Existing Conditions. Periodic mixing events in the Brine Sink, caused primarily by wind, would continue to result in events that would kill fish (if present) and aquatic invertebrates in Phase I and as long as the Brine Sink supports aquatic life. The Saline Habitat Complex would function as described under Alternative 1.

Effects on Special Status Species

Impacts of construction and operations and maintenance of the Sedimentation/Distribution Basins and Air Quality Management facilities to special status species would be essentially the same as described under the No Action Alternative.

Impacts of constructing the Saline Habitat Complex would be similar to those described under Alternative 1, but over a larger area and longer duration.

Construction of the Berm for the Shoreline Waterway would intercept the drains, many of which could be occupied by desert pupfish. This construction activity has the potential to directly and adversely affect desert pupfish occupying drains at the construction sites. In addition, the constructed Berm would isolate desert pupfish downstream of the Berm location. Therefore, connection of the drains to the Shoreline Waterway could have significant impacts on desert pupfish. Once completed, the Shoreline Waterway would provide connectivity among pupfish using the drains and a benefit relative to the No Action Alternative.

Construction and operations and maintenance of the Air Quality Management Canal could disrupt breeding western snowy plovers as described under the No Action Alternative.

The evaluation of selenium risk suggests that selenium risk to desert pupfish based directly on the sediment concentrations would be moderate. This level of risk would be less than under Existing Conditions because they would not be found in the large area of Brine Sink under this alternative (see Table 8-8). This level of risk would be slightly greater than risks under the No Action Alternative. Similarly, risks to special status bird species based directly on sediment selenium concentration associated with Alternative 2 would be less than the risks under Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 2 was 1.9 for special status birds, suggesting a moderate risk in Phase IV. For black skimmer (and similar fish-eating birds), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 2.1). This level of risk would be less than the risk under Existing Conditions, but greater than the risks under the No Action Alternative, when fish would be largely absent (see Table 8-8). For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 3.8) would be slightly less than the level of risk under Existing Conditions under the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Effects would be the same as under the No Action Alternative.

Effects on Fish and Wildlife Movement

The effects of Alternative 2 on desert pupfish movement would be similar to those described for Alternative 1, except that Shoreline Waterway would provide a corridor for movement among drains rather than Pupfish Channels. In addition, desert pupfish might be able to move into the Saline Habitat Complex cells, but not back into the Shoreline Waterway or drains and creeks. Also, individual pupfish in San Felipe Creek could be conveyed to the Brine Sink during high flow conditions.

Alternative 3 – Concentric Rings

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins, Air Quality Management, First and Second rings, and Brine Sink.

The Brine Sink would decrease in size and increase in salinity through all phases. All water facilities, roads, dikes, and other structures would need to be maintained on a regular basis. Pupfish connectivity would be provided around the perimeter of the Salton Sea in the First Ring. Habitats provided in Alternative 3 are summarized in Table 8-13.

Table 8-13
Summary of Habitats/Components for Alternative 3

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Saline Habitat Complex	0	0	0	0
First Ring (20,000–30,000 mg/L salinity)	25,000 acres with Pumping plant	Same as Phase I	Same as Phase I	Same as Phase I
Second Ring (30,000–40,000 mg/L salinity)	Not Applicable	36,000 acres with Pumping plant	Same as Phase II	Same as Phase II
Sedimentation/Distribution Basins	2 Basins 200 acres each	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	166,000 acres 88,000 mg/L	115,000 acres >350,000 mg/L	68,000 acres >350,000 mg/L	68,000 acres >350,000 mg/L
Exposed Sea Bed	6,000 acres	65,000 acres	123,000 acres	127,000 acres

Effects of Implementation on Fish and Wildlife

Although relatively shallow, the First and Second rings could periodically develop anoxic conditions in the hypolimnion. Water circulation by the pumps would help minimize the development of anoxic conditions, especially near the pumps. Thus, much of the water column would provide suitable conditions for fish and invertebrates. These organisms would provide forage for a variety of bird species. The increase in shoreline associated with the First and Second rings would provide shorebird habitat where slopes are gradual and composed of fine grained material. Any remaining islands would continue to provide roosting, loafing, and nesting habitat protected from mammalian predators, but no new islands would be constructed. The lack of constructed islands and structures for roosting and nesting would diminish the overall value of the rings and likely would reduce their capacity to support birds.

The small amount of Saline Habitat Complex constructed as Early Start Habitat in Phase I under this alternative would provide habitat for tilapia and other forage fish species until completion of the First Ring. The First Ring constructed in Phase I would also support tilapia and forage fish and might also provide conditions suitable for introduction of marine sport fish species. The Second Ring constructed in Phase II would increase the amount of habitat for tilapia and potentially provide additional opportunities for introduction of marine sport fish species. Although the water quality in the Second Ring would be anticipated to provide conditions that could support the recreational sport fish species that were present historically in the Salton Sea, poorly understood factors related to life history and habitat requirements of these species could influence the success of any future introductions.

The long, linear configuration of the rings also reduces the level of management flexibility relative to Saline Habitat Complex, which is segmented into cells that could be managed independently. Because of the uncertainty associated with all alternatives, increased management flexibility provides the opportunity to respond to change and new information.

The Brine Sink would continue to stratify and generate high levels of hydrogen sulfide and ammonia as found in the existing Salton Sea during Phase I. Periodic mixing events that release compounds would continue to result in mortality of aquatic invertebrates in early Phase I before salinity reaches a level that could no longer support invertebrates. The Concentric Rings would be more frequently mixed because of the shallower depths, but some stratification and development of anoxic layers near the bottom would be expected. When mixing occurs following periods of stratification, fish and invertebrate kills could result, although likely of lesser magnitude than in the Brine Sink. In addition, because of the high nutrient levels and productivity in these water bodies, periods of very low dissolved oxygen levels likely would occur prior to sunrise and the resumption of oxygen generation through photosynthesis.

Based on the results of the modeling of potential bird use (Appendix C), construction of Alternative 3 would at least partially offset the loss of habitat anticipated as the inflows decline (Table 8-14). For most of the evaluated bird species there would likely be little change in habitat capacity relative to Existing Conditions (index values of ±1). Habitat capacity for long-billed curlew, marbled godwit, and black-necked stilt would be expected to increase by 25 to 75 percent while habitat capacity for *Aechmophorus* grebes would be expected to decrease by up to 50 percent relative to Existing Conditions.

Table 8-14
Change in Projected Habitat Capacity (2078) under Alternative 3 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	-2	5[a]
Eared Grebe	-1	5[a]
Ruddy Duck	-1	5[a]
American Avocet	1	5[a]
Black-necked Stilt	2	5[a]
Long-billed Curlew	3	5[a]
Marbled Godwit	2	5[a]
American White Pelican	1	5[a]
Double-crested Cormorant	1	5[a]
Dowitcher spp.[c]	1	5[a]
Dunlin	1	5[a]
Snowy Plover	1	5[a]
Western Sandpiper	1	5[a]
Snowy Egret	-1	5[a]

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of “5” was used to reflect the large benefit of restoration.
[b] Includes both western grebes and Clark’s grebes, which were not differentiated in the field.
[c] Includes both long-billed and short-billed dowitchers.

The evaluation of selenium risk suggests that overall risks to fish and birds associated with Alternative 3 would be greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 3 was 1.0 (see Table 8-7), suggesting that selenium would be at the threshold for effects in Phase IV. Overall risks due to selenium under this alternative would still be considered low for most birds.

Overall, Alternative 3 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases. These benefits likely would be less than anticipated for those species that are limited by the availability of islands and snags. The Brine Sink would also provide habitat for invertebrates and birds until salinity exceeded the threshold for invertebrate survival during Phase II.

Effects on Special Status Species

Construction and operations and maintenance of the Sedimentation/Distribution Basins would have impacts on special status species as described under the No Action Alternative, but only two basins would be built in the south, with no impacts at the Whitewater River delta. Existing snags and islands could remain in the First Ring, but construction activities near these habitats could cause temporary abandonment by nesting or roosting special status birds. As under the No Action Alternative, impacts of construction, and operations and maintenance of the Sedimentation/Distribution Basins on special status bird species would be significant due to temporary disturbance or loss of habitat. No Pupfish Channels would be constructed under this alternative nor would islands and structures for roosting and nesting.

The First Ring would provide connectivity for all desert pupfish populations, although some individuals could be injured or killed by passage through the circulation pumps. Beach habitat used by nesting western snowy plovers would also be maintained in this alternative. These are benefits not provided by the No Action Alternative. The First and Second rings would provide foraging habitat for special status birds that feed on fish, such as the brown pelican and double-crested cormorant.

Harbor construction would result in significant impacts on desert pupfish. Construction and use of staging areas could result in significant impacts on special status terrestrial species as described above.

The selenium risk to desert pupfish based directly on the sediment concentrations would be moderate (HI = 1.8) and less than the risks under Existing Conditions because there would be less habitat for this species in high selenium areas under this alternative. This level of risk would be somewhat higher than risks under the No Action Alternative (see Table 8-8). The selenium risks to special status birds based directly on sediment selenium concentrations associated with Alternative 3 would be less than the risks associated with Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 3 was 1.8, suggesting a moderate risk in Phase IV. For black skimmer (and similar fish-eating birds), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 2.8). This level of risk would be less than that associated with Existing Conditions, but greater than the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 3.6) would be slightly lower than the level of risk under Existing Conditions and the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Relative to Existing Conditions, impacts of construction and operations and maintenance of the Sedimentation/Distribution Basins would be the same as the No Action Alternative. However, this alternative would result in a beneficial effect relative to the No Action Alternative during Phase I because only two basins (New and Alamo rivers) would be constructed. Effects of developing staging areas on sensitive natural communities and wetlands would depend on the specific locations and would be analyzed during project-level analyses.

Effects on Fish and Wildlife Movement

Under Alternative 3, harbor and Perimeter Dike construction as well as operations and maintenance during Phase I could interfere with movement of desert pupfish along the shoreline and result in significant impacts relative to both Existing Conditions and the No Action Alternative. Upon completion, the First Ring would provide connectivity among all desert pupfish populations and provide a benefit relative to the No Action Alternative in subsequent phases. However, the circulation pumps could limit local movement in the vicinity of the pumps.

Alternative 4 – Concentric Lakes

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins; First, Second, Third, and Fourth lakes; and Brine Sink. All water facilities, roads, Berms, and other structures would need to be maintained on a regular basis. Desert pupfish connectivity would be provided in the First and Second Lakes. Habitats provided in Alternative 4 are summarized in Table 8-15.

Table 8-15
Summary of Habitats/Components for Alternative 4

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Saline Habitat Complex	0	0	0	0
Surface Water Area of Lakes	First Lake 7,000 acres	Same as Phase I	Same as Phase I	Same as Phase I
	Second Lake Not Applicable	21,000 acres	Same as Phase II	Same as Phase II
	Third Lake Not Applicable	20,000 acres	Same as Phase II	Same as Phase II
	Fourth Lake Not Applicable	Not Applicable	40,000 acres	Same as Phase III
Salinity of Lakes	First Lake 20,000 mg/L	Same as Phase I	Same as Phase I	Same as Phase I
	Second Lake Not Applicable	58,000 mg/L	35,000 mg/L	Same as Phase III
	Third Lake Not Applicable	188,000 mg/L	45,000 mg/L	45,000 mg/L
	Fourth Lake Not Applicable	188,000 mg/L	60,000 mg/L	60,000 mg/L
Sedimentation/Distribution Basins	2 Basins 200 acres each	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	205,000 acres 79,000 mg/L	132,000 acres 299,000 mg/L	71,000 acres >350,000 mg/L	22,000 acres >350,000 mg/L
Exposed Sea Bed	12,000 acres	40,000 acres	66,000 acres	111,000 acres

Effects of Implementation on Fish and Wildlife

The Concentric Lakes would provide habitat for fish and invertebrates throughout the water column. The First, Second, and Third lakes would provide habitat for fish and invertebrates by the end of Phase III, while the Fourth Lake would provide habitat for invertebrates and possibly fish with high salinity tolerance. These organisms would provide forage for a variety of bird species. The increase in shoreline associated with the Berms and other habitat features would provide shorebird habitat where slopes are gradual and composed of fine grained material. Islands constructed within the lakes would provide roosting, loafing, and nesting habitat protected from mammalian predators.

The lakes are expected to provide aquatic habitats similar to what would be provided by Saline Habitat Complex, as described under Alternative 1, including the incorporation of constructed islands and roosting and nesting structures for birds. Similar to Saline Habitat Complex, the First Lake constructed in Phase I would support tilapia and forage fish, but would not be expected to provide opportunities for introduction of marine sport fish. The Second and Third lakes would provide similar conditions and would increase the amount of habitat for the forage fish. The Fourth Lake would support invertebrates and provide foraging opportunities for many bird species, but because salinity in the Fourth Lake would reach 60,000 mg/L, it is uncertain if it would support fish. The higher salinity in the Fourth Lake also would increase habitat diversity and encourage continued avian diversity.

The Brine Sink during Phases I and II would continue to provide conditions that would result in the periodic release of hydrogen sulfide and events that kill aquatic life similar to those that occur in the existing Salton Sea. Similar to Saline Habitat Complex, the Lakes would be more frequently mixed because of the shallow depths, and stratification and development of an anoxic layer near the bottom would not be expected, but periods of very low dissolved oxygen levels likely would occur during the early morning hours prior to sunrise and the resumption of oxygen generation through photosynthesis. Fish tolerant of low dissolved oxygen levels, such as tilapia, would be expected to persist under these conditions. If future nutrient loads were reduced, the magnitude of periods of low dissolved oxygen would be reduced and the Lakes could become suitable for a broader range of fish species.

As described for Alternative 3, the long, linear configuration of the lakes would reduce the level of management flexibility and possibly impair the ability to adaptively respond to change and new information.

Based on the results of the modeling of potential bird use (Appendix C), construction of Alternative 4 would partially offset the loss of habitat anticipated as the inflows decline (Table 8-16). For most of the evaluated bird species, habitat capacity would be expected to increase by at least 50 percent relative to Existing Conditions. The exceptions would be American white pelican and double-crested cormorant where habitat capacity would be expected to increase but by less than 50 percent, and ruddy duck and *Aechmophorus* grebes, where habitat capacity would be expected to decline relative to Existing Conditions. However, all of the evaluated bird species would benefit in relation to the No Action Alternative.

The evaluation of selenium risk suggests that overall risks to fish and birds associated with Alternative 4 would be greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 4 was 1.1, suggesting that selenium would be just above the threshold for effect in Phase IV (see Table 8-7). Therefore, overall risks due to selenium under this alternative would be considered moderate.

Overall, Alternative 4 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases. The Brine Sink would also provide habitat for invertebrates and birds until salinity exceeded the threshold for invertebrate survival during Phase II, although this water body would continue to be subject to periodic events that kill fish and aquatic invertebrates.

Table 8-16
Change in Projected Habitat Capacity (2078) under Alternative 4 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	-2	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	-1	5[a]
American Avocet	5	5[a]
Black-necked Stilt	5	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	5	5[a]
American White Pelican	1	5[a]
Double-crested Cormorant	2	5[a]
Dowitcher spp.[c]	5	5[a]
Dunlin	5	5[a]
Western Snowy Plover	3	5[a]
Western Sandpiper	5	5[a]
Snowy Egret	3	5[a]

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of "5" was used to reflect the large benefit of restoration.

[b] Includes both western grebes and Clark's grebes, which were not differentiated in the field.

[c] Includes both long-billed and short-billed dowitchers.

Effects on Special Status Species

Construction and operations and maintenance of the Sedimentation/Distribution Basins would be similar to conditions described under Alternative 3. Construction, and operations and maintenance activities for each Lake could affect nesting or roosting special status birds using the adjacent Lake. The First Lake would provide connectivity for desert pupfish along the southern shoreline. The Second Lake would provide connectivity for desert pupfish populations in the drains and creeks along the remaining shoreline from north of San Felipe Creek to north of Bombay Beach. The Lakes would support fish and provide benefits for special status birds that feed on fish relative to the No Action Alternative. Construction and operations and maintenance of the Lakes could have significant but avoidable impacts on special status birds and desert pupfish in Phases I and II. Connection of the drains to the Second Lake could have significant impacts on desert pupfish similar to those described for connecting the drains to the Pupfish Channels in Alternative 1. Connection of the drains to the First Lake would have similar impacts as those described under Alternative 2. Habitat benefits for special status birds would be provided in Phases II through IV.

The selenium risk to desert pupfish based directly on the sediment concentrations would be moderate (HI = 2.0). This level of risk would be less than under Existing Conditions because there would be less habitat in high selenium areas for this species under this alternative. This level of risk would be somewhat higher than the estimated risks associated with the No Action Alternative (Table 8-8). The selenium risks to special status birds based directly on sediment selenium concentrations associated with Alternative 4 would be slightly less than those under Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 4 was 2.1, suggesting a moderate risk in Phase IV. For black skimmer (and similar fish-eating birds), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 3.2). This level of risk would be less than under Existing Conditions, but greater than the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 4.0) would be similar to the level of risk under Existing Conditions and the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Impacts of construction and operations and maintenance of the Sedimentation/Distribution Basins would be similar to those described for Alternative 3.

Effects on Fish and Wildlife Movement

Under Alternative 4, desert pupfish connectivity would be achieved in the First and Second Lakes. The First Lake would connect all drains on the southern shoreline as well as San Felipe Creek, while the Second Lake would provide connectivity for desert pupfish populations in the drains and creeks along the remaining shoreline from north of San Felipe Creek to north of Bombay Beach.

Alternative 5 – North Sea

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins, Air Quality Management, Saline Habitat Complex, Shoreline Waterway, Saltwater Conveyance, Marine Sea, Marine Sea Recirculation Canal, and Brine Sink. Pupfish connectivity would be provided along the southern shoreline in the Shoreline Waterway and along the northern shoreline in the Marine Sea. All water facilities, roads, Berms/barriers, and other structures would require regular maintenance. Habitats provided in Alternative 5 are summarized in Table 8-17.

Table 8-17
Summary of Habitats/Components for Alternative 5

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Saline Habitat Complex	7,500 acres (total) 7,500 acres (wet)	45,500 acres (total) 33,500 acres (wet)	Same as Phase II	Same as Phase II
Marine Sea	Not Applicable	62,000 acres 35,000 mg/L	Same as Phase II	Same as Phase II
Sedimentation/Distribution Basins	2 Basins 200 acres each	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	207,000 acres 76,000 mg/L	68,000 acres >350,000 mg/L	14,000 acres >350,000 mg/L	13,000 acres >350,000 mg/L
Exposed Sea Bed (AQM)	30,000 acres	73,000 acres	115,000 acres	117,000 acres

Effects of Implementation on Fish and Wildlife

By late Phase II, the Marine Sea salinity would be less than 40,000 mg/L and could provide habitat function similar to the current or recent Salton Sea, albeit at a smaller scale. The Saline Habitat Complex would function similarly to that described under Alternative 2. The Brine Sink would also provide habitat for invertebrates and birds until salinity exceeds the threshold for invertebrate survival at the end of Phase II.

The small amount of Saline Habitat Complex constructed in Phase I as Early Start Habitat would provide habitat for tilapia and other forage fish species. Additional Saline Habitat Complex constructed in Phase II would increase the amount of habitat for forage fish species. The Marine Sea would have salinity levels above the tolerance levels for most fish species until late Phase II when it would begin to provide habitat for tilapia and other salt-tolerant fish.

Alternative 5 would result in a Marine Sea that is considerably smaller than the present Salton Sea. The thermal stratification in the Marine Sea would be sharper and more persistent than under the No Action Alternative. Wind mixing of deeper water would be less frequent, and, when it did occur, the potential for anoxic conditions and hydrogen sulfide in surface water would be greater than under Existing Conditions. These conditions could result in more pronounced fish kills than occur under Existing Conditions and could adversely affect the ability of the Marine Sea to support sustainable populations of fish. These conditions could also preclude the introduction of the marine sport fish that historically occupied the Salton Sea. If eutrophic conditions in the Marine Sea are improved in the future, the frequency and magnitude of fish kills due to mixing events could be reduced and conditions for fish would be improved.

Based on the results of the modeling of potential bird use (Appendix C), this alternative would partially offset the loss of habitat anticipated as the water recedes (Table 8-18). For most of the evaluated bird species, habitat capacity would be expected to increase by at least 50 percent compared to Existing Conditions. The exceptions would be American avocet, western snowy plover, and snowy egret where habitat capacity would increase but by less than 50 percent, and ruddy duck and American white pelican where habitat capacity would be expected to decrease relative to Existing Conditions. However, all of the evaluated bird species would benefit in relation to the No Action Alternative.

The evaluation of selenium risk suggests that overall risks to fish and birds associated with Alternative 5 would be greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 5 was 1.0, suggesting that selenium generally would be at the threshold effect level in Phase IV (see Table 8-7). Overall risks due to selenium under this alternative would still be considered low for most birds.

Overall, Alternative 5 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases. The Brine Sink would also provide habitat for invertebrates and birds until salinity exceeded the threshold for invertebrate survival during Phase II.

Table 8-18
Change in Projected Habitat Capacity (2078) under Alternative 5 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	5	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	-1	5[a]
American Avocet	2	5[a]
Black-necked Stilt	5	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	3	5[a]
American White Pelican	-1	5[a]
Double-crested Cormorant	4	5[a]
Dowitcher spp.[c]	5	5[a]
Dunlin	4	5[a]
Western Snowy Plover	1	5[a]
Western Sandpiper	5	5[a]
Snowy Egret	1	5[a]

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of “5” was used to reflect the large benefit of restoration.
[b] Includes both western grebes and Clark’s grebes, which were not differentiated in the field.
[c] Includes both long-billed and short-billed dowitchers.

Effects on Special Status Species

Effects of construction and operations and maintenance of the Sedimentation/Distribution Basins and Air Quality Management facilities on special status species would be the same as described for the No Action Alternative.

Snags in the north that are used by special status birds would remain for some unknown time, while those in the south and the existing islands would be temporarily lost as described for Alternative 1. Because of high salinity, fish would not be supported in the Marine Sea until the latter part of Phase II. The Saline Habitat Complex in Phases I and II, however, would provide aquatic habitat capable of supporting forage fish, but in a much smaller area. Thus, populations of fish-eating birds, such as pelicans and double-crested cormorants, would be significantly impacted during Phases I and II.

Alternative 5 would result in loss of western snowy plover nesting habitat on the western shoreline from the barrier south to San Felipe Creek due to the construction of the Air Quality Management Canal as described for the No Action Alternative. Operations and maintenance activities for all facilities except the Marine Sea would result in periodic disturbance of special status species through dredging, human presence, and noise from equipment, as described under Alternative 2.

The selenium risk to desert pupfish based directly on the sediment concentrations would be moderate (HI = 1.7) and less than under Existing Conditions because there would be less habitat in high selenium areas for this species under this alternative. This level of risk would be somewhat higher than risks under the No Action Alternative (see Table 8-8). The selenium risks to special status birds based directly on sediment selenium concentrations associated with Alternative 5 would be less than those under Existing Conditions and under the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 5 was 1.7, suggesting a moderate risk in Phase IV. For black skimmer (and similar species), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 2.7). This level of risk would be less than under Existing Conditions, but greater than the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 3.4) would be slightly less than under Existing Conditions and the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Impacts of construction and operations and maintenance of the Sedimentation/Distribution Basins would be similar to Alternative 3.

Effects on Fish and Wildlife Movement

Desert Pupfish movement would be accommodated by the Marine Sea, which would connect the drains along the northern shoreline and Salt Creek. The drains on the southern shoreline and San Felipe Creek would be connected by the Shoreline Waterway in three segments as described for Alternative 2. This would represent a significant impact relative to Existing Conditions during Phase I and a benefit relative to the No Action Alternative in the subsequent phases because all drains along the northern shoreline and Salt Creek would remain connected.

Alternative 6 – North Sea Combined

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basin, Air Quality Management, Pupfish Channels, Saline Habitat Complex, Shoreline Waterway, Saltwater Conveyance, Marine Sea, Marine Sea Mixing Zone, Marine Sea Recirculation Canal, and Brine Sink. Desert pupfish connectivity would be provided in the Marine Sea and Marine Sea mixing Zone. All water conveyance facilities, roads, Berms/barriers, and other structures would need to be maintained on a regular basis. The Marine Sea habitat includes both the deeper Marine Sea with salinity of 30,000 to 40,000 mg/L and the Marine Sea Mixing Zone with a salinity of 20,000 to 30,000 mg/L. Habitats provided in Alternative 6 are summarized in Table 8-19.

Table 8-19
Summary of Habitats/Components for Alternative 6

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Saline Habitat Complex	4,000 acres (total) 4,000 acres (wet)	29,000 acres (total) 21,500 acres (wet)	Same as Phase II	Same as Phase II
Marine Sea	Not Applicable	74,000 acres @ 35,000 mg/L	Same as Phase II	Same as Phase II
Sedimentation/ Distribution Basins	1 Basin 200 acres	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	207,000 acres 76,000 mg/L	72,000 acres >350,000 mg/L	11,000 acres >350,000 mg/L	11,000 acres >350,000 mg/L
Maximum Exposed Sea Bed	30,000 acres	86,000 acres	130,000 acres	131,000 acres

Effects of Implementation on Fish and Wildlife

The Saline Habitat Complex would provide a benefit to aquatic organisms and birds as described in Alternative 2. The Brine Sink would provide habitat for invertebrates and birds for part of Phase I and Phase II.

The small amount of Saline Habitat Complex constructed in Phase I as Early Start Habitat would provide habitat for tilapia and other forage fish species. Additional Saline Habitat Complex constructed in Phase II would increase the amount of habitat for forage fish species. The Marine Sea would have salinity levels above the tolerance levels for most fish species until late Phase II, and then could provide habitat for tilapia and other salt-tolerant fish.

Alternative 6 would result in a Marine Sea that is considerably smaller than the present Salton Sea. Thermal stratification would be more persistent than in the No Action Alternative resulting in conditions (including fish kills) similar to those described for Alternative 5. Under this alternative, however, the Marine Sea Mixing Zone component could partially ameliorate the effects of fish kills because it would not be affected by the conditions that result in fish kills in the Marine Sea and could serve as a source population to repopulate the Marine Sea when fish numbers are depressed.

Based on the results of the modeling of potential bird use (Appendix C), this alternative would partially offset the loss of habitat anticipated as the water recedes (Table 8-20). Compared to Existing Conditions, habitat capacity for most of the evaluated bird species would be expected to increase. Those species with predicted declines in habitat capacity (ruddy duck, American avocet, American white pelican, western snowy plover, and snowy egret) would be expected to decline by less than 25 percent relative to Existing Conditions, but all of the evaluated bird species would benefit relative to the No Action Alternative.

Table 8-20
Change in Projected Habitat Capacity (2078) under Alternative 6 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	4	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	-1	5[a]
American Avocet	-1	5[a]
Black-necked Stilt	5	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	2	5[a]
American White Pelican	-1	5[a]
Double-crested Cormorant	3	5[a]
Dowitcher spp.[c]	5	5[a]
Dunlin	2	5[a]
Snowy Plover	-1	5[a]
Western Sandpiper	5	5[a]
Snowy Egret	-1	5[a]

Relative Change:		
	1	0 to 25 percent change
	2	25 to 50 percent change
	3	50 to 75 percent change
	4	75 to 100 percent change
	5	over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of "5" was used to reflect the large benefit of restoration.

[b] Includes both western grebes and Clark's grebes, which were not differentiated in the field.

[c] Includes both long-billed and short-billed dowitchers.

The evaluation of selenium risk suggests that overall risks to fish and birds associated with Alternative 6 would be greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 6 was 0.9, suggesting that selenium generally would be just below the observed effect level in Phase IV (see Table 8-7). Therefore, overall risks due to selenium under this alternative would be considered low.

Overall, Alternative 6 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases. The Brine Sink would continue to support invertebrates and bird use until Phase II.

Effects on Special Status Species

Effects of construction and operations and maintenance of the Sedimentation/Distribution Basin and Air Quality Management facilities on special status species would be the same as described for Alternative 5. All desert pupfish populations would be connected in the Marine Sea and Marine Sea Mixing Zone, except populations north of the Alamo River would be connected via a Pupfish

Channel. This would be a beneficial impact as compared to the No Action Alternative. The Salt Creek desert pupfish populations would not be isolated from other pupfish populations.

Existing snags along the northern and southern shorelines used by special status birds would continue to function as in the No Action Alternative. Snags between Salt Creek and Bombay Beach would be located on the Exposed Playa and would be less beneficial for birds. Fish would not be supported in the Marine Sea until the latter part of Phase II. Construction of the Saline Habitat Complex in Phases I and II, however, would provide aquatic habitat capable of supporting forage fish, but in a much smaller area. Populations of fish-eating birds, such as pelicans and double-crested cormorants, could decline until the end of Phase II. Fish forage would be re-established following the completion of the Marine Sea.

Alternative 6 would maintain western snowy plover nesting habitat around much of the Salton Sea as described for the No Action Alternative.

The selenium risk to desert pupfish based directly on the sediment concentrations would be moderate (HI = 1.6). This level of risk would be less than the risk associated with Existing Conditions because there would be less Marine Sea habitat (in proportion to other habitat) for this species and somewhat higher than risks under the No Action Alternative (see Table 8-8). The selenium risks to special status birds based directly on sediment selenium concentrations associated with Alternative 6 would be less than those under Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 6 was 1.6, suggesting a moderate risk in Phase IV. For black skimmer (and similar fish-eating birds), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 2.6). This level of risk would be less than under Existing Conditions, but greater than the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 3.3) would be slightly less than under Existing Conditions and the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Impacts of construction of the Sedimentation/Distribution Basin would be significant relative to Existing Conditions, but beneficial relative to the No Action Alternative because only one basin (Alamo River) would be built and the New and Whitewater rivers would be unaffected.

Effects on Fish and Wildlife Movement

Under Alternative 6, desert pupfish connectivity would be achieved by the Marine Sea Mixing Zone, the Marine Sea, and a Pupfish Channel. During Phase I, the Pupfish Channel would be constructed to connect the drains along the southeastern shoreline north of the Alamo River. This would isolate this segment of the population from the others, all of which would remain connected in Phase I. The construction of the Perimeter Dikes and the Barrier, however, could result in disruption of local movement in the vicinity of the construction. Isolation of one segment of the desert pupfish population would represent a significant impact in Phase I relative to Existing Conditions. Impacts would be less than those under the No Action Alternative.

In Phase II, the Marine Sea Mixing Zone would connect all desert pupfish using the drains along the southern shoreline west of the Alamo River, including San Felipe Creek. The Marine Sea Mixing Zone would flow into the Marine Sea, which would connect all drains along the northern shoreline and Salt Creek. This would provide connectivity for all desert pupfish populations except those connected by the Pupfish Channel. Implementation of Alternative 6 would result in a significant impact on desert pupfish movement relative to Existing Conditions and a beneficial effect relative to the No Action Alternative.

Alternative 7 – Combined North and South Lakes Alternative

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basin, Air Quality Management using Protective Salt Flat on Exposed Playa below -255 feet msl, Exposed Playa without Air Quality Management above -255 feet msl, Saline Habitat Complex, Recreational Saltwater Lake, Recreational Estuary Lake, Marine Sea Recirculation Canal, IID Freshwater Reservoir, two Treatment Plants, and Brine Sink. Pupfish connectivity would be provided in the Recreational Saltwater and Recreational Estuary lakes. All water facilities, roads, Berms/barriers, and other structures would require regular maintenance. Habitats provided in Alternative 7 are summarized in Table 8-21.

Table 8-21
Summary of Habitats/Components for Alternative 7

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Saline Habitat Complex[a] along eastern shoreline	0	12,000 acres (total) 6,000 acres (wet)	Same as Phase II	Same as Phase II
Recreational Saltwater and Recreational Estuary Lakes with average inflows of 717,000 acre-feet/year	Not Applicable	104,000 acres @ 62,000 mg/L	104,000 acres @ 57,000 mg/L	104,000 acres @ 50,000 mg/L
Recreational Saltwater and Recreational Estuary Lakes with average inflow of 800,000 acre-feet/year	Not Applicable	115,000 acres @ 53,000 mg/L	115,000 acres @ 50,000 mg/L	115,000 acres @ 35,000 mg/L
Sedimentation/Distribution Basins	1 Basin 200 acres	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink with average inflows of 717,000 acre-feet/year	208,000 acres 76,000 mg/L	28,000 acres >350,000 mg/L	15,000 acres >350,000 mg/L	15,000 acres >350,000 mg/L
IID Freshwater Reservoir		11,000	Same as Phase II	Same as Phase II
Maximum Exposed Sea Bed with average inflows of 717,000 acre-feet/year	30,000 acres	89,000 acres	92,000 acres	97,000 acres

[a] 1,200 acres of marine quality Saline Habitat Complex provided by the Whitewater River

Effects of Implementation on Fish and Wildlife

The small amount of Saline Habitat Complex constructed in Phase I as Early Start Habitat would provide habitat for tilapia and other forage fish species. Additional Saline Habitat Complex constructed in Phase II would increase the amount of habitat for tilapia and other fish species. However, the proportion of the Saline Habitat Complex maintained at salinity levels suitable for fish would be lower by comparison to the Saline Habitat Complex in other alternatives because the supply water from the Recreational Saltwater Lake would be higher than 40,000 mg/L throughout the 75-year period. The Recreational Saltwater Lake would have salinity above the tolerance levels for most fish species in Phases I and II, but could provide habitat for tilapia and other salt-tolerant fish in Phase III, depending on inflows. The Recreational Saltwater Lake likely would not support the marine sport fish species that were historically found in the Salton Sea due to high salinity levels unless salinity could be reduced to less than 40,000 mg/L. Lower salinity in the Recreational Estuary Lake would likely support tilapia and other fish and allow introduction of estuarine fish that could provide a sport fishery. Although the details of management and operation of the IID Freshwater Reservoir have not been determined, it is likely that it would support a fish assemblage similar to that currently occupying IID canals and could support a variety of birds on its surface and along the margins.

Thermal stratification in the Recreational Saltwater Lake would be more persistent than in the No Action Alternative and could result in events that produce fish kills that are more severe than occur under Existing Conditions. These events, however, would be less severe than those that would occur under alternatives with a smaller Marine Sea located in the north basin.

Based on the results of the modeling of potential bird use (Appendix C) assuming average inflows of 717,000 acre-feet/year, this alternative would partially offset the loss of habitat anticipated as the inflows decline (Table 8-22). Compared to Existing Conditions, habitat capacity would be expected to increase substantially (more than 75 percent) for about half of the bird species evaluated. Habitat capacity for the other species evaluated would be expected to decline by up to 50 percent.

The evaluation of selenium risk suggests that overall risks to fish and birds associated with Alternative 7 would be greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 7 was 0.9, suggesting that selenium would be just below the threshold effect level in Phase IV (see Table 8-7). Therefore, overall risks due to selenium under this alternative would be considered low for most birds.

Overall, Alternative 7 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases.

Table 8-22
Change in Projected Habitat Capacity (2078) under Alternative 7 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	-2	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	-2	5[a]
American Avocet	-1	5[a]
Black-necked Stilt	5	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	-1	5[a]
American White Pelican	-2	5[a]
Double-crested Cormorant	-1	5[a]
Dowitcher spp.[c]	4	5[a]
Dunlin	1	5[a]
Snowy Plover	-2	5[a]
Western Sandpiper	5	5[a]
Snowy Egret	4	5[a]

Relative Change:		
	1	0 to 25 percent change
	2	25 to 50 percent change
	3	50 to 75 percent change
	4	75 to 100 percent change
	5	over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of “5” was used to reflect the large benefit of restoration.

[b] Includes both western grebes and Clark’s grebes, which were not differentiated in the field.

[c] Includes both long-billed and short-billed dowitchers.

Effects on Special Status Species

Effects of construction and operations and maintenance of the Sedimentation/Distribution Basin on special status species would be essentially the same as described for Alternative 6. Connectivity for desert pupfish populations at the Salton Sea would be better in Alternative 7 than in the No Action Alternative because the northern drains and Salt Creek would all be connected to the Recreational Saltwater Lake. The Recreational Estuary Lake in the southwest would provide habitat as well as connectivity among the drains and San Felipe Creek. The desert pupfish populations in the IID drains in the southeastern portion of the Salton Sea, however, would be isolated from other pupfish populations.

Existing snags in the north and south that are used by special status birds would continue to function as in the No Action Alternative. With receding water, the snags near Bombay Beach would be left on Exposed Playa and would provide fewer benefits for birds. The Recreational Saltwater Lake would have salinity levels above the tolerance levels for most fish species in Phase I, but could provide habitat for tilapia and other salt-tolerant forage fish beginning in Phase III, and possibly Phase II, depending on inflows. These fish would provide foraging opportunities for fish-eating special status birds. The IID water storage reservoir also could support fish and invertebrates that provide foraging opportunities for special status birds as well as freshwater needed for drinking and bathing. The operation of this facility is unknown and it is uncertain how operational fluctuations in water depth and area would affect its long term habitat value.

Alternative 7 would maintain western snowy plover nesting habitat around much of the Salton Sea as described for the No Action Alternative.

The selenium risk to desert pupfish based directly on the sediment concentrations would be moderate (HI = 1.6) and less than under Existing Conditions because there would be less Marine Sea habitat (in proportion to other habitat) for this species under this alternative. This level of risk would be somewhat higher than risks under the No Action Alternative (see Table 8-8). The selenium risks to special status birds based directly on sediment selenium concentrations associated with Alternative 7 would be less than those under Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 7 was 1.6, suggesting that selenium risk is moderate in Phase IV. The evaluation for black skimmer suggests that selenium risk associated with the food web (diet) pathway would be moderate (HI = 2.5). This level of risk would be less than under Existing Conditions, but greater than the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 2.8) would be somewhat less than under Existing Conditions and the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Impacts of construction of the Sedimentation/Distribution Basin would be similar to that described under Alternative 6. In addition to the potential impacts on riparian vegetation at the river mouths, this alternative could impact riparian vegetation upstream of these locations. As described in Chapter 3, Alternative 7 assumes construction of treatment wetlands on the New and Alamo rivers to improve water quality. These wetlands could substantially contribute to the availability of freshwater marsh and habitat for marsh species in the areas south of the Salton Sea. Construction, operations and maintenance, and selenium risks of these wetlands would be evaluated through separate, project-level environmental documentation.

Effects on Fish and Wildlife Movement

The effects of Alternative 7 on desert pupfish movement would be similar to those described for Alternative 6, except that drains in the Coachella Valley containing desert pupfish would be extended into the Recreational Saltwater Lake. Desert pupfish along the southern and western shoreline west of the Alamo River would be connected by the Recreational Estuary Lake. The Recreational Estuary

Lake would flow into the Recreational Saltwater Lake, which connect the drains along the northern shoreline and Salt Creek. Drains south of Salt Creek and northeast of the Alamo River would flow directly into Saline Habitat Complex. Desert pupfish occupying these drains would be isolated from the larger population and could become isolated further within the individual cells of the Saline Habitat Complex.

Alternative 8 – South Sea Combined

As described in Chapter 3, this alternative would involve construction and operations and maintenance activities for the Sedimentation/Distribution Basins, Air Quality Management, Saline Habitat Complex, Shoreline Waterway, Marine Sea, Marine Sea Recirculation Canal, and Brine Sink. Desert pupfish connectivity would be provided in the Marine Sea, except for Salt Creek. All water facilities, roads, Berms/barriers, and other structures would need to be maintained on a regular basis. Habitats provided in Alternative 8 are summarized in Table 8-23.

Table 8-23
Summary of Habitats/Components for Alternative 8

Habitat/Component	End of Phase I (2020)	End of Phase II (2030)	End of Phase III (2040)	End of Phase IV (2078)
Saline Habitat Complex	0	18,000 acres (total) 13,500 acres (wet)	Same as Phase II	Same as Phase II
Marine Sea	Not Applicable	83,000 acres @ 37,000 mg/L	Same as Phase II	Same as Phase II
Sedimentation/ Distribution Basins	2 Basins 200 acres each	Same as Phase I	Same as Phase I	Same as Phase I
Brine Sink	207,000 acres 76,000 mg/L	62,000 acres >350,000 mg/L	9,000 acres >350,000 mg/L	9,000 acres >350,000 mg/L
Maximum Exposed Sea Bed	30,000 acres	96,000 acres	128,000 acres	128,000 acres

Effects of Implementation on Fish and Wildlife

The small amount of Saline Habitat Complex constructed in Phase I as Early Start Habitat would provide habitat for tilapia and other fish species. Additional Saline Habitat Complex constructed in Phase II would increase the amount of habitat for these fish species. The Marine Sea could provide habitat for tilapia and other salt-tolerant forage fish in Phase II. Water quality in the Marine Sea would be anticipated to provide conditions that could support the recreational sport fish species that were present historically in the Salton Sea. These and other marine fish species could be reintroduced to the Marine Sea once salinity was stabilized in Phase II.

Alternative 8 would result in a Marine Sea smaller than the present Salton Sea and a salinity less than 40,000 mg/L. Thermal stratification in the deeper water body (e.g., adjacent to the Barrier) would be less persistent than in the No Action Alternative as a result of the higher velocity of winds at the southern Marine Sea. Wind mixing of deeper water would be more frequent, and nearly continuous. Thus, the potential for anoxic conditions and lethal levels of hydrogen sulfide to occur in the surface layers would be less than under Existing Conditions. Nonetheless, periodic fish kills would continue, although the frequency and magnitude of these events could be less than under Existing Conditions. Once salinity is stabilized in Phase II, the Marine Sea would be suitable for tilapia and might support introduction of the marine sport fish that historically occupied the Salton Sea.

Based on results of the modeling of potential bird use (Appendix C), this alternative would partially offset the loss of habitat anticipated as the water recedes under the No Action Alternative (Table 8-24). Compared to Existing Conditions, habitat capacity would be expected to decline by up to 50 percent for about half of the bird species evaluated. Habitat capacity for the other bird species evaluated would be expected to increase relative to Existing Conditions.

The evaluation of selenium risk suggests that overall risks to fish and wildlife associated with Alternative 8 would be greater than under Existing Conditions and the No Action Alternative. The area-weighted HI for Alternative 8 was 1.0, suggesting that selenium would be at the threshold effect level in Phase IV (see Table 8-7). Overall risks due to selenium under this alternative would still be considered low for most birds.

Overall, Alternative 8 would result in less than significant impacts on aquatic and avian resources relative to Existing Conditions in Phases II through IV and benefits relative to the No Action Alternative in all phases. The Brine Sink would also provide habitat for invertebrates and birds until salinity exceeded the threshold for invertebrate survival during Phase II.

Table 8-24
Change in Projected Habitat Capacity (2078) under Alternative 8 Relative to Existing Conditions and No Action Alternative

Species	Change Relative to Existing Conditions	Change Relative to No Action Alternative
Aechmophorus spp.[b]	1	5[a]
Eared Grebe	5	5[a]
Ruddy Duck	-2	5[a]
American Avocet	-2	5[a]
Black-necked Stilt	4	5[a]
Long-billed Curlew	5	5[a]
Marbled Godwit	-1	5[a]
American White Pelican	-2	5[a]
Double-crested Cormorant	1	5[a]
Dowitcher spp.[c]	3	5[a]
Dunlin	-1	5[a]
Snowy Plover	-2	5[a]
Western Sandpiper	5	5[a]
Snowy Egret	-2	5[a]

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity relative to baseline
Negative numbers indicate a decrease in habitat capacity relative to baseline

[a] This species is not expected to occur under the No Action due to high salinity. A relative change of "5" was used to reflect the large benefit of restoration.

[b] Includes both western grebes and Clark's grebes, which were not differentiated in the field.

[c] Includes both long-billed and short-billed dowitchers.

Effects on Special Status Species

Effects of construction and operations and maintenance of the Sedimentation/Distribution Basin on special status species would be essentially the same as described for Alternative 3. Connectivity for desert pupfish populations at the Salton Sea would be better in Alternative 8 than in the No Action Alternative because the northern and southern drains and San Felipe Creek would be connected to the Marine Sea, which would provide habitat as well as connectivity among the drains. The desert pupfish populations in Salt Creek, however, would be isolated from other pupfish populations.

Existing snags in the north and south that are used by special status birds would continue to function as in the No Action Alternative. Fish would not be supported in the Marine Sea during Phase I and the early portion of Phase II. Construction of the Saline Habitat Complex in Phase II, however, would provide aquatic habitat capable of supporting forage fish, but in a much smaller area. Thus, populations of fish-eating birds, such as pelicans and double-crested cormorants, could decline during Phase I. Forage fish would become established following the completion of the Barrier and Marine Sea in Phase II.

Alternative 8 would maintain western snowy plover nesting habitat around much of the Salton Sea as described for the No Action Alternative.

The selenium risk to desert pupfish based directly on the sediment concentrations would be moderate (HI = 1.6) and less than under Existing Conditions because there is less Marine Sea habitat (in proportion to other habitat) for this species under this alternative. This level of risk would be somewhat higher than risks under the No Action Alternative (see Table 8-8). The selenium risks to special status birds based directly on sediment selenium concentrations associated with Alternative 8 would be less than those under Existing Conditions and the No Action Alternative. The area-weighted HI for the sediment pathway under Alternative 8 was 1.8, suggesting that selenium risk associated with the sediment pathway would be moderate in Phase IV. For black skimmer (and similar fish-eating birds), the evaluation of selenium risk suggests that risk associated with the food web (diet) pathway would be moderate (HI = 2.6). This level of risk would be less than under Existing Conditions, but greater than the No Action Alternative, when fish would be largely absent. For western snowy plover, the moderate risk associated with the food web (diet) pathway (HI = 3.5) would be less than under Existing Conditions and the No Action Alternative.

Effects on Riparian, Sensitive Natural Communities, and Wetlands

Impacts of construction of the Sedimentation/Distribution Basins would be similar to that described for Alternative 3.

Effects on Fish and Wildlife Movement

Under Alternative 8, the Marine Sea would allow desert pupfish to move around the perimeter except along the eastern shoreline. Desert pupfish using Salt Creek would become isolated from the other populations. Construction of the Barrier and Perimeter Dikes could adversely affect desert pupfish movement during Phase I. Impacts relative to Existing Conditions would be significant in all phases. However, upon completion, Alternative 8 would be beneficial relative to the No Action Alternative in Phases II to IV.

PERFORMANCE RELATIVE TO HISTORIC CONDITIONS

An objective of the alternatives is to provide long term stable aquatic and shoreline habitat for the historic levels and diversity of fish and wildlife at the Salton Sea. The ability of the alternatives to meet this objective is discussed below.

Fish

Achieving historic levels and diversity of fish requires the recognition of three functional groups of fishes in the Salton Sea ecosystem: sport fishes, forage fishes, and protected species (desert pupfish). There are group-specific considerations raised by the different habitat components proposed in the restoration alternatives. Unlike the bird community, the fish community of the Salton Sea has changed dramatically from recent conditions, both in species composition and levels. The marine sport fish have disappeared from the fish samples at the Salton Sea and the once extremely abundant tilapia has diminished substantially in number. Because of the recent changes in the fish community, achieving historic fish diversity would require introductions or reintroductions of sport fish species to the ecosystem. The specific conditions within restored water bodies at the Salton Sea would dictate which species could be successfully introduced.

Several of the alternatives include a Marine Sea intended to stabilize and retain a portion of the habitat values currently provided by the Salton Sea. The Marine Sea would mimic, to the extent possible, the historic conditions and community associated with the open water and shoreline of the Salton Sea. Many of the species currently found in the Salton Sea and the rivers and drains flowing to the Salton Sea would inhabit the Marine Sea. Elements of the restoration could improve water quality over time to the extent that the Marine Sea could support higher densities of fish and invertebrates than current conditions. However, the smaller Marine Sea likely would not support the same absolute levels of fish abundance recently seen at the Salton Sea. Restoration of the historically important sport fish species or other fish that could provide a sport fishery would require introductions of these species from other areas.

Several of the alternatives include constructed Saline Habitat Complex intended to replace a portion of the habitat values currently provided at the Salton Sea. Design objectives include constructing cells that mimic, to the extent possible, historic habitat conditions and support the fish and wildlife communities associated with the shoreline of the Salton Sea. The Concentric Lakes constructed in Alternative 4 would function similarly to the Saline Habitat Complex. Various members of the forage fish community that currently occupy the Salton Sea and adjacent rivers and drains likely would persist in the Saline Habitat Complex and other constructed waterways and would continue to provide a forage base for fish-eating birds. This community is the product of past introductions and the ability of those species to tolerate conditions at the Salton Sea. If changes in conditions following restoration impaired the ability of the Saline Habitat Complex to support the current fish community, fish species better adapted to the conditions following restoration could be introduced as part of future habitat management.

Birds

Because the Saline Habitat Complex and other constructed features (e.g., concentric waterways) represent an environment (particularly the highly saline areas) not currently present at the Salton Sea, the extent to which it would be used by birds at the Salton Sea is uncertain. However, estimates can be made by comparison to similar habitats located elsewhere. One environment comparable to the Saline Habitat Complex is the salt ponds adjacent to San Francisco Bay. The salt ponds are similar to the Saline Habitat Complex in that they are relatively shallow and composed of cells with a broad range of salinities. However, the salt ponds are adjacent to a variety of other habitat types, including tidal wetlands and mudflats, an enclosed bay, and several freshwater rivers that offer a wide variety of foraging opportunities in addition to those of the salt ponds. In addition, bird use of the salt ponds is relatively well documented (e.g., Takekawa et al., 2001, Warnock et al., 2002). The Concentric Lakes in Alternative 4 are anticipated to function much like linear versions of the Saline Habitat Complex.

As previously described, expectations regarding the capacity of these habitats to support use by selected species were based on habitat modeling described in Appendix C. To serve as the basis for evaluating the performance of the restoration alternatives relative to the goals of the restoration, historic levels were identified for selected bird species based on available survey results (see Appendix H-1 for additional discussion of historic levels of bird use). The seasonal estimates presented in Appendix C were averaged to compute a single estimate of habitat capacity (potential number of birds that could be supported) for comparison to the historic level of use.

Habitat capacity predicted using the model is not directly comparable to historic levels of bird use because the model uses bird densities observed during the 1999 comprehensive shoreline survey of the Salton Sea (Shuford et al., 2000) to predict the potential number of birds that could be supported (habitat capacity) in the future mix of habitats under each alternative. This method not only assumes that habitat is the limiting factor controlling bird density at the Salton Sea, but that densities observed in 1999 reflect the habitat capacity (past, present, and future) at the Salton Sea. While the habitat capacity predicted by the model is not directly comparable to historic levels of use, it does provide a basis for comparison of the alternatives. The predictions of habitat capacity under Existing Conditions are included in the analysis to help identify instances where 1999 densities differed from historic levels and could lead to an overestimate or underestimate of habitat capacity.

Table 8-25 and Figure 8-2 present the results of the analysis of habitat capacity relative to historic conditions. Results are presented only for habitat conditions expected at the end of the restoration (2078) for all alternatives. No alternative will achieve its maximum habitat value until Phase II (2020-2030). Some will not achieve this maximum habitat value before half of the 75 year life of the project period is over. Because of the high salinities that would develop under the No Action Alternative, effectively no habitat would be suitable for use by birds in 2078 if inflows declined as in the No Action Alternative-Variability Conditions. Because habitat capacity under the No Action Alternative is essentially zero, this alternative is not included in the figure or table below, and all of the alternatives would reflect a substantial benefit to birds relative to the No Action Alternative. Results are presented as numeric index values from -4 to +5 representing “quartiles” of change from a decrease of 75 to 100 percent (-4) to a greater than 100 percent increase (+5) by 25 percent increments. The ranking of alternatives is based on the sum of index values for all species; a higher sum indicating that the habitat capacity would be similar to or greater than historic levels for more species. Alternatives are ranked from high to low; a ranking of “1” indicating the highest overall habitat capacity and a rank of “8” indicating the least overall habitat capacity.

These rankings are based on the habitat capacity of each alternative as configured and described in Chapter 3. Factors such as water depth and salinity influence the habitat capacity of these alternatives, and modifications during future project-level design could improve the capacity to support birds, as could adaptive management. Nonetheless, the projected capacity of the alternatives to support birds provides an indication how a given alternative would perform relative to other alternatives and historic conditions at the Salton Sea.

Table 8-25
Change in Projected Habitat Capacity (by 2078) Relative to Historic Abundance – All Seasons

Species	Existing Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7	Alternative 8
Aechmophorus spp.[a]	-2	1	5	-3	-3	2	2	-3	-1
American Avocet	-2	-2	2	-2	2	-1	-2	-3	-3
American White Pelican	-1	-3	1	-1	1	-1	-2	-2	-2
Black-necked Stilt	-1	5	5	1	5	5	5	4	2
Double Crested Cormorant	-2	-1	5	-1	1	2	1	-2	-1
Dowitcher spp.[b]	-3	-1	5	-3	3	2	-1	-2	-2
Dunlin	1	2	5	2	5	5	3	1	1
Eared Grebe	-4	-2	2	-4	5	-2	-3	-3	-3
Long-billed Curlew	-3	4	5	-2	5	5	3	1	-1
Marbled Godwit	-1	-1	5	1	5	2	-1	-2	-2
Ruddy Duck	1	-2	2	-1	-1	1	-1	-2	-1
Snowy Egret	1	-1	5	-1	3	1	-1	4	-2
Snowy Plover	2	1	5	3	5	4	2	1	-1
Western Sandpiper	-4	-1	5	-3	1	1	-1	-2	-2
TOTAL	**-18**	**-1**	**57**	**-14**	**37**	**26**	**4**	**-10**	**-18**
RANK		**5**	**1**	**7**	**2**	**3**	**4**	**6**	**8**

Relative Change:
1 0 to 25 percent change
2 25 to 50 percent change
3 50 to 75 percent change
4 75 to 100 percent change
5 over 100 percent change

Positive numbers indicate an increase in habitat capacity.
Negative numbers indicate a decrease in habitat capacity.

Overall Rank represents the sum of the index values for change relative to historic abundance from high (most benefit) to low (least benefit).

[a] Includes both western grebes and Clark's grebes, which were not differentiated in the field.
[b] Includes both long-billed and short-billed dowitchers.

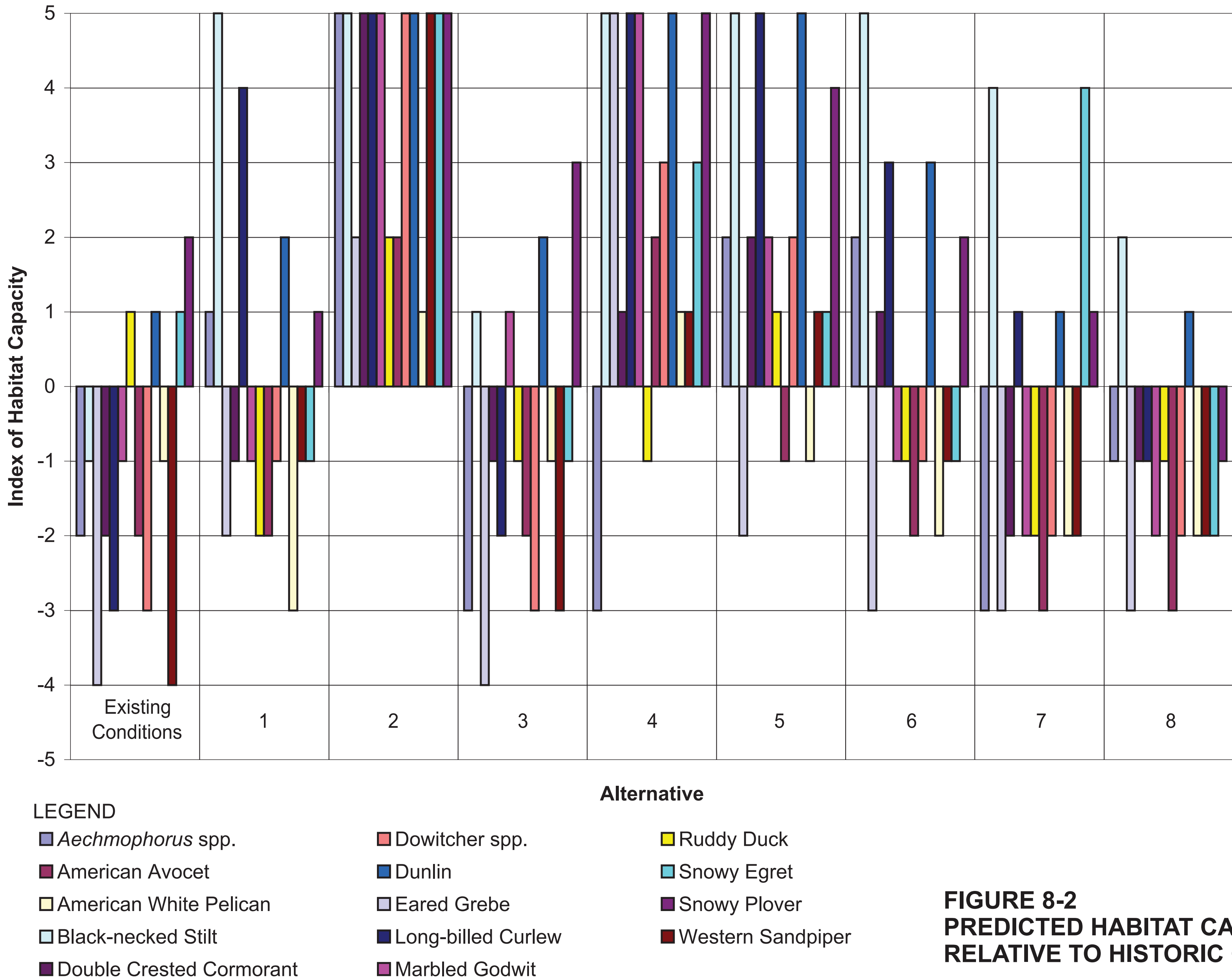

FIGURE 8-2
PREDICTED HABITAT CAPACITY RELATIVE TO HISTORIC CONDITIONS

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In general, the results of the modeling suggest that the levels of birds at the Salton Sea in 1999 (the baseline information used in the model) was lower than historic levels for most of the species evaluated.[1] Because the analysis relied on observed densities in 1999, predicted habitat capacity for the action alternatives also reflects the lower levels (and density) of birds observed relative to historic conditions. Differences between alternatives reflect differing amounts of various habitats that would be available and the higher densities of most species that could be supported in the Saline Habitat Complex. Some species (e.g., eared grebe, black-necked stilt) are observed at higher densities in higher salinity habitats and the predicted habitat capacity is higher for alternatives that provide this type of habitat. The habitat capacity associated with Alternative 2 was higher than historic levels for all species evaluated, suggesting that conditions under Alternative 2 at the end of 75 years could support greater numbers of birds on average than occurred historically. The large habitat capacity associated with Alternative 2 reflects the relatively large amount of Saline Habitat Complex and the high densities (for many species) that can be supported in this habitat type. Alternatives 4 and 5 also would perform better than historic conditions, although several species (most notably eared grebe under Alternative 5) could experience a decline in habitat capacity relative to historic conditions. The lower habitat capacity for eared grebe under Alternative 5 (and Alternatives 3, 6, 7, and 8) is due to the smaller amount of higher salinity habitat preferred by this species. While Alternative 3 and Alternative 4 have a similar configuration, Alternative 4 performs better for most species because of the added area available in the Fourth Lake and because the salinity in the Fourth Lake would be higher. Higher salinity in the Fourth Lake favors some species such as eared grebe and western sandpiper. The remaining alternatives would support substantially less habitat capacity, and Alternative 8 would support the least habitat capacity for the birds evaluated, although it still would be similar to the levels associated with the 1999 values that served as the basis for the model and Existing Conditions.

Next Steps

During the project-level analyses, detailed biological field investigations would be conducted to determine specific locations of fish and wildlife resources. Experienced biologists and resource managers would use this information to develop specific biological impact avoidance criteria and assist in the development of engineering design criteria. The project-level design would consider a range of construction techniques and schedules as well as facility locations to minimize the impacts on biological resources. Locations of facilities or excavation activities could be needed to avoid areas with sensitive, protected or limited biological resources.

During future detailed project-level analyses the following plans, evaluations and mitigation measures should be considered:

- Avoid disturbance of breeding or roosting special status birds by scheduling the construction or maintenance activities near those habitats outside the breeding season and times of large roosting aggregations. Impacts of habitat loss could be partially offset by creation of similar habitats;
- Avoid or minimize impacts to desert pupfish during drain extension and construction of the Pupfish Channels by conducting surveys prior to the work, capture and relocation of individuals in the work area consistent with the Service and DFG recommendations, scheduling the work to avoid the breeding season, and isolating the work area so that desert pupfish cannot enter;
- Develop an adaptive management program;

[1] It should be noted that current conditions (2006) at the Salton Sea likely support lower densities of some bird species than in 1999. Thus, habitat capacity for some bird species under Existing Conditions (as of 2006) might be lower than 1999 relative to historical conditions. Species for which the model in some alternatives indicated decreased habitat capacity relative to Existing Conditions may have improved habitat capacity relative to current conditions.

- Develop a comprehensive monitoring program that will generate the information needed to assist in the project-level design and future adaptive management;
- Conduct pilot projects to confirm assumptions about colonization of Saline Habitat Complex by invertebrates, fish, and birds;
- Develop a plan to evaluate the efficacy of the installation of snags, islands and other resting/loafing areas in managed habitats;
- Evaluate the need and methods for incorporating areas of freshwater within Saline Habitat Complex to accommodate the requirements of breeding birds and their young.
- Determine the appropriate ratio of wetted to dry areas within the Saline Habitat Complex necessary to maximize the habitat value.
- Develop a maintenance plan for the Sedimentation/Distribution Basins that minimizes dredging in wetlands in both time and space;
- Explore alternative to connect populations of desert pupfish in San Felipe and Salt creeks and the agricultural drains, including piping river channels to the Brine Sink;
- Evaluate the efficacy of installing pumps or fish screens that would avoid or minimize the potential to injure or kill desert pupfish;
- Develop a genetic exchange plan for those alternatives that do not achieve connectivity among desert pupfish populations;
- Evaluate the effectiveness of constructing and closing the southern portion of the First Ring under Alternative 3 to create functioning habitat while the northern portion of the First Ring is constructed;
- Prior to project-level design, implement studies to further characterize the distribution of selenium in the sediments, especially in the interior portion of the Salton Sea, and collect additional co-located biota, sediment, or water samples to refine predictions of selenium risk and reduce uncertainty. Modify design to minimize selenium uptake in the food web; and,
- If recreation is to be considered in all or part of restored habitats, develop plans and criteria to protect special status resources. Development of the plans could include surveys to determine the effects of recreation on avian resources, and the development of specific measures to reduce or avoid impacts.