Chapter 3 – Affected Environment

3.1 Introduction

This chapter describes the environment that may be affected by the various management actions presented in Chapter 2 for the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR. The affected environment includes important habitats and resources within and around the southern end of San Diego Bay and the westernmost reaches of the Otay and Sweetwater Rivers. The project study area (Area of Potential Effect) is depicted Figure 3-1. The Sweetwater Marsh Unit is made up of five distinct areas, including the F&G Street Marsh, Sweetwater Marsh, Gunpowder Point, D Street Fill, and Paradise Marsh (refer to Figure 1-3). The South San Diego Bay Unit includes three distinct areas; the Otay River floodplain, the salt ponds, and the open bay (refer to Figure 1-4).

3.2 Regional and Historic Setting

The Sweetwater Marsh and South San Diego Bay Units encompass approximately 2,620 acres of land and water located in the southern portion of San Diego Bay in San Diego County, California. The lands and waters included within the San Diego Bay Refuge abut the urbanized communities of National City, Chula Vista, San Diego, Imperial Beach, and Coronado. Refuge habitats offer resting, foraging, and nesting areas for an abundant and diverse assemblage of birds, as well as habitats that support a variety of fish and marine and terrestrial invertebrates, and a smaller array of amphibians, reptiles, and mammals.

Approximately 2,100 acres of open water within San Diego Bay are included within the acquisition boundary of the South San Diego Bay Unit. Of that total, approximately 1,000 acres are currently managed as a NWR (refer to Figure 1-5). San Diego Bay is a natural, nearly enclosed crescent-shaped embayment that originated from alluvial plains of the Otay, Sweetwater, and San Diego Rivers. The bay has a water surface area of approximately 17 square miles at mean lower low water (MLLW) and a total length of approximately 15 miles (*SDUPD 1990*).

San Diego Bay is located within an area referred to as the Southern California Bight, a curve in the southwestern California coastline that extends from Point Conception to just south of the Mexican border. The marine ecosystem and overall biodiversity within the Southern California Bight are influenced by the dramatic change in the angle of the coastline, which creates a significant backwater eddy. This backwater eddy results in the northern flow of equatorial waters along the nearshore and the southern flow of subarctic waters offshore. The biological transition zone that occurs between these warm and cold waters supports approximately 500 marine fish species and more than 5,000 invertebrate species (*Southern California Coastal Water Research Project 1998*).

San Diego Bay receives minimal freshwater input and has a high evaporation rate. Freshwater contributions come primarily from the Otay and Sweetwater Rivers, with some minor input provided by several small creeks. Historically, the bay floor and margins were characterized by sand, silt, clay, mud, and mudstone. Today, sand particles dominate the sediments at the mouth of the bay, while finer mud and silt deposits occur in the South Bay.

An 1859 survey map of San Diego Bay (Figure 3-2) indicates that prior to human disturbance, the South Bay consisted of coastal salt marsh, intertidal mudflats, and shallow subtidal (less then 12

Figure 3-1
San Diego Bay NWR Comprehensive Conservation Plan
Project Study Area (Area of Potential Effects)

N

0 0.25 0.5 Miles

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

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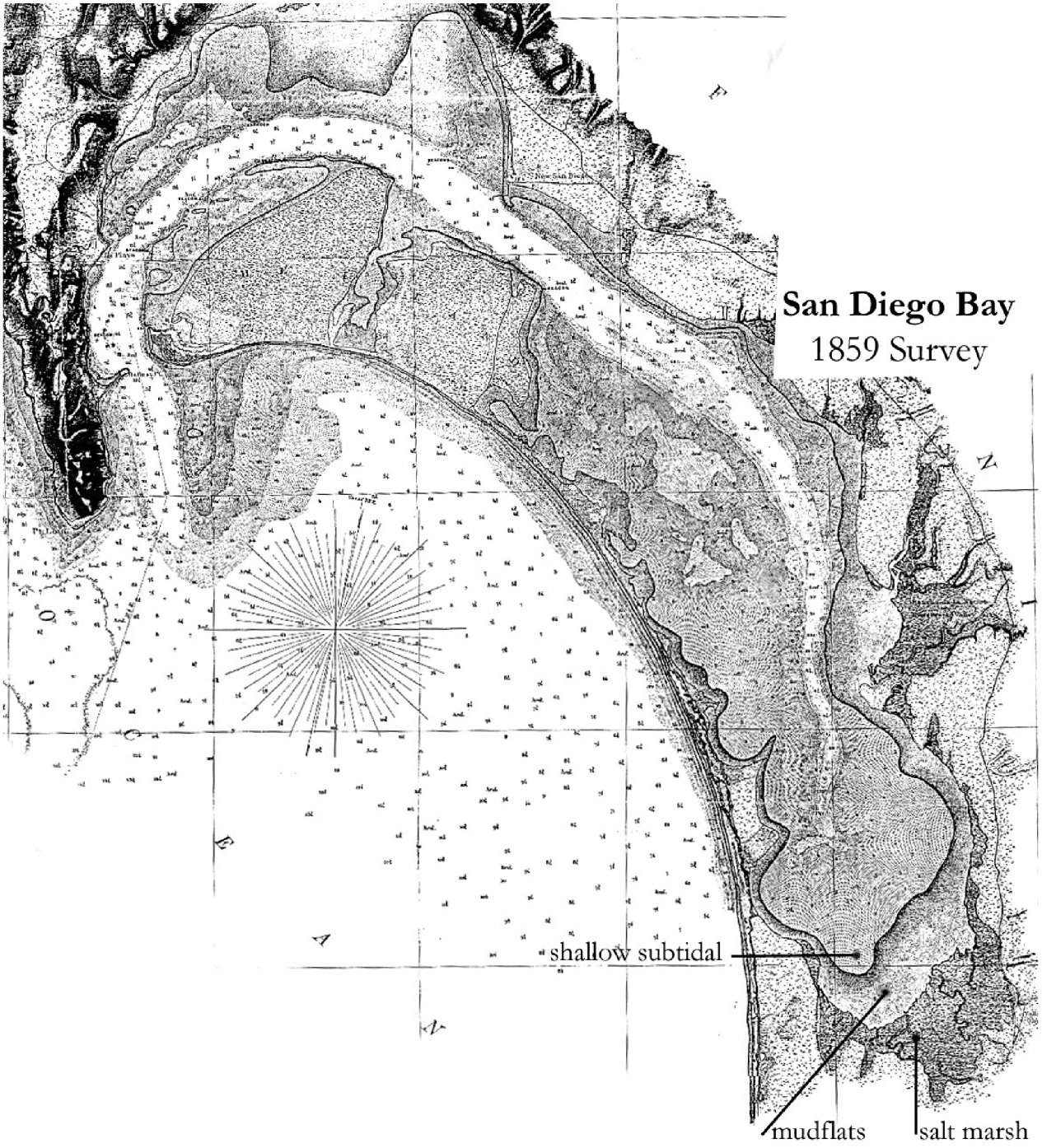

Figure 3-2
Historical Condition of San Diego Bay (1859)

N

No scale.

Source: Survey of the Coast of the United States, Coastal Survey Office, 1859.

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feet in depth) habitats. A deep narrow channel extended from the mouth of the bay to about the southern end of what is now the Sweetwater Marsh Unit. This channel is considerably deeper and wider today, as a result of years of dredging to accommodate military and commercial ship passage. A significant portion of the upper and central bay has been dredged to accommodate various port activities, with much of the dredge material used to fill in the adjacent tidelands.

Unlike the northern and central portions of the bay, the South Bay has experienced only limited dredging and filling activity. Those areas that have been filled include the area now occupied by the Chula Vista Wildlife Reserve and the industrial areas to the north and east of the Chula Vista marinas (refer to Figure 1-6). Dredging has occurred on the east and west sides of the South Bay to create channels deep enough to accommodate boat passage from the main part of the bay into the Coronado Cays and the Chula Vista Marina. Another remnant channel was also created in Emory Cove.

A significant area of historic coastal salt marsh habitat is protected along the eastern edge of the south bay within the Sweetwater Marsh Unit of the San Diego Bay NWR Refuge. This habitat supports a variety of migratory shorebirds and wintering waterfowl, as well as the endangered light-footed clapper rail, a year-round resident of the marsh. Although the upland areas on this Unit have experienced extensive human disturbance, today, portions of these uplands provide important habitat for ground nesting birds. Other upland areas provide opportunities to restore native upland and wetland habitats that historically occurred here. The Sweetwater Marsh Unit provides habitat for two federally endangered bird species, the California least tern and light-footed clapper rail, one threatened species of bird, the western snowy plover, and one endangered plant species, salt marsh bird's beak. The American Bird Conservancy has designated this Refuge Unit as a Globally Important Bird Area.

The most significant change to the natural environment within the southern end of the bay can be attributed to the creation of solar salt evaporation ponds, which are still used today to produce salt. At its peak, the salt works occupied an area of approximately 1,300 acres. Today, the salt works occupies approximately 1,060 acres. Figure 3-3 illustrates the natural condition of the bay in 1859 and the extent of salt marsh habitat that has been lost to the creation of the salt works and other uses over the last 140 years. The salt pond complex, which consists of diked open water cells with differing levels of salinity, provides roosting habitat for a variety of migratory birds during high tide, supplemental foraging habitat for various shorebirds, and primary foraging habitat for other species such as phalaropes and eared grebes. The salt pond levees also provide nesting habitat for a variety of ground nesting birds, including the endangered California least tern, the threatened western snowy plover, and an array of other tern species, some of which only nest in a few locations in the United States. The American Bird Conservancy has designated the South San Diego Bay Unit as a Globally Important Bird Area due to the presence of globally significant numbers of nesting gull-billed terns and continentally significant numbers of surf scoters, Caspian terns, and western snowy plovers. The entire southern end of San Diego Bay, including the Sweetwater Marsh and South San Diego Bay Units, has also been recognized as a Western Hemisphere Shorebird Reserve Network Site.

Very little natural habitat remains on the upland areas adjacent to the bay, and only scattered remnants of the coastal estuaries that once occupied the lower reaches of the Sweetwater and Otay Rivers have been preserved. The majority of this remaining natural habitat within the south bay is protected within the boundaries of the San Diego Bay NWR. Opportunities to restore native uplands and important wetland/upland transition areas are available on both the Sweetwater Marsh and South San Diego Bay Units.

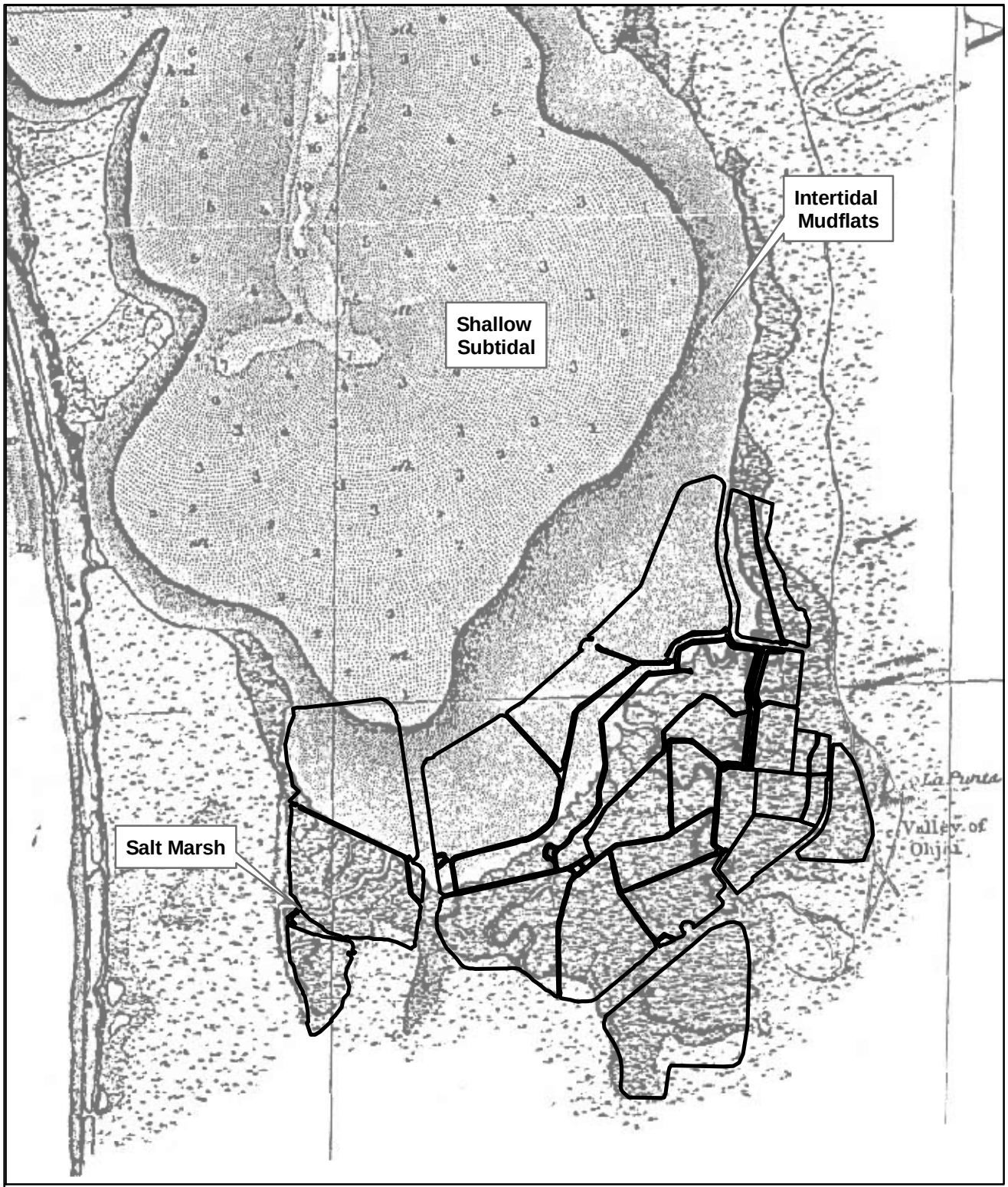

Figure 3-3
Comparison of Historic and Existing Conditions in the South Bay

Salt ponds

N

0 1,000 2,000 Feet

Sources: Survey of the Coast of the United States, Coastal Survey Office, 1859; USFWS

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3.3 Physical Environment

Elements of the physical environment include climate, geology, soils, agricultural resources, topography/visual quality, hydrology/water quality, contaminants and noise.

3.3.1 Climate

Coastal San Diego County's mild, year-round climate is characterized as subtropical Mediterranean, with dry, warm summers and wet, cool winters. The average annual temperature is 60.4 °F, with an average high temperature of 67.3 ° F and an average low temperature of 53.4 ° F (*USFWS 1991*).

Along the coast, fog is common in the summer and seasonal rainfall averages 10 inches (25.4 centimeters) between November and March. Upstream in the coastal drainages the mean annual precipitation is closer to 19 inches (48.26 centimeters). Annual precipitation is extremely variable in this region. For example, over the past century annual precipitation has ranged from 3.02 inches (7.67 centimeters) to 26 inches (66.04 centimeters) at the San Diego gauge (*City of San Diego 2001*). The 3.02 inches of rainfall received in San Diego between July 1, 2001 and June 30, 2002 represents the driest year on record (*NOAA 2002*).

Winds over the bay are usually breezy (about 10 knots), although the area also experiences stronger seasonal and diurnal winds. During much of the year, westerly winds increase in the afternoon as cool air moves inland. Calmer evening and early morning easterly winds are common in the winter. Stronger winds, associated with cold fronts moving through the region, are also likely at times during the winter months. Easterly Santa Ana winds may be quite strong in the fall, driven by high pressure over inland deserts. Winds are generally greater south of the Coronado Bridge than north of it, with the greatest wind speeds in the central South Bay, west of the Sweetwater Channel (*U.S. Navy 2001*). Prevailing winds in the vicinity of the salt ponds are from the northwest.

3.3.2 Topography/Visual Quality

3.3.2.1 Sweetwater Marsh Unit

The wetlands and uplands of the Sweetwater Marsh Unit occur on a gentle westerly-sloping wave-cut abrasion terrace. The overall inclination is about 1 foot per 100 feet (*Keller 1991*). Gunpowder Point, situated just a few feet higher than the surrounding marsh at about 10 feet Mean Sea Level (MSL), is the most prominent natural upland area within the Unit. This area consists of exposed Bay Point Formation. The flat, manmade uplands that form the D Street Fill are also situated at about 10 feet MSL. Paradise Marsh, located to the north of the main Refuge area, is confined by a Bay Point Formation terrace, which forms the natural bluffs along the northwest margin of the marsh. Exposed Bay Point Formation also isolates the F&G Street Marsh from the other wetland areas within the Refuge. This marsh occurs within a broad, drainage that flows southward to the bay.

The lack of significant topographic relief across the Refuge facilitates broad views of the Refuge from I-5, portions of E Street in Chula Vista, Pepper Park in National City, and from across the bay along the Silver Strand. The most prominent visual features on the site as viewed from outside the Refuge include the Chula Vista Nature Center, the Refuge office, interpretive elements along the public trail system, and a few non-native trees planted prior to the establishment of the Sweetwater Marsh Unit.

3.3.2.2 South San Diego Bay Unit

The predominant topographic features of this open water dominated Refuge Unit include the levee system within the salt works, the Chula Vista Wildlife Reserve, and the uplands of the Otay River floodplain. Portions of the Chula Vista Wildlife Reserve extend above the highest high tide levels and are visible from the public areas around the Chula Vista Marina, the north end of salt ponds, and from across the bay along the Silver Strand. The levees that form the salt ponds at the south end of the bay are visible from the bay and much of the developed upland areas that border the bay to the south. The relatively flat Otay River floodplain gently slopes from southeast to northwest, with elevations ranging from about 18.5 feet to 9.5 feet above MSL.

3.3.3 Geology and Soils

3.3.3.1 Sweetwater Marsh Unit

Geologically, the Sweetwater Marsh Unit is situated on the westerly-sloping Nestor Terrace, one of a series of well-defined wave-cut abrasion terraces created during the Pleistocene glacial episodes (*Keller 1991*). This Unit is underlain by the Bay Point Formation, which dates to approximately 120,000 years. This geologic formation is exposed on Gunpowder Point. Overall, Gunpowder Point consists of a combination of Bay Point Formation and unnamed, nearshore, marine sandstone (*Kennedy and Tan 1977*). The lower portions of the Refuge Unit, particularly the wetland areas, consist of undifferentiated alluvium and slope wash.

The predominant soils within the coastal wetland areas of the Sweetwater Marsh Unit are identified as tidal flats, while the upland areas on Gunpowder Point are overlain by Huerhuero loam (*USDA 1973*). The constituents of tidal flats can range from clays to very fine sands. Huerhuero loam consists of sandy to clay loam and is characterized by very slow permeability and slow to medium runoff. The erosion hazard is considered slight to moderate.

The D Street Fill was created in 1969 as part of a dredging project in which dredge spoils from the construction of the Sweetwater Channel and the National City Marina were deposited within an existing wetland on habitat similar to that found in Sweetwater Marsh. Today, the D Street Fill consists of vegetated and unvegetated dredge spoil with elevations ranging from 2 to 12 feet above MSL.

3.3.3.2 South San Diego Bay Unit

Approximately 130 acres of upland are included within the South San Diego Bay Unit with open water and salt ponds dominating the remainder of the Refuge. These upland areas are located at the southeast corner of the Refuge, within the Otay River floodplain. This floodplain consists of soft Alluvial/Bay Deposits overlain with three to five feet of uncompacted fill soils (*GEOCON 1986*). Uncompacted fill soils, characterized as loose, dry to moist, tan to brown silty sands and sandy silts occur throughout much of this upland area, as well as within the levees that surround Pond 20A (*GEOCON 1986*).

The Alluvial/Bay Deposits that occur below the fill soils in the Otay River floodplain consist of loose to moderately dense, silty sands and soft to firm, sandy clays. Exploratory borings conducted in this area in 1986 indicated that a majority of the sand deposits within the upper 15 to 20 feet of the existing grade possess a relative density ranging from approximately 60 to 80 percent (*GEOCON 1986*). A fairly dense gravel layer was also identified approximately 25 to 30 feet below the existing ground surface and groundwater was encountered at elevations ranging from about +3 to +8 feet above MSL.

The Soil Survey (*USDA 1973*) characterizes the soils to the west of Saturn Boulevard and within Pond 20A as Grangeville fine sandy loam, a soil type typically found on alluvial fans and alluvial plains. The fertility of this soil is high and permeability is moderately rapid. Runoff is very slow and the erosion hazard is slight. This soil has a water holding capacity that ranges from six to eight inches.

The area located generally to the east of Saturn Boulevard is characterized as Visalia sandy loam (*USDA 1973*). Similar to Grangeville fine sandy loam, runoff is slow and the erosion hazard is slight. Permeability is moderately rapid and the available water holding capacity is eight to 9.5 inches.

Other soil types within this portion of the Refuge include Riverwash, which occurs within the Otay River channel and Nestor Creek. This soil type consists of a range of particle sizes from sandy to gravelly to cobbly. Along the northern edge of Imperial Beach, between the Bayshore Bikeway and the river channel, the soil is characterized as Huerhuero urban land complex (*USDA 1973*). This soil occurs on marine terraces where the material exposed in cuts consists of unconsolidated sandy marine sediments. This soil type is easily eroded.

No known faults exist within this Refuge Unit, however, the potential for liquefaction is relatively high, as is the potential for settlement should fill soil be placed on existing surfaces. GEOCON (*1986*) concluded that based on existing soil characteristics the placement of six to 12 feet of fill soil over the existing ground surface could cause settlement ranging from six to 10 inches in depth.

Excavated borings in the vicinity of Pond 20A indicate that at least 40 acres of this area historically supported salt marsh habitat (*Michael Brandman Associates 1989*). This historical salt marsh was established on soils that include a variety of sediment sizes ranging from clay to sand. This is consistent with the types of soils found at other river mouth wetlands, such as the Tijuana River Estuary.

In 1985, a series of exploratory borings were excavated within the salt works on the levees and adjacent upland areas (*GEOCON 1985*). Although this study did not provide any information about soil characteristics on the bottoms of the salt ponds, it does provide general information about the soil characteristics below the ponds. The investigation revealed that the levees are overlain by two to seven feet of fill soils composed of loose to moderately dense, silty sand and sandy gravel. Underlying these fill soils are Bay Deposits, Older Bay/Alluvial Deposits, and Bay Point Formation. The majority of the salt works is underlain by Bay Deposits, which consist primarily of soft bay muds. The thickness of the Bay Deposits varies from about 23 feet near the center of the salt works to less than five feet at the eastern edges of the crystallizer ponds. Older Bay Deposits/Alluvium occurs below the Bay Deposits and is comprised of saturated, firm, silty sandy clays and moderately dense to dense silty sands. The Bay Point Formation was encountered below shallow Bay Deposits and/or Older Bay Deposits/Alluvium, and immediately beneath the fill soils along the southeastern edge of the Refuge. The soil characteristics of the Bay Point Formation include stiff to hard, sandy clays and dense to very dense silty sand (*GEOCON 1985*).

3.3.4 Agricultural Resources

3.3.4.1 Sweetwater Marsh Unit

The predominant soils within the Sweetwater Marsh Unit include tidal flats, which support coastal wetland habitat, and Huerhuero loam, which occurs in the vicinity of Gunpowder Point (*USDA 1973*). None of the soils within this Refuge Unit are identified as having agricultural importance on the 1998 San Diego County Important Farmland Map (*California Department of Conservation*

2000). However, the property just to the southeast of the Refuge boundary is identified as "Farmland of Local Importance." Gunpowder Point and the area to the southeast of the Refuge were farmed from about 1946 to 1986. Hothouse tomatoes were the largest crop produced on the site, although some additional row crops were planted in the 1970s and 1980s. No agricultural activities have occurred on the site since 1986.

3.3.4.2 South San Diego Bay Unit

The Otay River floodplain is overlain by soils that have been identified on the 1998 San Diego County Important Farmlands Map as Prime Farmland (*California Department of Conservation 2000*). The Department of Conservation defines Prime Farmland as land with the best combination of physical and chemical characteristics able to sustain long-term production of agricultural crops. The map also states that the land must have been used for production of irrigated crops at some time during the four years prior to the mapping date. Although this area was identified as Prime Farmland by the State in 2000, the property has not been in production since 1988.

The predominant soils within the area identified as Prime Farmland include Visalia sandy loam and Grangeville fine sandy loam (*USDA 1973*). Both soils are recognized as being good for farming. The site is located within the Maritime Climate Zone, a climate zone with temperatures and humidity that are strongly influenced by ocean conditions. This climate zone is characterized by narrow seasonal and diurnal temperature changes and high humidity which is considered favorable for agricultural production.

From the mid 1930s until about 1988, much of the Otay River floodplain was farmed. A wide variety of irrigated row crops were grown on the site, including bell peppers, beans, tomatoes, cucumbers, cabbage, and celery. Tomatoes were the principal crop until water and labor costs forced a change to alternative truck crops. Drip irrigation, double-cropping, and the use of polyethylene sheeting to protect early plantings from freezes all helped to improve production and increase the potential to compete with other markets. In 1986, the production of cucumbers on the property was profitable. However, due to uncertainties in the marketplace and increasing costs, the land was permanently taken out of agricultural production in 1988 (*CIC Research, Inc. 1987*).

In 1987 CIC Research Inc. prepared an assessment of the physical resources and economic feasibility of continued or renewed agriculture on this property. The results of this assessment indicated, "The overall quality of the site for continued agriculture is only moderate. The resource base is good. However, the location for direct marketing and ability to employ optimum management practices are sub-optimal. Water and labor costs are high relative to competing areas, causing a general rating of site attributes to be only moderate and not sufficient for the current and expected future competitive environments" (*CIC Research, Inc. 1987*).

3.3.5 Hydrology

The hydrological conditions within the San Diego Bay NWR are influenced by tidal processes and surface water runoff (freshwater flows entering the Refuge from various rivers, creeks, and minor drainages). Tidal inundation is essential to the coastal wetland habitats supported on this Refuge. The ebb and flow of tides within the bay circulate and mix ocean and bay waters and produce currents that influence salinity levels and temperatures throughout the bay (*U.S. Navy 2000*). The water levels in the bay vary with the astronomical tides, with water levels highest during high tide. In the Southern California Bight, the tides are of the mixed, semi-diurnal type, with two highs and two lows of unequal height occurring each lunar day (an average duration of 24.4 hours).

The tidal conditions in San Diego Bay are measured by the National Oceanographic and Atmospheric Administration (NOAA), which operates and maintains a long-term primary tide gage at Navy Pier near downtown San Diego. This gage has been in operation since 1900. Tidal measures collected over a previous tidal epoch (19-year period from 1960 – 1978) have been statistically reduced to obtain long-term average values of Mean Lower Low Water (MLLW), Mean Lower Water (MLW), Mean Tidal Level (MTL), Mean Higher Water (MHW), and Mean Higher High Water (MHHW). The highest observed water level in the bay, 8.35 feet MLLW, was recorded on January 27, 1983, and the lowest observed water level, -2.88 feet MLLW, was recorded on December 17, 1973 (*National Ocean Service Data, publication data 06/03/1991*).

The diurnal difference in the high MHHW and the low MLLW tides in the Bay is 5.6 feet, with extremes of 9.8 feet (*U.S. Navy 2000*). The highest tides occur in January and June. Water levels in the Bay are also affected by storm surge, El Nino-Southern Oscillation events, and long-term changes in sea level. The tidal characteristics in San Diego Bay are provided in Table 3-1. The effects of storm surge on water levels in the bay are relatively small; by contrast, El Nino conditions that tend to occur every four to seven years result in changes in water level that have led to increases in monthly MSLs of up to one foot in the Southern California Bight during the 1997-1998 season. Yearly MSL data recorded at San Diego indicates a rise in sea level of eight inches per century (*California State Lands Commission et. al. 2001*).

Those Refuge habitats that are located within the lowest reach of the watershed are also influenced by the quality and quantity of freshwater flows that pass through the Refuge and ultimately flow into the Bay.

3.3.5.1 Sweetwater Marsh Unit

The Sweetwater Marsh Unit is located at the western terminus of two watersheds, the Sweetwater watershed and the Pueblo San Diego watershed. Today, freshwater flows from the Pueblo San Diego watershed, the smaller of the two watersheds, flows into Paradise Marsh via Paradise Creek and Bannister Creek. Paradise Creek enters the northeast corner of Paradise Marsh via a channel

Table 3-1
Tidal Datums for San Diego Bay

Mean Tidal Datum	Tidal Statistics for San Diego Bay (feet)	
	Local MLLW Datum	NAVD88 Datum
Maximum Measured Water Level (01/27/1983)	8.35	7.70
MHHW	5.73	5.08
MHW	4.98	4.33
MTL	2.96	2.31
MSL	2.76	2.11
National Geodetic Vertical Datum – 1929 (NGVD)	2.72	2.07
MLW	0.94	0.29
MLLW	0.00	-0.65
Minimum Measured Water Level (12/17/1973)	-2.88	-3.53

Source: Published Tidal Datums for NOAA Tide Gage No. 9410170 (San Diego Bay)

under I-5. The creek then flows south through the marsh terminating at the Sweetwater flood control channel. The drainage basin for Paradise Creek is approximately six square miles. Prior to human disturbance, flows from Paradise Creek followed a major slough channel that meandered through a much larger Paradise Marsh, emptying directly into the Bay well to the north of the Sweetwater Channel. The historical alignments of the Sweetwater River and Paradise Creek as they existed in 1859 are illustrated in Figure 3-4.

Bannister Creek, with a drainage basin of approximately 0.75 square miles, is a much smaller drainage within the Pueblo San Diego watershed. This creek enters Paradise Marsh from the east, near the southern end of the marsh. This drainage collects runoff from an area developed with industrial uses.

The Sweetwater watershed encompasses approximately 230 square miles and extends from the Bay to the Laguna Mountains. The primary tributary within this watershed is the Sweetwater River, which has undergone significant changes over the past 100 years. Changes to the historic river system began in 1888 with the construction of the Sweetwater Reservoir. This was followed in 1945 by the construction of the Loveland Reservoir near the eastern end of the drainage. The construction of these dams has significantly reduced the volume of freshwater flowing from the watershed into the Bay. The Sweetwater Reservoir controls approximately 84 square miles of the drainage basin, while the Loveland Reservoir controls about 98 square miles of the basin. Major discharges of freshwater flows from the Sweetwater and Loveland Reservoirs occur only when the water levels in the reservoirs are high enough to permit flow over the dam spillways.

The configuration of the lower reach of the river has also been altered. This reconfiguration has significantly reduced the volume and frequency of the freshwater flows entering the intertidal habitats within the Sweetwater Marsh Unit. The first significant alteration to the historic alignment of the lower Sweetwater River occurred in the late 1960s in association with the construction of the D Street Fill. As part of this fill project, the river mouth was relocated to the southwest and a new channel was excavated to the south of the fill. The historical river mouth and slough channel (refer to Figure 3-4) were then buried beneath the 85-acre fill (*Philip Williams & Associates 1990*).

The configuration of the river was once again altered in the 1980s when the Corps began construction of the Sweetwater Flood Control channel. This project converted approximately 3.2 miles of natural river upstream of the marsh into a trapezoidal channel with earth bottom and riprap side slopes. It also diverted the flow of the river from the existing Sweetwater wetlands complex to the flood control channel. To reduce the impact of diverting the majority of the freshwater flows from the marsh, a freshwater diversion weir was constructed within the connector marsh to divert some of the freshwater storm flows from the flood control channel into Sweetwater Marsh via a connector marsh. According to the Service's Biological Opinion for the flood control project, dated March 30, 1988, the 150-foot-wide diversion structure would permit approximately 3,200 cubic feet per second (cfs) to enter Sweetwater Marsh during a combined maximum high tide and 500-year storm. An additional 700 cfs would be expected to enter the marsh from urban areas to the east of I-5. This compares to a 66,000 cfs flow that would have occurred prior to the construction of the flood control channel.

When the flood control channel was constructed, a flashboard weir was installed at the south end of the tidal channel in Paradise Marsh. Although no flashboards were in place during a 1993 study to monitor the morphology of the marsh, monitors observed that the rock sill of the weir was preventing Paradise Marsh from draining below elevations of about 0.0 feet NGVD *(Philip Williams & Associates 1993)*. The weir does not appear to dampen the upper portion of the tidal

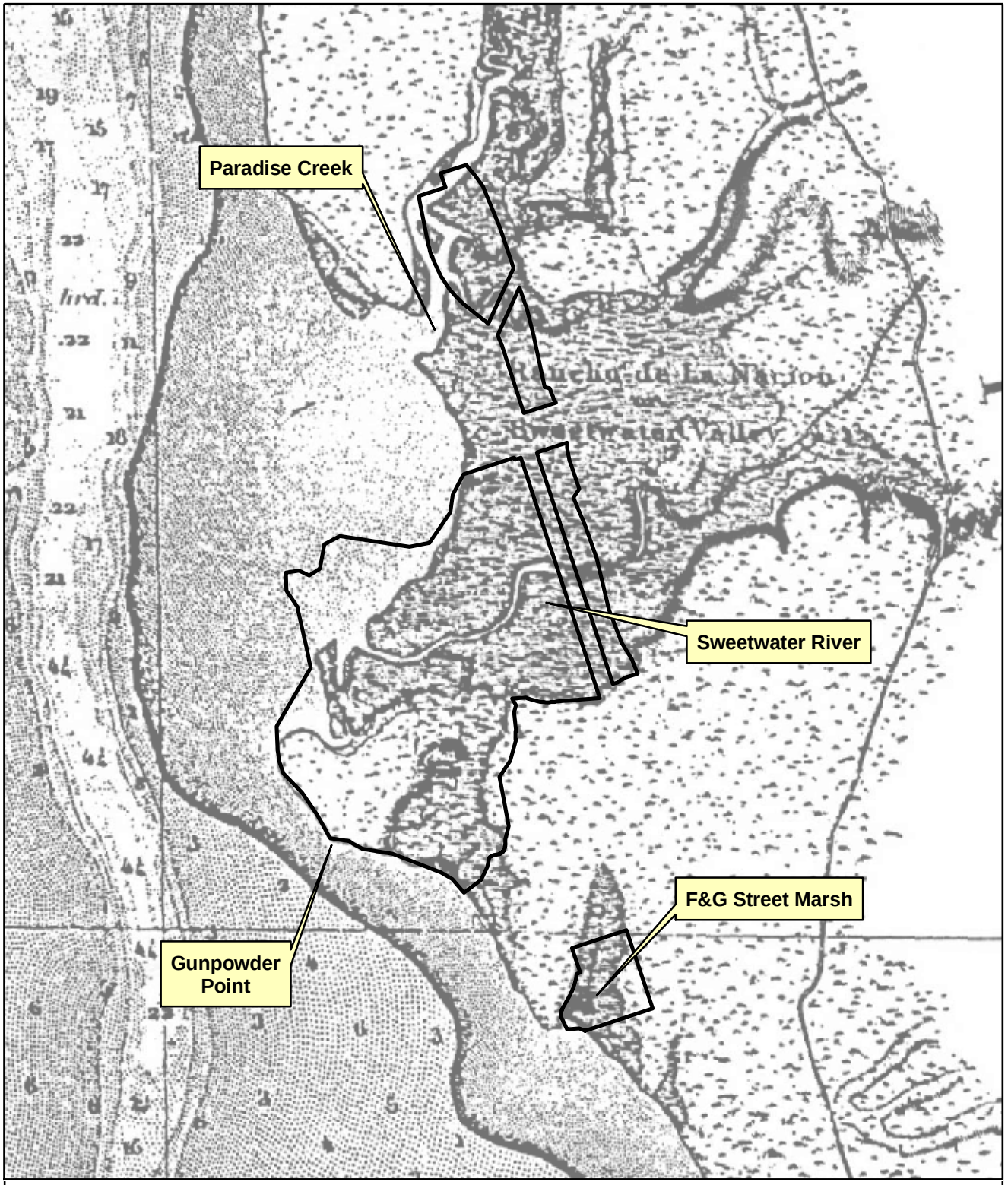

Figure 3-4
Historical View of the Sweetwater Marsh (1859)

Sweetwater Marsh Unit of the SDBNWR

N

0 500 1,000 Feet

Sources: Survey of the Coast of the United States, Coastal Survey Office, 1859; USFWS

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cycle, but it does significantly restrict lower tidal drainage. A more recent evaluation of the marsh by the City of National City (*2002*) indicates that the weir maintains water levels in the marsh at an elevation of approximately 4.5 to 5 feet MLLW. This situation is likely resulting in hypersaline (salinities in excess to sea water) sediment conditions and sedimentation that could lead to channel accretion. Further, the lack of drainage may be affecting soil saturation characteristics and could have a long-term negative effect on vegetation. Philip Williams & Associates suggested in the 1993 monitoring report that the natural slough channel should have an invert elevation at the location of the weir of –2.0 to –4.0 feet NGVD, with a 40 to 50-foot top width and a cross-sectional area of about 120 square feet below MHHW. The report further recommended that if there are no good reasons for maintaining the weir, it should be removed or at least lowered to a depth sufficient to allow a natural channel to develop.

3.3.5.2 South San Diego Bay Unit

The majority of the open water within the southern end of San Diego Bay is included within the approved acquisition boundary of the South San Diego Bay Unit (refer to Figure 1-5). Also included within this Unit are most of the salt ponds within the South Bay Salt Works and the westernmost reach of the Otay River and its associated floodplain.

The majority of the freshwater flows entering the South Bay originate from the Sweetwater and Otay watersheds. Major watercourses in these watersheds include the Sweetwater River, Otay River, Telegraph Canyon Creek, and Nestor Creek. Several smaller drainages also enter the bay including an unnamed drainage that flows between Ponds 15 and 28, entering the bay near the South Bay Power Plant cooling outfall.

The specific drainage basins that terminate near the southernmost end of the Bay include the Telegraph Canyon Creek Basin, which enters the bay just to the north of the Chula Vista Wildlife Reserve; the Otay River Basin, which flows from the east under I-5 and through the southern end of the Refuge; and the South Bay Drainage Group, which includes the Nestor Creek drainage (*U.S. Navy 2000*). All of these drainages have been substantially altered as a result of urban development. Within the Refuge, the natural flow of the Otay River from I-5 west was altered in the early part of the twentieth century to accommodate the development of the salt works and the construction of a railroad. Nestor Creek, which conveys runoff from the adjacent community, enters the Refuge from the south.

The Otay River drains a watershed of approximately 143 square miles, extending for a distance of 25 miles east from San Diego Bay to the Cleveland National Forest. The hydrologic conditions in the lower reach of the watershed are influenced by the presence of the Upper and Lower Otay Reservoirs. These reservoirs, which control approximately 69% of the watershed, reduce the frequency of flows in the river and capture sediments that historically were carried by the river into San Diego Bay. Immediately upstream of the project site, past and current sand and gravel operations have altered the characteristics of the river through open pit mining in the streambed, which has created a series of ponds that act as sediment traps, capturing sediments carried by the river during storm flows.

Historic maps from the mid 1800s illustrate the natural configuration of the Otay River delta prior to human disturbance (refer to Figure 3-2). Prior to disturbance, the Otay River mouth consisted of a series of three or four shifting channels that flowed generally to the northwest across a gentle sloping alluvial fan (*Michael Brandman Associates 1989*). The shading between the major channels that is depicted in Figure 3-2 indicates a tidal marsh environment that was regularly inundated. Near the bayward fringe of this historical salt marsh, smaller tidal-slough type

channels existed that would have conveyed ebb and flood tides to and from the outer marsh plain (*Philip Williams and Associates 2002*).

Since the early 1900s, the Otay River floodplain has experienced significant disturbance that has impaired the natural hydrologic, geomorphic, and ecologic functions of the river/marsh plan complex. These disturbances include the construction of the salt ponds, the realignment and constriction of both the Otay River channel and the Nestor Creek drainage, the construction of the railroad along the south end of the salt ponds, and development and operation of a sewer treatment facility near the northeast corner of Pond 20A in the 1950s and 1960s. In addition, the flood of 1916 deposited an undetermined amount of sediments within the marsh plain.

Today, the Otay River enters the Refuge just west of the I-5 bridge. It extends west and then northwest for approximately 2,500 feet before turning sharply to the west, and then to the southwest, following the southern edge of the salt pond levees. Nestor Creek, a comparatively small tributary to the Otay River, conveys local runoff from the community of Nestor, northward under Palm Avenue, flowing east of Pond 20A until it joins the Otay River. Downstream of the Otay River/Nestor Creek confluence, the Otay River channel is confined between the Pond 20A levee to the south and other salt pond levees to the north, resulting in a hydraulic constriction. Approximately 1,000 feet downstream of the Nestor Creek confluence, the Otay channel splits into two parallel reaches, separated by the railroad right-of-way. The southern reach of this channel appears to carry the majority of the freshwater low flows, while tidal flows extend upstream into both channels. This side-by-side channel configuration continues for roughly 1,500 feet until the two reaches reunite as one channel. The Otay River then continues to flow approximately one mile northwest and then straight north, discharging into the bay (*Philip Williams & Associates 2002*).

The natural upland portion of the Refuge is included within the 100-year floodplain of the Otay River and most of this area is also delineated as floodway by the Federal Emergency Management Agency (FEMA). This lower portion of the Otay River represents a transitional hydrologic zone that is influenced by both the freshwater flows of the river and the tidal flows of the estuarine system that occur near the river mouth. Within this zone, a complex mixing of freshwater, brackish, and tidal flows occurs. Tidal flows from the bay enter the river channel and extend approximately 1,500 feet upstream from the river's confluence with Nestor Creek. The tidal flows, characterized by diurnal (daily) and spring-neap (monthly) variations, inundate the lower reaches of the Otay River and Nestor Creek channels twice daily. In contrast to the tides, freshwater flows from the watershed to the Otay River and Nestor Creek are relatively sparse throughout the year (*Philip Williams & Associates 2002*). During extreme rainfall events, however, freshwater flows would be expected to dominate the system, typically exceeding channel capacity and flooding much of the Refuge's upland area, as well as many of the surrounding properties.

Alterations to the river channel have created a longer channel to the Bay that is constrained on both sides by levees to prevent freshwater overflow into the salt ponds. These two factors severely limit the channel capacity, and during major flood flows, the river backs up and causes shallow flooding over properties located in the immediate vicinity of the Refuge, including the mobile home park located to the south of the Refuge, the parking lots within the commercial center to the east of Saturn Boulevard, and Swiss Park and other properties to the north of Main Street (refer to Figure 2-5 of Appendix I for specific locations). In addition, previous modeling analyses, observed flood levels, and published FEMA Flood Insurance Studies all indicate that during extreme flood events, excess flows from the Otay River will overtop the salt pond levee system at several locations. This was confirmed by recent modeling analyses conducted for the lower Otay River (*Philip Williams & Associates 2002*). The modeling analysis indicated that during a 100-year

flood, localized overbank flooding would begin almost immediately with the onset of a flood event. Overbank flooding would be exacerbated by the hydraulic constriction between the Pond 20A levee to the south and the other salt pond levees to the north. Water levels would continue to rise until the levels exceed the height of the adjacent levees, at which time the flood waters would overflow into the neighboring salt ponds, possibly impacting Ponds 20 and 22. Although the sediment delivery into the ponds from the floodwaters would be low, sediments within the ponds would likely be redistributed in association with levee overtopping. The existing peak water surface elevations under 100-year flow conditions, as determined by the model, are provided in Table 3-2.

Table 3-2
Existing Peak Water Surface Elevations Under 100-Year Flow Conditions

Location[1]	Ground Level Elevation (feet – NAVD88)	Water Surface Elevation (feet – NAVD88)
A. Approximately 1,000 feet downstream from the I-5 bridge	18.0	18.8
B. Location where the Otay River meets the salt works levee system	19.8	18.2
C. Confluence of the Otay River and Nestor Creek	15.9	17.9
D. Northwestern edge of Pond 20A	14.3	13.0
E. Nestor Creek, approximately 2000 feet upstream from the confluence of the Otay River	17.5	18.2

[1] See Figure 3-5 for comparison locations.
Source: (Philip Williams & Associates 2002)

Soil borings conducted within the Otay River floodplain in 1986 and 1989 demonstrated that groundwater occurs relatively close to the surface. In 1986, test borings encountered groundwater at 3 to 7 feet below the ground surface (+2 to +7 feet MSL), with a wetted zone (capillary fringe) assumed to extend approximately 1 to 2 feet above the recorded groundwater elevation (*GEOCON 1986*). Slightly brackish groundwater (2 to 3 parts per thousand [ppt]) was encountered in 1989, when an additional test boring was conducted in the north central portion of the floodplain (*Michael Brandman Associates 1989*). This investigation suggested that the groundwater elevations observed in 1986 had not changed significantly from the groundwater elevation noted during subsequent testing.

3.3.6 Water Quality

3.3.6.1 Overview

Water quality within the Sweetwater Marsh Unit during the dry season is influenced almost exclusively by tidal action in the bay, while freshwater inputs from Paradise Creek, the Sweetwater River, and various drainages and municipal storm drains influence water quality during periods of measurable rainfall. Although not yet quantified, water quality within this Refuge Unit could also be influenced by the presence of contaminants within the sediments of the marsh and adjacent parcels (see Section 3.3.8, Contaminants). This is particularly true in the vicinity of Paradise Marsh, the east end of Sweetwater Marsh, and F&G Street Marsh.

Within the South San Diego Bay Unit, which includes much of the southern third of San Diego Bay, the quality of the water within the Bay has the potential to influence a significant portion of the wildlife habitat within the Refuge. Water quality within this Unit is also influenced by freshwater flows from the Otay River and Nestor Creek during periods of heavy rainfall.

Figure 3-5
Reference Locations for Tables 3-2 and 4-1 Comparing 100-yr Water Surface Elevations

N

0 500 1000 1500 Feet

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

Carlsbad Field Office - 2003
/stem/stacey/ssdbay/fig_4-03/figures.apr

3.3.6.2 San Diego Bay

Between the early 1800s and the mid to late 1900s, water quality in San Diego Bay suffered serious degradation due to the discharge of untreated municipal sewage and a variety of toxic and nontoxic industrial wastes (*Michael Brandman & Associates 1990*). It has been estimated that in 1952 at least 50 million gallons of sewage and industrial wastes were being discharged into the bay (*U.S. Navy 2000*). The situation continued to deteriorate. In 1960, much of the bay was declared polluted due to high bacteria levels. As a result, all water contact activities were prohibited. It was not until 1964 that domestic sewage discharges into the bay, including those from San Diego, Chula Vista, Coronado, and the Naval Amphibious Base, finally ceased and the discharge was instead routed to an ocean outfall. By the early 1970s, major industrial process discharges had also been diverted to the Metropolitan Sewage System. At about the same time, the Navy began eliminating waste discharges into the bay and by 1980, all sewage and industrial waste discharges into the bay from naval operations ceased (*U.S. Navy 2000*).

Until the 1970s, pollution issues in the bay focused on bacterial contamination from discharged sewage, but as bacterial levels were reduced, the focus on the bay's water quality shifted to contaminants related to the discharge of industrial wastes. The effects of discharging heavy metals and toxicants into the bay were not clearly understood, prompting the initiation of several studies. The results of these studies indicated that much of the Bay's chemical pollution occurred in the bay sediments rather than in the water column. Further studies identified high levels of copper, tributyltin (TBT), polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) in bay sediments, prompting the identification of new actions to control the pollutant levels in the bay.

The San Diego Bay Interagency Water Quality Panel (Panel) was established in 1988 to address the Bay's water quality concerns, as well as to ensure the long-term viability of San Diego Bay. The panel initiated a number of technical studies in order to better understand the water quality issues in the bay. In 1992, the Panel was reauthorized and charged with the development of a comprehensive management plan and a coordinated monitoring program for San Diego Bay. A Comprehensive Management Plan for San Diego Bay was completed in 1998. The purpose of the plan is to "protect, manage, preserve, and enhance San Diego Bay's valuable and unique natural resources and beneficial uses for the enjoyment and benefit of present and future generations."

Also during the 1990s, the California Bay Protection and Toxic Cleanup Program was established to address pollution problems in bays and estuaries statewide. The goals of this program are to provide protection of present and future beneficial uses of the bays and estuarine waters of California; to identify and characterize toxic hot spots; to plan for toxic hot spot cleanup or other remedial or mitigation actions; and to develop prevention and control strategies for toxic pollutants. The 1996 California Bay Protection and Toxic Cleanup Program Report identified five discrete locations of sediment contamination, toxicity to marine life, and benthic community impairments within San Diego Bay (*City of San Diego 2002a*). In response, a Toxic Hot Spots Work Group was formed in 1999 that included the City of San Diego, the Port and the U.S. Navy. This group is working in cooperation with the San Diego Regional Water Quality Control Board (Regional Board) and the Southern California Coastal Water Research Project, to develop a comprehensive toxicity study for the bay.

In 1998, San Diego Bay was included on California's Section 303(d) list as an impaired water body by the California State Water Resources Control Board (SWRCB) due to benthic community degradation and toxicity. Section 303(d) of the Federal Clean Water Act (33 USC 1250, et seq., at

1313(d)) requires States to identify "water quality limited segments" and then rank each segment, taking into account the severity of the pollution and the uses to be made of the waters. A water quality limited segment is defined by regulation as "any segment [of a water body] where it is known that water quality does not meet applicable water quality standards, and/or is not expected to meet applicable water quality standards, even after application of technology-based effluent limitations required by Clean Water Act Sections 301(b) or 306." The section 303(d) list must include a description of the pollutants causing the violation of water quality standards. The section 303(d) list is required to be reviewed and updated every two years.

In 2002, California's Section 303(d) list was reevaluated and as a result, the SWRCB amended the previous list to designate only segments of the bay as impaired, rather than the entire bay. Two water quality limited segments identified within the Bay occur in proximity to the San Diego Bay NWR. These include the San Diego Bay Shoreline, north of 24th Street Marine Terminal segment and the San Diego Bay Shoreline, Chula Vista Marina segment. The 24th Street Marine Terminal segment is identified due to benthic community effects and sediment toxicity, while the Chula Vista Marina segment exceeds water quality standards for bacterial indicators. These sites were included on the State's list of water quality limited segments, which was approved by the Environmental Protection Agency (EPA) in July 2003.

As part of the 303(d) listing process, members of the public raised concerns regarding water quality in the vicinity of the South Bay Power Plant. After reviewing the data provided by the public, SWRCB staff determined that it would not be appropriate to list this area as a water quality limited segment because there is not adequate data available to confirm the possibility of impacts to beneficial uses caused by discharges from the power plant. This portion of the South Bay was placed on a Monitoring List because more information is needed to determine if water quality objectives are being attained. The SWRCB has stated that waters on the Monitoring List will be high priorities for monitoring before the next review of the Section 303(d) list is completed. In the past, monitoring at the South Bay Power Plant has focused on chlorine, copper and zinc levels, temperature, and turbidity. Recent studies associated with the plant's renewal of their discharge permit focused on chlorine, temperature, and turbidity.

The salinity and temperature characteristics of the South Bay differ from those areas to the north. This a result of the natural conditions that exist here, including shallow water depths and poor flushing, as well as human related conditions, such as the discharge of cooling water into the bay from the South Bay Power Plant. With respect to salinity, the area generally between the Coronado Bay Bridge and the Sweetwater Marsh Unit has been described as a seasonally hypersaline region. Here, water is stratified by salinity gradients induced by evaporation. The area south of the Sweetwater Marsh Unit is described as the estuarine region. In this region, residence time of bay water can exceed one month. During the summer months the evaporation rate can be as high as 62.7 inches (159 cm)/year, causing the bay water in this region to become hypersaline, or saltier than seawater. While conducting a fish inventory in San Diego Bay in the late 1990s, Allen (1999) observed that salinities in the bay varied depending upon the location in the bay and the time of year. Allen found that salinities in the bay were typically higher than 34 ppt, the average value for seawater. During the first two years of the study, salinities in the bay varied from 39.8 ppt to 33.4 ppt. In October 1996, the South Bay was particularly hypersaline (39.8 ppt).

Temperatures in the South Bay tend to be higher than in the northern end of the bay, although this is not always the case. In addition to the shallow depth of the water, temperatures in the South Bay are also influenced by the South Bay Power Plant, which discharges heated cooling water into the bay just south of the Chula Vista Wildlife Reserve. Studies of marine life in the

vicinity of the outfall indicate that the thermal pollution from the power plant discharge causes adverse effects to marine life within 1,801 to 3,901 feet (549 to 1,189 meters) of the discharge point (*U.S. Navy 2000*). Adverse effects to the marine life beyond the cooling channel were however determined to be minimal, mainly affecting crustaceans and gastropod mollusks. Additional monitoring is expected to occur as a result of this area's placement on the Monitoring List of Section 303(d) sites. Studies to evaluate the effects of the power plant's cooling intake and discharge on the bay environment have recently been completed in association with a request to reauthorize the plant's National Pollutant Discharge Elimination System (NPDES) permit.

3.3.6.3 Freshwater Systems

Urban runoff from streets, yards, and commercial and industrial areas is collected by the municipal storm water systems and until recently routinely discharged untreated into the bay, adjacent river, or local stream channel. Untreated runoff can not only adversely affect the water quality of receiving waters, but can also adversely affect wildlife and human health. The problem is generally greatest immediately following the first rainfall of an extended dry period (described as the first flush). However, urban runoff can cause problems year round due to many types of urban water uses that result in discharges to the storm water system, such as lawn irrigation, car washing, pool draining, and similar activities.

Ever increasing quantities of nonpoint source pollution in our local drainages lead to calls for new regulations to reduce urban runoff and the levels of containments carried by runoff. The Federal Clean Water Act amendments of 1987 established a framework for regulating storm water discharges from municipal, industrial, and construction activities under the National Pollutant Discharge Elimination System (NPDES) Permitting Program. As a result of these amendments, municipalities throughout the nation are required to obtain a Municipal NPDES Permit. The primary goal of the Municipal Permit is to stop polluted discharges from entering the storm water conveyance system and local receiving and coastal waters.

On February 21, 2001, Regional Board issued a Municipal Storm Water (NPDES) Permit to the City of San Diego, County of San Diego, Port, and 17 other cities. This permit required the development and implementation of storm water regulations to address storm water pollution issues in planning and construction for both public and private development projects. Specifically, development projects are required to include storm water best management practices (BMPs), both during construction and in permanent design, to reduce pollutants discharged from project sites to the maximum extent practicable.

Storm Water Standards have been developed in several municipalities surrounding the Bay that are intended to effectively prohibit non-storm water discharges and reduce the discharge of pollutants from storm water systems during construction and throughout the use of a developed site. In California, the SWRCB, through the nine Regional Boards, administers the NPDES storm water municipal permitting program. Any grading proposed on these Refuges in excess of one acre would require the incorporation of BMPs into the project design as part of the approval of a NPDES Permit (*Water Quality Order 99-08-DWQ - General Permit for Storm Water Discharges Associated with Construction Activity*) from the Regional Board.

In addition, in accordance with Section 401(a)(1) of the Clean Water Act, activities proposed on the Refuge that result in discharge of dredge or fill material into navigable waters of the U.S. would most likely require a 401 Water Quality Standards Certification from the Regional Board. Some of the permits that require a 401 Certification include permits issued under Section 404 of the Clean Water Act and NPDES permits issued by the U.S. Environmental Protection Agency (EPA) under Section 402 of the Clean Water Act. To obtain this certification, the Regional Board must certify

that the project will comply with water quality standards related to beneficial uses designated in the Basin Plan for water bodies in Region 9 (San Diego County), water quality objectives, and the Antidegradation Policy, which requires that existing high-quality waters be protected and maintained, unless the need to lower water quality is justified.

There are many factors known to cause poor water quality including temperature, sedimentation, runoff, erosion, dissolved oxygen, pH, decayed organic materials, pesticides, and an array of other toxic and hazardous substances. Surface and groundwater quality in the Sweetwater and Otay River watersheds have been described as degraded due to concerns related to coliform bacteria, trace metals, and other toxic substances. The sources of these pollutants are urban runoff, agricultural runoff, and faulty sewer and septic systems. Water quality monitoring during the rainy season is currently being conducted for both water basins. In addition, in September 2002 the County of San Diego announced it was initiating a watershed planning effort for the Otay River watershed. The purpose of this planning effort is to develop a Watershed Management Plan that will address issues related to conflicting or redundant wetland regulations, non-point source pollution, coastal water quality, recreation, flood management, and protection of groundwater, surface water supplies, wetlands, and habitat. The plan is scheduled to be completed in 2005.

3.3.7 Air Quality

The Sweetwater Marsh and South San Diego Bay Units are located within the southern coastal region of the San Diego Air Basin. Air quality within the basin is influenced to some extent by climatic conditions, particularly a common atmospheric condition known as a temperature inversion. During a temperature inversion, air temperatures get warmer with increasing height rather than cooler. Inversions occur during the warmer months (May through October) when descending air associated with the Pacific high-pressure cell comes into contact with cool marine air. The boundary between the layers of air represents a temperature inversion that traps pollutants below it. The inversion layer is approximately 2,000 feet MSL during the months of May through October, and approximately 3,000 feet MSL during the winter months (November through April). Inversion layers impact local air quality by inhibiting the dispersion of pollutants, which results in the temporary degradation of air quality.

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere, which is generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). A large body of scientific evidence associates air pollution exposure with a variety of harmful health effects. To protect human health, the EPA and the California Air Resources Board have adopted ambient (outdoor) air quality standards. These national and state health-based standards identify outdoor pollutant levels that are considered safe for the public, including those individuals most sensitive to the effects of air pollution, such as children and the elderly. These standards also provide the basis for determining the significance of a particular pollutant concentration.

The Federal Clean Air Act (42 U.S.C. §§ 7401-7671q) requires the EPA to set outdoor air quality standards for the nation, referred to as National Ambient Air Quality Standards (NAAQS). To date, standards have been established for sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter equal to or less than 10 microns in size (PM10), fine particulate matter equal to or less than 2.5 microns in size (PM2.5), and lead (Pb). The Clean Air Act also permits states to adopt additional or more protective air quality standards if needed. Within California, the California Ambient Air Quality Standards (CAAQS) set parameters for certain pollutants, such as particulate matter and ozone, that provide greater protection of public health than the respective Federal standards. California has also set standards for some pollutants

that are not addressed by Federal standards, including sulfates (SO_4), hydrogen sulfide (H_2S), and visibility reducing particles. The current national and state ambient air quality standards are provided in Appendix G.

New CAAQS will take effect over the next few years in response to the Children's Environmental Health Protection Act (*Senate Bill 25, Escutia 1999*), which requires the California Air Resources Board (ARB), in consultation with the Office of Environmental Health Hazard Assessment (OEHHA), to "review all existing health-based ambient air quality standards to determine whether, based on public health, scientific literature, and exposure pattern data, [the CAAQS] adequately protect the health of the public, including infants and children, with an adequate margin of safety." This review, which began with an analysis of particulate matter and sulfates, resulted in new, stricter standards for particulate matter. Effective July 5, 2003, the annual-average standard for PM10 was lowered from 30 $\mu g/m^3$ to 20 $\mu g/m^3$, which is not to be exceeded, and a new annual-average standard of 12 $\mu g/m^3$, which is not to be exceeded, was established for PM2.5. The 24-hour-average standards of 50 $\mu g/m^3$ for PM10 and 25 $\mu g/m^3$ for sulfates were retained. In October 2002, the ARB and OEHHA began their review of the CAAQS for ozone; however, the results of this review are not yet available.

The San Diego Air Basin is managed by the San Diego Air Pollution Control District (APCD). In accordance with its monitoring responsibilities, the APCD maintains an ambient air monitoring network and records air quality readings to determine compliance with national and California standards. Compliance with air quality standards is measured, based on these records,

Specific geographic areas are classified as either "attainment" or "nonattainment" areas for each pollutant based upon the comparison of measured data with NAAQS and CAAQS. When an air basin is in compliance with these standards, it is designated as an attainment area. Conversely, when an air basin is not in compliance with a National and/or California air quality standard, it is designated as a nonattainment area for that pollutant. The San Diego Air Basin is currently designated by the State of California as a "serious" nonattainment area for O_3 and a nonattainment area for PM10 and PM2.5. In 2001, the county met the one-hour National standard for ozone and was recently redesignated from a serious nonattainment area to an attainment area. The air basin is, however, a nonattainment area for the Federal eight-hour ozone standards. In February 2004, the State recommended to the EPA that the San Diego Air Basin be designated a nonattainment area for the Federal PM2.5 standards.

Ambient air pollutant concentrations in the basin are measured at ten monitoring stations operated by San Diego APCD. The monitoring stations located closest to the Refuge are in Chula Vista and downtown San Diego (San Diego-Logan Avenue). Since 1999, the region has experience consistent improvement in attaining the national and state standards for O_3 concentration over a one-hour period. The concentration of PM10 in the South Bay region has remained relatively constant, with State standards exceeded each year. National and state standards for PM2.5 have been exceeded at the downtown monitoring station each year since 1999 and at the Chula Vista station two out of the last five years. Both stations have exceeded the state PM2.5 standards since 1999.

The most significant regional sources of O_3, NO_2, and CO are automobiles and other on-road vehicles. O_3 is formed by the reaction of volatile organic compounds (VOC) and oxides of nitrogen (NOx), which are combustion products from gas and diesel engines. Other important sources of VOC are paints, coatings and process solvents. The major sources of PM10 are construction, demolition, and dust from paved and unpaved roads.

In addition to monitoring regional ambient air quality, the San Diego APCD also evaluates and issues air quality permits to ensure that proposed new and changed operations and industrial equipment meet emission standards. Construction and operation permits are required for any operation or equipment capable of emitting air contaminants. Persons building, altering, or replacing equipment, which may emit air pollutants, are required to obtain an Authority to Construct Permit. In addition, persons operating equipment, which may emit air pollutants, are required to obtain a Permit to Operate. The Rules and Regulations established for the APCD do not specifically address grading projects and no permit is required for construction. However, the APCD does have the authority to regulate construction activities that meet the definition of a "nuisance" as provided in Rule 51 of the APCD Rules and Regulations. Rule 51 states: "A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property." In the case of large-scale grading operations, such as those required to restore the Otay River floodplain, the APCD may require specific measures to minimize the generation of dust during excavation.

Rule 1501 (Conformity of General Federal Actions) of the APCD Rules and Regulations requires that a Federal agency must, when applicable, make a determination that a Federal action conforms to the state implementation plan for achieving the NAAQS before the action is taken. A conformity determination is required for each pollutant, where the total direct and indirect emissions in a nonattainment or maintenance area caused by a Federal action would equal or exceed any of the following rates:

PM_{10} – 100 tons/year,
Ozone (NO_x), SO_2 or NO_2 – 100 tons/year,
Ozone (VOCs) – 100 tons/year,
Carbon monoxides – 100 tons/year, or
Lead (Pb) – 25 tons/year.

The requirements of Rule 1501 do not apply to Federal actions where the total of direct and indirect emissions is below these emission levels. However, when the total of direct and indirect emissions of a pollutant from a Federal action represents 10 percent or more of an area's total emissions of that pollutant, the action is defined as a regionally significant action. Such actions would require a conformity determination and must comply with all reporting requirements described in section 1551.855 of Rule 1501.

3.3.8 Contaminants

3.3.8.1 Introduction

Contaminants are substances (human-made or naturally occurring) that enter the air, water and land in a variety of ways and originate from many different sources. Contaminants may include pesticides, such as dichlorodiphenyltrichloroethane (DDT) and chlordane; industrial chemicals and by-products, such as polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) and other dioxins; and toxic elements, such as mercury and lead. These substances can be individually toxic, or they may trigger negative effects to ecosystems by alteration of normal biochemical processes. Contaminants may also interact with various other biological or physical processes that can result in detrimental effects to a variety of receptor organisms.

As the primary Federal agency dedicated to protecting wildlife and their habitats, the Service conducts contaminant studies on important wildlife species, such as migratory birds, anadromous fish, and threatened and endangered species. These and other studies confirm that many environmental contaminants can alter reproductive system function in adult animals and affect early life stages of fish, mammals, and birds. The Service's contaminants specialists, in cooperation with the U.S. Geological Survey, Biological Resources Division's Biomonitoring of Environmental Status and Trends (BEST) Program, have also developed tools such as the Contaminants Assessment Process (CAP) to assist in evaluating contaminant threats to National Wildlife Refuges, as well as other Service lands.

The CAP provides a standardized approach for documenting and assessing contaminant threats to lands and biota, and involves two primary components: 1) a retrospective analysis of known and suspected contaminant sources and contaminated areas, and the investigation of existing or potential contaminant transport pathways; and 2) a determination of Refuge areas that are vulnerable to spills and/or contamination. This data can then be used to increase awareness and understanding of contaminant issues and how they might affect trust resources. The CAP assists Refuge staff in prioritizing necessary sampling and/or cleanup actions, develop proposals for future investigations, and initiate pollution prevention activities. CAPs have recently been completed for the Sweetwater Marsh and South San Diego Bay Units.

3.3.8.2 Sweetwater Marsh Unit

The Sweetwater Marsh Unit adjoins the highly urbanized cities of National City and Chula Vista and is situated at the end of the watershed. Urban runoff and storm water from industrial, commercial, and residential areas carry pollutants, such as coliform bacteria, trace metals (particularly copper and zinc), and other toxics directly into Paradise Marsh and Sweetwater Marsh. In the past, the lands within and adjacent to this area were utilized for industrial, agricultural, and landfill purposes. These past and present uses represent potential sources of contaminants that could adversely affect refuge resources.

Recent investigations have identified the remains of a former municipal burn dump within and adjacent to the northeastern portion of the Refuge. Over the years, these deposits have introduced contaminants onto Refuge lands and waters, representing a potential threat to refuge resources. The primary threat relates to the burn ash deposits. Burn ash was produced when rubbish and other solid waste was reduced at the dump site through the practice of burning. This was a common method of solid waste disposal in San Diego County until about the mid 1970s. The burn ash present at such sites commonly contains heavy metals, most notably lead, and other chemical constituents that represent a threat to human health and safety. Analyses of limited sediment and groundwater sampling in this area have detected elevated concentrations of arsenic, cadmium, copper, lead, mercury, nickel, zinc, and polychlorinated biphenlys (PCBs). Volatile organic compounds (VOCs) were also detected.

The former dump, which operated in this area between the 1920s and the 1950s, was used primarily as a rubbish disposal site. Usable items and scrap metal were removed and the remaining rubbish was burned and dispersed into Paradise Marsh (*California Integrated Waste Management Board and Geologic Associates 2003*). When this operation ended, the disposal area was graded and leveled, creating what is now referred to as the North Fill Bank. This fill bank consisted of a 15- to 23-foot deep fill area and associated slope composed of undocumented fill and construction debris (*Ninyo & Moore 1998*). A portion of this former dump site occurs within the northern end of the Refuge Unit, where much of the debris was deposited within the fill bank located immediately to the north of Paradise Marsh. In 2004 and 2005 a site cleanup project was implemented by the State of California in cooperation with the City of National City and the

Service. Remediation involved the removal of miscellaneous debris from the fill bank, the regrading and capping of the fill bank slope with two feet of clean soil, and the revegetation of the capped slope with plant species native to the immediate area. Storm water runoff controls were also provided to keep runoff from flowing over the capped slope.

Gunpowder Point (refer to Figure 1-3) was the site of various industrial and agricultural activities over the decades, therefore, contaminants such as metals, hydrocarbons, pesticides, and fertilizers could be present in the soil and/or the groundwater. In August 1988 a contaminants remediation project was implemented on Gunpowder Point involving the removal of approximately 3,000 gallons of waste oil and 50 fifty-five gallon drums of solids from two concrete vaults (*Woodward-Clyde Consultants 1989*). Following removal of the hazardous wastes, the vaults were demolished and removed from the site. Polyurethane sheeting is also known to be buried on the property beneath a shallow cap of soil and nonnative vegetation. The sheeting was disposed of in this manner by a previous agricultural leaseholder.

Previously conducted limited investigations of the dredge spoils within the D Street Fill (refer to Figure 1-3) found detectable levels of petroleum hydrocarbons and some metals. The concentration levels, however, were relatively low for all constituents detected.

Potential sources of contaminants in the F&G Street Marsh (refer to Figure 1-3) include illegal dumping in the northern portion of the marsh and the introduction of runoff into the south end of the marsh from a storm water conveyance system that has collected runoff from an adjacent aviation and aerospace manufacturing facilities for over 60 years. Analyses of recent soil and groundwater sampling indicate the presence of excessive levels of lead, mercury, cadmium, zinc, dioxins, and total recoverable petroleum hydrocarbons (TRPHs) in the sediments and groundwater that occur in the north end of the marsh. In addition, the presence of VOCs and specific metals (particularly chromium and lead) were detected at the southern end of the marsh.

Refuge resources may also be exposed to contaminants present in bay water. San Diego Bay has a long history of contamination. Studies have shown that constituents of concern are present in the water column, as well as in bay sediments. These and other contaminants may bioaccumulate in invertebrates, fish, and plants and eventually be transferred to avian and terrestrial species that feed on these organisms. California horn snail, fiddler crabs, estuarine fish, and various migratory and resident birds may be adversely affected as a result of bioaccumulation.

A contaminants assessment conducted by the Carlsbad Fish and Wildlife Office in 2000 indicated that sediment and biota (crabs and small fish) showed elevated concentrations of several metals or metalloids (i.e. arsenic, boron, cadmium, chromium, copper, mercury, lead, nickel, and zinc) that normally occur in trace concentrations in the environment (*USFWS 2000b*). Sample sites for this study included Gunpowder Point, the mouth of the Sweetwater River, Paradise Creek, and F&G Street Marsh. Total PCBs and copper concentrations in invertebrates that represent an important food source for many birds supported by the Refuge were found at levels above dietary thresholds for birds. Investigations of contaminant levels in plants also found that toxicity levels for copper and lead exceeded accepted threshold standards. Impacts to plants due to copper toxicity include iron chlorosis, thick roots, and the inability to put forth new roots. Excessive levels of lead in plants that are a food resource for some species of birds may result in a wide range of sublethal effects or death for those birds that feed on these plants. Results also indicated elevated levels of zinc in some fish. Exposure to high levels of zinc can impact fish growth, reproduction, and survival. Zinc levels in those species of fish that are considered an important food resource for birds were found to be within acceptable levels for bird consumption.

Contaminant assessments are currently being conducted for various portions of the Refuge, including Paradise Marsh and the F&G Street Marsh. The purpose of these assessments is to characterize the presence and extent of constituents of concern within marsh sediments, benethic infauna, and other biota present on the Refuge. Additional studies are also recommended in the CAP that was completed for this Refuge Unit in 2004.

3.3.8.3 South San Diego Bay Unit

Located immediately adjacent to the urbanized communities of Chula Vista, San Diego, and Imperial Beach, this Refuge Unit receives urban runoff and storm water from upstream industrial, commercial, and residential areas. In addition, past and ongoing uses within and adjacent to the Refuge are known to have introduced contaminants onto Refuge lands, while other uses may have introduced contaminants that have not yet been verified. Pre-acquisition surveys conducted by the FWS have confirmed the presence of contaminants on Refuge lands and within San Diego Bay. Such contaminants include the widespread presence of organochlorine pesticides within the Otay River floodplain and detectable levels of barium, chromium, cobalt, copper, lead, nickel, vanadium, and zinc just to the northeast of Pond 20A. The source of the organochlorine pesticides is directly related to the historic use of this property for agricultural production, primarily tomatoes and other truck crops (cucumbers, squash and celery). A sewer treatment plant that operated within the Otay River floodplain between the mid 1950s and the early 1960s is considered the source of the various metals detected in some of soil samples.

With the exception of a few sediment samples that were analyzed during a Level III pre-acquisition survey, virtually no information is available regarding the environmental condition of the sediments within the salt ponds. Activities associated with commercial solar salt production at this site could have resulted in the introduction of various constituents of concern into the system. Several potential contaminant issues have been identified that warrant further investigation. These relate to the past practice of permitting the discharge of cooling waters from the South Bay Power Plant into the salt ponds and the current practice of redepositing brines back into the pond system. The completed CAP for this Refuge Unit recommends the development and implementation of a sampling plan to characterize the nature and extent of contamination within sediments, surface water, and brine invertebrates within the salt pond system.

Various studies of San Diego Bay have also documented the presence of constituents of concern within the water column. These and other contaminants may bioaccumulate in invertebrates, fish, and plants and eventually be transferred to avian and terrestrial species that feed on these organisms.

A Level III Preacquisition Contaminant Survey was prepared for the proposed South San Diego Bay Refuge in 1991. The need for this level of analysis resulted from observations of numerous dead gulls within the proposed Refuge; the potential for trace elements that could pose a threat to trustee resources; and elevated levels of contaminants in some Caspian tern (*Hydroprogne caspia*) eggs. The survey identified DDE (dichlorodiphenyldichloroethylene), a breakdown product of DDT, in Caspian tern eggs. As a result of these findings and the lack of quantifiable data related to contaminants on the future Refuge site, a baseline contaminant study was recommended (*USFWS 1991*). In response, a study of organochlorine (used in pesticides such as DDT) contaminants in eggs of tern species and western snowy plovers nesting in San Diego Bay was conducted in the early 1990s (*USFWS 1997*). This study did not identify significant levels of contaminants within the eggshells of eggs that failed to hatch at the salt works and elsewhere in the bay; however, detectable levels of the pesticides oxychlordane and DDE were found in eggs collected from the salt works. In addition, all of the samples analyzed had detectable

concentrations of PCBs. The report concluded that additional studies are needed and the Service continues to pursue funding to complete these studies.

Recent studies conducted as part of the Bight '98 Regional Survey (*City of San Diego 2004*) indicate that contamination remains widespread in San Diego Bay sediments, as well as in the tissues of various species of fish. Contaminants of concern, such as chromium, copper, lead, mercury, zinc, PCBs and PAHs, continue to be present at levels that exceed one or more sediment quality criteria thresholds. Mercury, zinc, PCBs, and DDT occurred in over 80% of fish tissues. The overall level of contamination in the Bay does however appear to be less than in previous decades.

Additional contaminants assessments to characterize the presence and extent of constituents of concern within various portions of this Refuge Unit are recommended in the CAP that was completed in 2004.

3.3.9 Noise

3.3.9.1 Introduction

Noise, which can be defined as unwanted or undesired sound, is generally considered disturbing or annoying to humans because of its pitch and/or its loudness. Pitch is the property of sound that fluctuates with variation in the frequency of vibration. Higher pitched signals sound louder to humans than sounds with a lower pitch. Loudness is intensity of sound waves combined with the reception characteristics of the ear. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance and, in the extreme, hearing impairment. The combination of noise from all sources near and far is defined as the Ambient Noise Level.

Several noise measurement scales are used to describe noise in a particular location. A decibel (dB) is a unit of measurement that indicates the relative amplitude of a sound. Because the human ear is not equally sensitive to all frequencies within the sound spectrum, a method called "A-weighting" is used to filter noise frequencies that are not audible to the human ear. The "A-weighted" noise scale (dBA) gives greater weight to the frequencies of sound most sensitive to the human ear.

Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10-decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Sound levels for typical noise sources and noise environments are presented in Table 3-3.

Sound levels are rarely constant in the natural or built environment; therefore, noise levels are often presented as average noise levels over a period of minutes or hours. Such noise levels are expressed as dB Leq. The most common averaging period is hourly, but Leq can describe any period of time. When the one-hour average is used, the noise level is stated as dB Leq, however if a different period of time average is used, such as an 8-hour average, the measurement would be described as Leq(8). Construction noise standards are usually stated as average noise levels over a period of 1, 8 or 12 hours.

During the evening and nighttime hours, human sensitivity to noise increases, particularly because excessive noise can interfere with the ability to sleep. In fact, noise levels as low as 35 to 45 dBA

Table 3-3 Sound Levels of Typical Noise Sources and Noise Environments			
Noise Source at a Given Distance	A-Weighted Sound Level in Decibels (dB)	Noise Environment	Subjective Impression of Loudness (Relative to a Reference Loudness of 70 dB*)
	140		
Military Jet Take-off w/ Afterburner (50 ft) Civil Defense Siren (100 ft)	130	Carrier Flight Deck	
Commercial Jet Take-off (200 ft)	120		Threshold of Pain *32 times as loud
Pile Driver (50 ft)	110	Rock Music Concert	*16 times as loud
Ambulance Siren (100 ft) Newspaper Press (5 ft) Power Lawn Mower (3 ft) Motorcycle (25 ft) Propeller Plane Flyover (1000 ft) Diesel Truck, 40 mph (50 ft) Garbage Disposal (3 ft)	100 90 80	 Boiler Room Printing Press Plant High Urban Ambient Sound	Very Loud *8 times as loud *4 times as loud *2 times as loud
Passenger Car, 65 mph (25 ft) Living Room Stereo (15 ft) Vacuum Cleaner (3 ft) Electronic Typewriter (10 ft)	70		Moderately Loud *70 dB (Reference Loudness)
Normal Conversation (5 ft) Air Conditioning Unit (100 ft)	60	Data Processing Center Department Store	*1/2 as loud
Light Traffic (100 ft)	50	Private Business Office	*1/4 as loud
Bird Calls (distant)	40	Lower Limit of Urban Ambient Sound	Quiet *1/8 as loud
Soft Whisper (5 ft)	30	Quiet Bedroom	
	20	Recording Studio	Just Audible
	10		Threshold of Hearing
	0		

have been documented by the California Department of Public Health to cause sleep interruption (*County of San Diego 1980*). To account for this increased sensitivity, 24-hour descriptors have been developed that incorporate penalties for noise generated during evening and nighttime hours. One such descriptor, used primarily in California, is the Community Noise Equivalent Level (CNEL). CNEL is a 24-hour weighted average measure of community noise that adds 5 dB to the average hourly noise levels during evening hours (7 P.M. to 10 P.M.) and 10 dB to the average hourly noise levels at night (10 P.M. to 7 A.M.). Another 24-hour descriptor is the Day/Night Average Sound Level (Ldn). Ldn differs from CNEL in that it weights only the nighttime hours. Noise contours developed by CNEL and Ldn procedures rarely differ by more than one decibel.

3.3.9.2 Sensitive Noise Receptors

To evaluate the effects of increased noise levels on the surrounding environment, it is important to identify the noise sensitive receptors in the vicinity of a project area. Noise sensitive receptors generally include land uses associated with indoor and/or outdoor human activities that may be

subject to stress and/or significant interference from noise. These include single- and multi-family residences and associated outdoor use areas, mobile homes, hotels and motels, hospitals, nursing homes, and other related medical care facilities, educational facilities, libraries, churches, parks, and other places where the public gathers. Wildlife areas can also be a noise sensitive receptor, particularly during the breeding season. Noise issues related to wildlife are addressed under the Vegetation and Wildlife Habitat sections of this document.

The primary uses surrounding the Sweetwater Marsh Unit are industrial or commercial in nature and are not considered sensitive noise receptors. Existing sensitive noise receptors within the Refuge include the Chula Vista Nature Center and the Refuge's nature trails located on Gunpowder Point. The land to the east and southeast of the Refuge, referred to as the Mid-Bayfront area, is currently vacant; however, the Chula Vista General Plan designates this land for mixed-use development, including residential uses, which would be considered noise sensitive receptors. Effects on these uses would only be considered if the units have been constructed and are occupied prior to the completion of enhancement/restoration activities within the Refuge.

A variety of noise sensitive receptors occur in proximity to the South San Diego Bay Unit. These include a mobile home park, located to the south the Otay River floodplain within the City of San Diego; residential uses and an elementary school located along the south end of the bay within the City of Imperial Beach; and residential development located just to the west of the Refuge boundaries in the City of Coronado.

The State of California recognizes the relationship between noise and noise-sensitive land uses, and emphasizes the need to control noise at the local level through land-use regulation. Section 65302(g) of the California Government Code requires that each City have a Noise Element as part of its General Plan. Grading activities associated with the various enhancement/restoration proposals being considered for the Sweetwater Marsh Unit in the CCP would be subject to the noise standards and/or guidelines adopted by the cities of National City and/or Chula Vista, as established by their respective General Plans and zoning ordinances. Grading activities associated with the enhancement/restoration proposals under consideration for the South San Diego Bay Unit could be subject to the General Plan and zoning ordinance standards and/or guidelines adopted by one or more of the following cities: San Diego, Imperial Beach, Chula Vista, and Coronado. All of these jurisdictions have adopted construction noise standards that would be applicable to such projects. These noise standards, which are typically located in a noise ordinance, include limitations on the hours when construction can occur, maximum allowable noise levels, or both. In addition to specific noise standards, each ordinance typically includes a "General Prohibition" that prohibits the generation of noise that is disturbing, excessive or offensive, and causes discomfort or annoyance to reasonable persons of normal sensitivity. The applicable construction noise limits for each jurisdiction in which habitat enhancement and/or restoration activities could occur are provided in Table 3-4. It should be noted that most jurisdictions have included specific procedures for obtaining variances from construction noise limitations within their noise ordinance.

Note that for multiple dwelling unit residential development in the City of Chula Vista, interior noise levels cannot exceed 50 dBA for more than one minute per hour or 45 dBA for more than five minutes per hour. If, however, the ambient noise level already exceeds these standards, the allowable noise level is equivalent to the ambient level (*City of Chula Vista 2003*).

3.3.9.3 Existing Noise Environment

Existing noise levels vary throughout the Sweetwater Marsh Unit, with the most significant noise generated by the military, commercial, and private fixed wing and rotary wing aircraft that fly

Table 3-4 Summary of Applicable Construction Noise Limits			
Receiver Site	Jurisdiction	Construction Noise Limits	Prohibited Construction Hours
Pepper Park	National City[2]	75 dBA[1] at or within the boundaries of residential use 85 dBA[1] at or within the boundaries of semi-residential/commercial[1]	7pm – 7 am Monday through Friday; all weekends; holidays
Mid-Bayfront (future)	Chula Vista[3]	55 dBA[1] at or within the boundaries of residential use (except multiple dwellings), 7 am – 10 pm (weekdays) and 8 am – 10 pm (weekends) and 45 dBA[1] 10 pm – 7 am (weekdays) and 10 pm – 8 am (weekends). 60 dBA[1] at or within the boundaries of multiple dwelling residential, 7 am – 10 pm (weekdays) and 8 am – 10 pm (weekends) and 50 dBA[1] 10 pm – 7 am (weekdays) and 10 pm – 8 am (weekends). 65 dBA[1] at or within the boundaries of commercial, 7 am – 10 pm (weekdays) and 8 am – 10 pm (weekends) and 60 dBA[1] 10 pm – 7 am (weekdays) and 10 pm – 8 am (weekends).	Not applicable
Mobile Home Park	San Diego[4]	75 dBA Leq (12) at residential properties	7 pm – 7 am Monday - Saturday; Sundays; City holidays
Residential Uses south of the Bay	Imperial Beach[5]	75 dBA[1] for any use	10 pm - 7 am
Residential Uses west of the Bay	Coronado[6]	75 dBA Leq at residential properties	7 pm - 7 am Monday-Saturday; Sundays; legal holidays

[1] Not to be exceeded at anytime.
[2]National City Municipal Code Section 12.10.160.
[3]Chula Vista Municipal Code Section 19.68.030.
[4]San Diego Municipal Code Section 59.5.0404; the section also allows exception by permit of the Noise Abatement and Control Administrator.
[5]Imperial Beach Municipal Code Section 9.32.020H; Section 9.32.060 allows exemption by permit of the City Manager.
[6]Coronado Municipal Code Section 41.10.40, the section also allows exceptions via a Noise Control Permit.

over Refuge lands. Other sources of noise in the vicinity of this Refuge Unit include vehicle traffic on I-5, boat operations in the adjacent navigation channel, and Port and other industrial activities that occur immediately to the north and northwest.

Within the South San Diego Bay Unit, noise levels are influenced by aircraft activity and boating on the bay, and to a minor extent by vehicular travel on I-5 and SR-75 and pedestrians and bicyclists using the Bayshore Bikeway.

3.4 Biological Resources

3.4.1 Historical and Regional Context

3.4.1.1 Overview of Historical Habitat Changes in the Bay

Early accounts indicate that there was little evidence of human related alterations to the ecosystems of San Diego Bay before the first Spanish settlement was established on the bay in 1769. The minor disturbances that did occur resulted from food gathering activities of the Native Americans who lived in the area (*Michael Brandman Associates, Inc. 1990*). After 1769, activities within the bay and along the shoreline increased as the bay became an active port for Spanish transport vessels. By the 1800s, the activities associated with California's whaling industry further increased the level of disturbance. The first major change to the bay's natural habitat occurred in 1850 with the construction of a pier at the end of Market Street. This was followed in 1853 and 1854 by the permanent diversion of San Diego River flows from San Diego Bay to Mission Bay (then called False Bay) (*U.S. Navy 2000*). This river diversion project resulted in the substantial loss of salt marsh and intertidal mudflat habitat along the northern edge of San Diego Bay. In 1859, the Bay encompassed approximately 18,500 acres (refer to Figure 3-2). The dominant habitats included shallow subtidal (6,400 acres) and intertidal mudflats (6,148 acres), representing 35 percent and 33 percent of the bay's total acreage, respectively. At that time, deep subtidal habitat accounted for only 12 percent (2,212 acres) of the bay's total acreage (*U.S. Navy 2000*).

The first major dredging project in the bay occurred in 1914 and substantial filling around the perimeter of the bay occurred between the 1930s and 1940s. This filling, which was conducted to accommodate bayfront development, eliminated intertidal mudflat and salt marsh habitat along much of the north and northeastern portions of the bay. Major changes to the subtidal habitats in the north and central portions of the bay occurred between 1940 and 1970, when natural shallow subtidal habitat was converted to deep water to accommodate commercial and military shipping channels and port facilities (*U.S. Navy 2000*).

Today, deep subtidal habitat accounts for 28 percent (4,443 acres) of the total acreage in the bay, an increase of 16 percent from 1859. Shallow subtidal habitat currently occupies about 24 percent (3,734 acres) of the bay and only six percent (979 acres) of the bay supports intertidal mudflat habitat, a 27 percent decrease in the total mudflat acreage present in the bay in 1859 (*U.S. Navy 2000*). These changes in habitat type have had a direct impact on the distribution and abundance of many plant and wildlife species historically supported by the natural habitats associated with San Diego Bay.

3.4.1.2 Historical Habitat Changes within Each Refuge Unit

Sweetwater Marsh Unit

In the vicinity of what is today the Sweetwater Marsh Unit, human activity has resulted in significant disturbance to coastal wetland and surrounding native upland habitats. Historically, a network of tidal channels connected the marshes of the Sweetwater wetlands complex, including Paradise Marsh, Sweetwater Marsh, and the E Street Marsh. This interconnected wetland complex extended from the marsh's current southern boundary northward to Paradise Creek and eastward into much of what is now National City. In addition, seasonal freshwater flows entered the marsh complex from Paradise Creek and the Sweetwater River.

Over the decades, the marsh complex's tidal network has been severely altered as a result of filling for roadways and development and dredging to create shipping and flood control channels. In addition, the construction of the Sweetwater Dam in 1888, the Loveland Reservoir in 1945, and the combined Sweetwater River Flood Control/State Route 54 project in the 1980s resulted in a dramatic reduction in the volume of freshwater flows entering the marsh complex. The implementation of the combined Federal project also resulted in the permanent loss of 15.6 acres of wetland habitat; of this, approximately 9.7 acres of the impacted wetland habitat were filled for the highway project and 5.9 acres were dredged to create a deep water flood control channel (*USFWS 1988*).

The native vegetation on Gunpowder Point, a natural upland area within the Sweetwater Marsh Unit, was continuously disturbed by industrial and agricultural uses from at least 1916 to 1988. As a result, only remnants of the original native upland vegetation exist on site. The other upland area within the Refuge is the D Street Fill. Created in 1969 from dredge spoil associated with the development of the 24th Street Marina and associated channel, this disposal operation eliminated 108 acres of marshland within the Sweetwater Marsh complex (*USFWS 1979*).

South San Diego Bay Unit

Although spared the impact of extensive dredging, the South Bay has nevertheless experienced significant habitat loss. Changes to the habitats in the South Bay began in 1871 with the construction of the La Punta Salt Works, a small-scale solar salt evaporation facility. Between 1911 and 1916, the area utilized for solar salt production was expanded to include the entire end of the South Bay. In 1933, the land now occupied by Ponds 11, 12, 14, and 15 was acquired for incorporation into the salt works. By 1942, Ponds 12, 14, and 15 had been constructed, followed later by the construction of Pond 11(*U.S. Coast and Geodetic Survey Chart 1942*). Based on the existing elevations of these ponds, it appears that in creating the salt ponds, significance portions of the intertidal mudflat and salt marsh habitat at the south end of the bay were eliminated.

Some dredging, although limited, has occurred in the South Bay. In the late 1960s, dredging was conducted to create the Chula Vista Marina and the mooring areas around the Coronado Cays. Several boat navigation channels have also been created to provide access to the Chula Vista Marina and adjacent shipyard, as well as to the Coronado Cays. The last major dredging activity to occur in the South Bay took place in the late 1970s, when a channel was created in Emory Cove. Tidelands now filled to support development occurred along the bayfront in National City, between G and J Streets in Chula Vista, and at the site of the Chula Vista Wildlife Reserve (*Michael Brandman Associates, Inc. 1990*). The native upland and wetland habitat of the Otay River floodplain was all but eliminated during the twentieth century as a result of industrial, agricultural, and municipal activities. Maps dating back as far as 1916 depict the Otay River in its present channelized configuration. A narrow corridor of salt marsh, freshwater marsh, and native riparian habitat are supported within the river channel, and remnant maritime succulent scrub habitat can still be found in the vicinity of the railroad right-of-way that extends between the south end of the salt works and the Otay River channel.

3.4.1.3 Regional Context

Overview

Coastal Southern California includes a unique combination of physical features, climate, and hydrology that have resulted in a diversity of plants and wildlife unlike any other

region in North America. Southern California also has the distinction of having more species listed as threatened or endangered than any other region in the continental United States (*City of San Diego 1998*). The habitats in San Diego Bay alone support four federally listed endangered species, including the light-footed clapper rail, California least tern, brown pelican, and salt marsh bird's beak, three species listed as threatened, including the western snowy plover, Pacific green turtle, and California gnatcatcher, and one State listed endangered species, the Belding's savannah sparrow (*Passerculus sandwichensis beldingi*).

The San Diego Bay NWR benefits from being situated within the Southern California Bight, a distinct bioregion of California that includes the marine-coastal interface and extends inland to include the coastal wetlands and watersheds of southern California (Figure 3-6). The Bight's embayments, which include San Diego Bay, and its marshes and estuaries, are among the most productive habitats on the Pacific Coast. Unfortunately, estimates by the Southern California Coastal Wetland Inventory prepared by the California Coastal Conservancy indicate that less than 30 percent of the wetlands that once occurred within the Bight are still present today. As a result, the coastal habitats that do remain within the Bight are of regional significance because of the many wetland dependent organisms that are supported by these habitats.

The remaining natural wetlands included within the Sweetwater Marsh and South San Diego Bay Units represent two of the 23 coastal wetland systems remaining in San Diego County. More importantly, much of what remains of San Diego Bay's historical shallow subtidal, intertidal mudflat, and salt marsh habitats are preserved within the San Diego Bay NWR. In addition to these natural wetland habitats, the Refuge also includes a system of salt ponds and associated levees that provide roosting, foraging, and/or nesting opportunities for tens of thousands of migratory birds. As such, the Refuge protects habitats essential to the migratory birds of the Pacific Flyway (refer to Figure 3-6). In recognition of the importance of the foraging and nesting habitats protected within this Refuge and the specific species these habitats support, the south bay has been designated a Western Hemisphere Shorebird Reserve Network Site and each Unit is recognized as a Globally Important Bird Area by the American Bird Conservancy.

These natural wetland systems, particularly those included in the Sweetwater Marsh Unit, are also of regional significance because they are permanently open to tidal flushing. As a result, they support a high diversity of salt marsh plant species, including a number of low marsh species, such as cordgrass, annual pickleweed (*Salicornia bigelovii*), and saltwort (*Batis maritima*), which are generally absent from nontidal wetland systems. Today, approximately half of the coastal wetlands in the Southern California Bight are either frequently closed or always closed to tidal influence, primarily as a result of human disturbance. Such closures reduce the availability of nutrients and dramatically alter salinities in the water column and within the soil. Many salt marsh plant species cannot tolerate these conditions, which over time have resulted in reduced native plant species diversity and lower habitat values.

Although now included within the San Diego Bay NWR, the majority of the bay's remaining wetlands have not escaped the impacts of human disturbance. On the Sweetwater Marsh Unit, wetland habitat values have been reduced by decreases in the volume of tidal and freshwater flows that historically entered the marsh complex, as well as changes in historical tidal circulation patterns. In addition, the salt ponds within the South

Figure 3-6 - Regional Setting
Location of the San Diego Bay NWR within the Southern California Bight[1] and the Pacific Flyway

★ San Diego Bay National Wildlife Refuge

1. The Southern California Bight extends from Point Conception in Southern California to Cabo Colonett and Bahia de San Quintin in Baja California, Mexico.

N

0 20 40 Miles

Carlsbad Field Office - 2003
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San Diego Bay Unit receive no benefit from tidal flushing. As a result, there are opportunities available at both of these Refuge Units for improving habitat values for wildlife, and avian species in particular.

Applicable Recovery Plans

The Service has prepared recovery plans for the federally listed species that occur within these Refuge Units. These recovery plans, which include the California Brown Pelican Recovery Plan (*USFWS 1983*), California Least Tern Recovery Plan (*USFWS 1985a*), Salt Marsh Bird's Beak (*Cordylanthus maritimus maritimus*) Recovery Plan (*USFWS 1985b*), Light-footed Clapper Rail Recovery Plan (*USFWS 1985c*), Recovery Plan for U.S. Pacific Populations of the Green Turtle *(Chelonia mydas*)(*National Marine Fisheries Service and USFWS 1998*) and the draft Western Snowy Plover (*Charadrius alexandrinus nivosus*) Pacific Coast Population Recovery Plan (*USFWS 2001*), are intended to serve as guidance documents for agencies, landowners, and the public. Each plan includes recommendations for actions considered necessary to satisfy the biological needs and assure the recovery of the listed species. These plans also emphasize opportunities for improved management of listed species on Federal and State lands. Recommended actions generally include protection, enhancement, and restoration of those habitats deemed important for recovery, monitoring, research, and public outreach.

The recommendations provided in the recovery plans for the listed species have been considered during the development of the CCP. Recommendations specific to the Sweetwater Marsh and/or South San Diego Bay Units are reflected in the goals, objectives, and strategies developed for each Refuge Unit.

Ecoregion Planning

The San Diego Bay NWR is included within the Southern California Ecoregion, as designated by the Service. The Southern California Ecoregion is defined by all watersheds (including coastal wetlands and off-shore islands) from Monterey Bay south to the US/Mexico border and east to the Arizona and Nevada state lines. This ecoregion includes distinct coastal and desert components, a rare combination of diverse habitat types, and one of the nation's highest concentrations of threatened and endangered species. The purpose of establishing these ecoregions is to develop and implement goals, priorities, objectives, and actions that will ensure an "ecosystem approach" to fish and wildlife conservation (*USFWS 1995*).

Shorebird Conservation Planning

The San Diego Bay NWR is also located within the Southern Pacific Shorebird Planning Region, as defined by the U.S. Shorebird Conservation Plan (*Brown et. al. 2001*). The Southern Pacific Region is an important wintering area for shorebirds that breed in the arctic and temperate zones, but is also important during migration, particularly for arctic-breeding species. There are also important breeding populations in the region. The major regional goal of the U.S. Shorebird Conservation Plan is "to ensure that adequate quantity and quality of habitat is identified and maintained to support the different shorebirds that breed in, winter in, and migrate through each region." The Southern Pacific Shorebird Conservation Plan (*Hickey et al. 2003*) includes several conservation priorities that are relevant to the San Diego Bay NWR. These include increasing the breeding population of the western snowy plover to 2,750 breeding adults; increasing or maintaining the breeding populations of the black-necked stilt, American avocet, and killdeer by restoring, enhancing, or creating nesting habitat; and increasing migratory and wintering populations

of all key shorebird species in the region using various protection, restoration, enhancement, and management strategies. The Plan identifies tidal flats as the most important shorebird habitat within the coastal embayments of California. The San Diego Bay NWR includes the largest remaining area of tidal mudflat habitat and the largest remaining area of coastal salt marsh habitat within San Diego Bay; therefore, the Regional Shorebird Plan's habitat goals for tidal wetlands are relevant to this Refuge. These goals include restoring tidal flats and marshes on the southern California coast; enhancing tidal action in existing wetlands as needed; and limiting human disturbance to shorebirds in all seasons. The Plan also includes goals for managed wetlands, which call for improving the value of existing managed wetlands to benefit shorebirds; restoring additional wetlands to support shorebirds; retaining and managing a sufficient amount of salt ponds and other shallow open water habitat to support shorebird populations.

San Diego Bay NWR provides breeding, wintering, and/or stopover habitat for most of the shorebirds identified in the Plan as having primary importance within the region. Of the ten species for which coastal habitats in the Southern Pacific Region are especially important, the black-bellied plover (*Pluvialis squatarola*), western snowy plover, semipalmated plover (*Charadrius semipalmatus*), willet (*Catoptrophorus semipalmatus*), marbled godwit (*Limosa fedoa*), black turnstone (*Arenaria melanocephala*), short-billed dowitcher (*Limnodromus griseus*), and red-necked phalarope (*Phalaropus lobatus*) are supported on this Refuge.

Waterbird Conservation

The North American Waterbird Conservation Plan (*Kushlan et al 2002*) provides a continental-scale framework for the conservation and management of 210 species of waterbirds, including seabirds, coastal waterbirds, wading birds, and marshbirds. Eighty percent of the species addressed in this plan are colonial nesters and of this group, approximately one third of the species are considered to be at risk of serious population loss. Many non-colonial waterbirds are also considered at risk. Threats to these species include habitat loss (e.g., destruction of coastal wetlands), introduced predators and invasive species, pollutants, human disturbance, and conflicts among species. The habitat goal for this plan is "to protect, restore, and manage sufficient high quality habitat and key sites for waterbirds throughout the year to meet species and population goals." Brandt's cormorant (*Phalacrocorax penicillatus*), black skimmer, least tern, tricolored heron (*Egretta tricolor*), pelagic cormorant (*Phalacrocorax pelagicus*), and gull-billed tern, all known to occur on the Refuge, are identified as high concern species in the Plan.

National Strategy for Coastal Restoration

The Estuary Restoration Act of 2002, signed into law in November 2000, establishes a strong Federal commitment to restore habitat in America's estuaries. The Act set a goal for restoring one million acres of estuarine habitat by 2010 by leveraging limited Federal resources with state and local funding. The Act makes restoring our nation's estuaries a national priority and authorizes funding for estuarine habitat restoration projects, to realize the priority of restoring habitat, strengthening local, regional, and national economies, and improving quality of life in coastal communities. A requirements of the Act is the development of an Estuary Habitat Restoration Strategy. To address this requirement, *A National Strategy to Restore Coastal and Estuarine Habitat* was issued in April 2002 by Restore America's Estuaries, a nonprofit organization, and the National Oceanic and Atmospheric Administration (NOAA).

The objectives of the *National Strategy* include: implementing habitat restoration projects; creating and maintaining public-private restoration partnerships; encouraging restoration planning and priority setting; applying the best appropriate restoration science and technology; evaluating and monitoring the effectiveness of restoration; increasing awareness of, support for, and being involved in restoration; and obtaining sufficient funding to implement these objectives. The National Strategy's Regional Analyses of Restoration Planning identifies a high need for restoring key habitats within coastal California and the Pacific Islands. These include estuarine habitats (e.g. tidal salt marsh and freshwater marsh), beaches and dunes, intertidal mudflats, and other wetlands.

During the development of the CCP, several of the actions presented in the National Strategy were considered including: evaluating potential habitat restoration projects based on regional priorities; addressing issues important to coastal communities and other stakeholders; and facilitating community and volunteer involvement in restoration planning. The CCP also proposes actions to increase public awareness of restoration efforts and identifies methods for involving the community in future restoration projects.

Marine Protected Areas

Marine Protected Areas (MPAs) are defined by Section 2(a) of Executive Order 13158 as "any area of the marine environment that has been reserved by the Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part of all of the natural and cultural resources therein" (65 Federal Register 34909, May 26, 2000). The San Diego Bay NWR is included on the marine managed areas inventory, which will be used to form a pool of sites that may later be considered for the list of MPAs.

MPAs may be established by Federal, State, or local governments to protect marine habitats and natural and cultural resources from overexploitation, destructive uses, or other threats, or to conserve species, habitat, or biological diversity. They may also be created to provide valuable opportunities for recreation, enjoyment, and study.

California Wildlife: Conservation Challenges, California's Wildlife Action Plan

The draft Wildlife Action Plan (*California Department of Fish and Game 2006*) identifies the species and habitats at greatest risk in California; describes the major stressors affecting wildlife and habitats; and presents statewide and regional conservation actions needed to restore and conserve ecosystems and wildlife populations. Conservation actions that apply to the management of the San Diego Bay NWR include: improve the implementation of the Natural Community Conservation Plans, in this case the San Diego Multiple Species Conservation Program; protect and restore coastal wetlands; control invasive species; protect sensitive species and important wildlife habitats; institute fire management practices to restore ecological integrity, while minimizing loss of property and life; and provide recreational opportunities compatible with wildlife habitat needs.

Regional Restoration Needs

Evaluation of the various enhancement and restoration opportunities on the Sweetwater Marsh and South San Diego Bay Units was an important aspect of the CCP process. The process included an assessment of the types of habitats that historically occurred within the Refuge, the types of habitats needed to support threatened and endangered species in the South Bay, and the overall habitat needs and priorities for the region. The historic perspective provided above demonstrates the need for restoration due to the extensive loss of coastal wetland habitat throughout southern California. Restoration is needed not only

because coastal wetlands historically occurred within the boundaries of the Refuge, but also because of the regional need to provide appropriate habitat for coastal wetland dependent species, including fish, wildlife, and plants. In completing this evaluation, the analysis and recommendations of various regional habitat management plans were also considered including the Multiple Species Conservation Plan (*City of San Diego 1998*) and accompanying subarea plans (*City of San Diego 1997, City of Chula Vista 2003*) and the San Diego Bay Integrated Natural Resources Management Plan (*U.S. Navy 2000*).

Habitat enhancement and restoration would also benefit the threatened and endangered species supported in the South Bay. This is particularly true for the light-footed clapper rail, California least tern, and western snowy plover. The population of clapper rails in the South Bay is extremely small. During the 2000 census of light-footed clapper rails in California, only four pairs were detected within the Sweetwater Marsh Unit. This is down from 11 in 1996 and just one pair was detected in the South San Diego Bay Unit in 2001 and 2002. Throughout their range, the estimated population of this species in 2004 was about 350 pairs (*Collins pers. comm.*). Although pairs have been detected in 15 coastal wetlands in southern California, the majority of these birds are concentrated in two locations, Upper Newport Bay and the Tijuana Slough NWR. Restoration of habitat and increased management are considered essential if the smaller subpopulations are to survive (*California Department of Fish and Game 1996*).

One of the primary reasons that the California least tern is endangered is reduction in available suitable nesting areas along beaches and sandy area near estuaries. Today, least tern nesting is confined to a relatively fixed number of sites, including the D Street Fill on the Sweetwater Marsh Unit and the pond levees of the South San Diego Bay Unit. Productivity of the existing nesting sites must be improved in order to continue least tern recovery and increase the San Diego Bay contribution to this recovery (*USFWS 2002*). The levees around the salt ponds provide an opportunity to create additional nesting areas for the least tern. Such improvements would also benefit the western snowy plover, which has similar nesting requirements.

3.4.2 Habitat and Vegetation

3.4.2.1 Summary of Vegetation Communities within the San Diego Bay NWR

The San Diego Bay NWR includes a variety of natural and disturbed habitat types ranging from sensitive coastal wetlands to disturbed uplands to commercial salt ponds. There are many opportunities for enhancing the habitat quality within several of the native habitat areas. Additionally, the Refuge provides numerous opportunities for restoring the significant native coastal wetland and upland habitats that once dominated the areas around San Diego Bay.

Terrestrial vegetation community descriptions provided in this section are based on Barbour and Major (*1988*). The salt marsh descriptions parallel those described by Zedler et al. (*1992*) and other aquatic habitat descriptions come from the San Diego Bay INRMP (*U. S. Navy 2000*). The habitats supported within the Refuge are presented below by Refuge Unit.

Sweetwater Marsh Unit

The various habitats present within the Sweetwater Marsh Unit were determined based on information provided by in-field observations and aerial photographs. The results of this analysis are provided in Figure 3-7. The approximate acreage of each habitat type is presented in Table 3-5.

Figure 3-7
Habitats of Sweetwater Marsh Unit

Source: James Thiede, Local Agency Partnership 2000 (2 ft imagery)

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Table 3-5 Summary of the Habitat Types Occurring on the Sweetwater Marsh Unit	
Habitat Type	Approximate Acres
Artificial Tidal Creek	0.5
Brackish Marsh	1.5
Coastal Sage Scrub	1.0
Coastal Sage Scrub (disturbed)	31.5
Developed/Fill	11.5
Exotic Shrubland	2.0
Fill w/ dune and scrub vegetation	56.5
Maritime Succulent Scrub	3.5
Mudflat	3.5
Nonnative Annuals	3.0
Open Water	1.5
Salt Marsh	184.0
Salt Pan/Salt Flat	7.0
Tidal Creek	9.0

South San Diego Bay Unit

The approximate acreage of each habitat type identified within the 2,300-acre current management boundary of the South San Diego Bay Unit is presented in Table 3-6 and illustrated in Figure 3-8.

Table 3-6 Summary of the Habitat Types Occurring on the South San Diego Bay Unit	
Habitat Type	Approximate Acres
Coastal Sage Scrub	2.0
Developed	2.0
Eel Grass	440.0
Intertidal Mudflat	220.0
Levee	85.0
Nonnative Annuals	98.0
Open Water	410.0
Pepper Tree/Eucalyptus Woodland	1.0
Riparian Woodland	5.0
Road	2.0
Salt Ponds	964.0
Salt Marsh	30.0
Salt Pan/Salt Flat	30.0
Tidal Creek	11.0

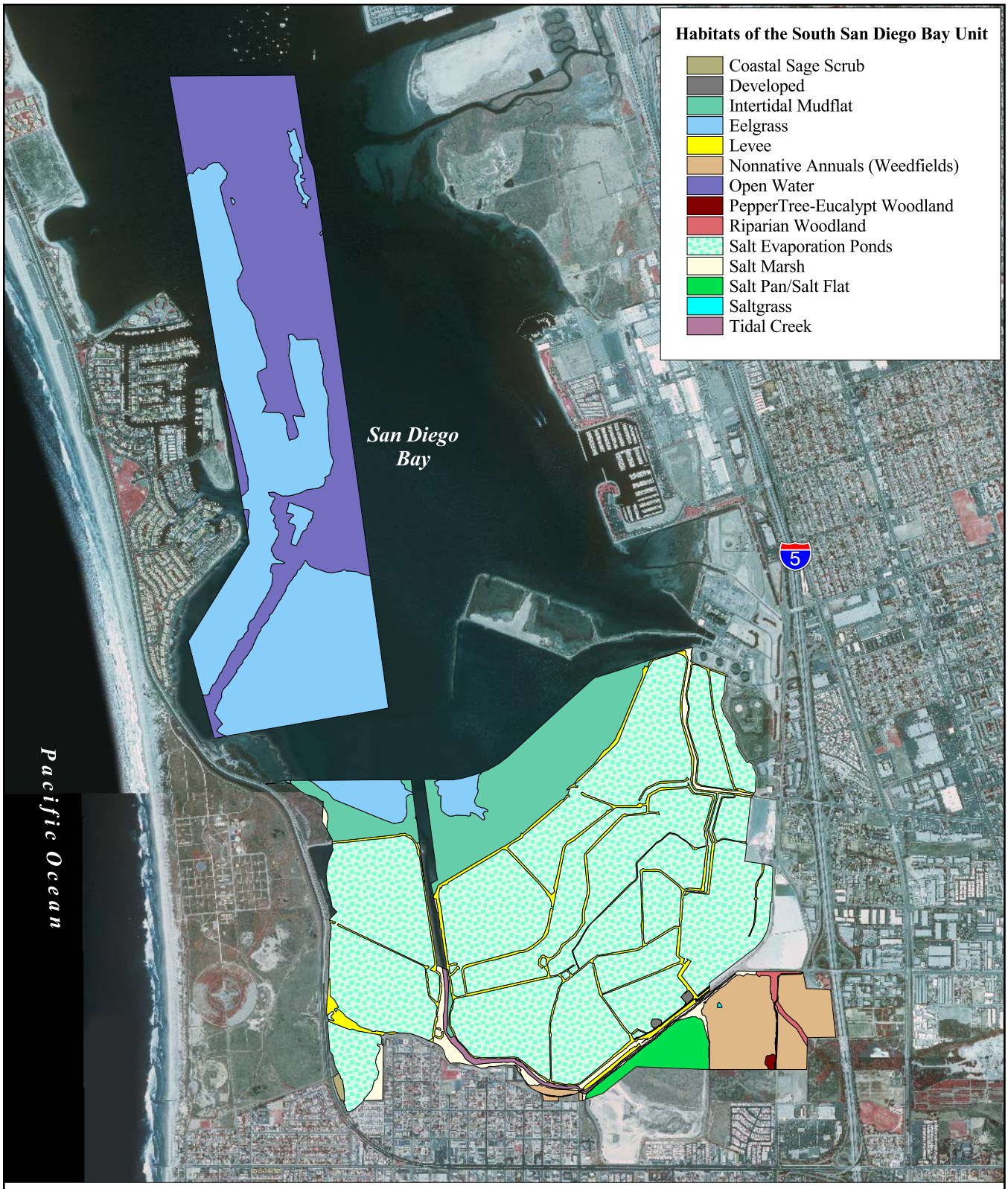

Figure 3-8
Existing Habitats of the South San Diego Bay Unit

Source: James Thiede, Merkel & Associates, Inc., Local Agency Partnership 2000 (2 ft imagery)

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3.4.2.2 Biological Resources

The following text summarizes the predominant habitat types within the Sweetwater Marsh and South San Diego Bay Units and discusses the various organisms that are supported by each habitat type. Much of this information comes from the San Diego Bay Integrated Natural Resources Management Plan (INRMP), prepared by the U.S. Navy and the Port in 2000 with input from a variety of other entities, including the Service, NOAA Fisheries, non-governmental organizations, and scientific advisors. Refer to the INRMP (*U.S. Navy 2000*) for a more detailed discussion of these habitats, particularly the habitats in the open waters of the bay.

Open Water (San Diego Bay)

This habitat type applies primarily to the South San Diego Bay Unit; little open water habitat occurs within the boundaries of the Sweetwater Marsh Unit.

Moderately Deep Subtidal

Moderately deep subtidal habitat, which occurs between the depths of –12 feet and –20 feet MLLW, extends from the approximate lower depth of most eelgrass to the approximate edge of the shipping channels in the bay. The only area within the South San Diego Bay Unit where moderately deep subtidal habitat occurs is at the upper end of the Emory Cove channel, near the northeastern edge of the South San Diego Bay Unit. Within the South Bay, this habitat generally represents areas that have been dredged in the past and have the potential for future restoration to shallow subtidal habitat.

Fish that dominate this habitat include round stingray (*Urolophus halleri*), spotted sand bass (*Paralabrax maculatofasciatus*), California halibut (*Paralichthys californicus*), and barred sand bass (*Paralabrax nebulifer*). This habitat also provides resting areas for bottom feeding diving birds, particularly rafting surf scoter, lesser scaup (*Aythya affinis*), greater scaup (*Aythya marila*), and bufflehead (*Bucephala albeola*) and feeding areas for plunge divers, such as terns and California brown pelicans.

Shallow Subtidal

The majority of the open waters of the South San Diego Bay Unit are classified as shallow subtidal habitat. This habitat is defined as continually submerged, shallow water habitat that extends from -2.2 feet to –12 feet MLLW. In San Diego Bay, shallow subtidal habitat supports an abundance of fish, and bird abundance and diversity is higher in this habitat than in any other subtidal habitats in the bay (*U.S. Navy 2000*).

From about the Coronado Cays south, the open bay consists almost exclusively of shallow subtidal habitat. This habitat includes both unvegetated, soft bottom areas and areas vegetated with eelgrass (*Zostera marina*). The unstable, soft bottoms of the unvegetated areas shift in response to tides, wind, waves, currents, and various human and biological activities. It is difficult for plants and animals to become anchored to the substrate in this area; therefore, they tend to burrow into the substrate rather than attach to it. An important component of these unvegetated areas is the presence of extensive mats of living algal material formed primarily by the red alga *Gracilaria verrucosa*. These mats, which also include the red algae *Hypnea valentiae* and *Griffithsia pacifica*, provide cover for many species of invertebrates and fishes and appear to serve as a food source for some invertebrates (*U.S. Navy 2000*).

The vegetated areas of the shallow subtidal habitat are dominated by eelgrass, a flowering plant that has adapted to growing submerged in shallow, saline environments, such as bays and estuaries within the earth's temperate regions (*Goals Project 2000*). Where eelgrass occurs, the substrate at the bottom of the bay is stabilized by the roots and rhizomes produced by the eelgrass. In addition, the eelgrass leaves slow the current and reduce the effects of wind and wave motion, allowing sediment and organic material to drop out and accumulate on the bottom (*U.S. Navy 2000*).

Eelgrass beds provide highly productive microhabitats for a wide variety of invertebrates and small fish. The eelgrass blades provide shelter for small fish, while small plants (epiphytes) and small animals (epizoites) use the leaves as a substrate for attachment. Other burrowing animals live in the sediment bed that has been stabilized by the eelgrass (*U.S. Navy 2000*).

Eelgrass provides food both directly and indirectly to a wide array of organisms. It can enter the food web as detritus, be eaten by fish that are sometimes eaten by fish-eating birds, or be consumed directly by birds, such as black brant, gadwall (*Anas strepera*), and northern pintail (*Anas acuta*). The bay's small population of Pacific green sea turtles also relies on eelgrass as an important food source. The density and biomass of the South Bay's eelgrass beds can vary widely from one season to another and are affected by water depth, sediment grain size, nutrients, light levels, temperature, salinity, and water quality. The extent of eelgrass beds within the South Bay has been studied several times between 1993 and 2003. The most recent survey, conducted by Merkel & Associates in May 2003, indicated that eelgrass has continued to expand throughout the South Bay since 1993. This expansion, which is illustrated in Figure 3-9, is likely the result of continuing improvements in water quality within the South Bay (*Tenera Environmental and Merkel & Associates 2004*). The data from the 2003 survey indicated that eelgrass was widespread within the western half of the southern end of the bed, generally from the southern end of the Coronado Cays on the north and the Otay River channel on the east. With the exception of one bed located near the mouth of the Otay River Channel, which covered 76 to 100 percent of the bottom cover, the majority of the eelgrass beds to the west of the Otay River Channel covered approximately 26 to 50 percent of the bay floor. From the Otay River east, the shallow subtidal habitat only supported sparse, isolated patches of eelgrass covering less than 25 percent of the bottom. These isolated patches were not expected to persist through the summer months when water temperatures are much higher than they are in the spring, when the survey was conducted (*Tenera Environmental and Merkel & Associates 2004*).

The South Bay's shallow subtidal habitat is important to a variety of fish species. Between 1994 and 1999 Dr. Larry Allen of the Nearshore Marine Fish Research Program, California State University, Northridge conducted a five-year research project that provided a definitive assessment of the fish populations inhabiting San Diego Bay (*Allen 1999)*. The results indicated that the most abundant species in the southern end of the bay included slough anchovy (*Anchoa delicatissima*), topsmelt (*Atherinops affinis*), arrow goby (*Clevelandia ios*), round stingray, northern anchovy (*Engraulis mordax*), and shiner surfperch (*Cymatogaster aggregata*). With respect to biomass, round stingrays, spotted sand bass, barred sand bass, and bat rays (*Myliobatis californicus*) were the dominant species in this area. Of these species, the slough anchovy, topsmelt, northern anchovy, and shiner surfperch represent important forage species for diving birds.

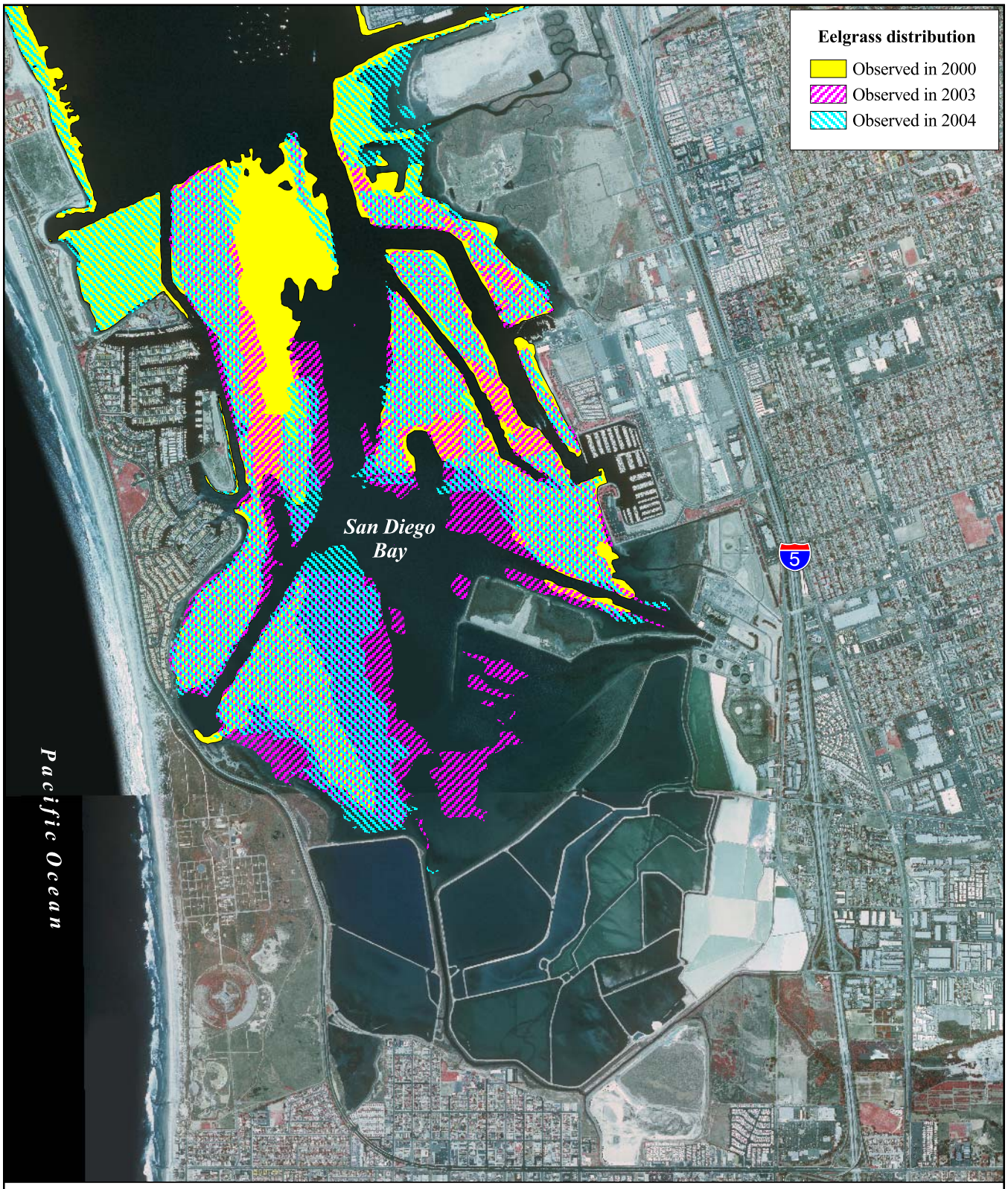

Figure 3-9
Eelgrass Distribution in South San Diego Bay

N

0 0.25 0.5 Miles

Source: Merkel & Associates, Inc., San Diego Port Authority, Local Agency Partnership 2000 (2 ft imagery)

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Allen also found that the South Bay provides significant habitat for a group of twelve species of fish that are indigenous to the bays and estuaries of the Southern California Bight (Table 3-7). According to Allen, the extensive shallow water habitat and eelgrass beds of the South Bay support "very high standing stocks of both fisheries species and of midwater, schooling fishes, such as northern anchovies, slough anchovies and topsmelt" (*Allen 1999*). These species, in turn, represent a major forage resource for predatory fish and avian species. In addition, Allen found that the warmer, hypersaline waters of South Bay offer shelter for a number of fish species commonly encountered further south in the Eastern Subtropical and Tropical Pacific. Such species include California halfbeaks (*Hyporhamphus rosae*), California needlefish (*Strongylura exilis*), Pacific seahorse (*Hippocampus ingens*), and red goatfish (*Pseudupeneus grandisquamous*). The presence of these species, referred to as southern "Panamic Province" fish species, make San Diego Bay "unique among all other southern California embayments" (*Allen 1999*). Other studies indicate that the South Bay may also function as an important nursery area for juvenile California halibut and young spotted and barred sand bass (*U.S. Navy 2000*).

Shallow subtidal habitat also provides foraging and resting habitat for thousands of migratory and resident birds, with waterbirds being more abundant near the shoreline. Bottom-feeding divers such as scoters and scaup, dabbling black brant, plunge divers such as terns, and the surface-foraging black skimmer appear to prefer these waters over the other subtidal habitats in the bay (*U.S. Navy 2000*).

Table 3-7
Fish Species Indigenous to the Southern California Bight's Bays and Estuaries

Scientific Name	Common Name
Anchoa compressa	Deepbody anchovy
Anchoa delicatissima	Slough anchovy
Fundulus parvipinnis	California killifish
Clevelandia ios	Arrow goby
Gillichthys mirabilis	Longjaw mudsucker
Syngnathus leptorhynchus	Bay pipefish
Syngnathus auliscus	Barred pipefish
Ilypnus gilberti	Cheekspot goby
Mugil cephalus	Striped mullet
Paralabrax maculatofasciatus	Spotted sand bass
Hypsoblennius gentilis	Bay blenny
Quietula ycauda	Shadow goby

Source: (Allen 1999)

Intertidal

Intertidal habitat includes the area between the high and low tides (+7.8 feet to –2.2 feet MLLW) and is subject to varying degrees of tidal submergence. Both intertidal mudflat and coastal salt marsh are included in this habitat type.

The predominant habitat type within the Sweetwater Marsh Unit is intertidal. This habitat occurs within Paradise Marsh, the Connector Marsh, Sweetwater Marsh, and the F&G Street Marsh. There are four major areas of intertidal habitat within the approved acquisition boundary for the South San Diego Bay Unit. These include the J Street Marsh,

located just south of the Chula Vista Marina; the South Bay Biological Study area, located just north of Pond 11; the extensive mudflats located to the north of the salt works; and approximately 11,500 feet of the Otay River channel, roughly from river mouth near the northern end of Pond 11 to approximately 1,500 feet upstream of the confluence of Nestor Creek and the Otay River. An additional area of intertidal mudflat habitat consisting of roughly 200 acres is located to the west of the Sweetwater Marsh Unit, outside the approved boundary of the San Diego Bay NWR. This habitat is managed by the Port.

The results of Allen's 1999 study showed that 70 percent of all individual fish captured in San Diego Bay were juveniles. He concluded that this high proportion of juveniles in the catch underscored the significance of the bay, particularly the bay's intertidal habitat, as an important nursery area for a large number of fish species, including halibut and surf perch. The intertidal habitats of the Sweetwater Marsh Unit provide important foraging areas, as well as protection from predators, for various juvenile species, including estuarine species such as California killifish, longjaw mudsucker, topsmelt, and arrow goby (*U.S. Navy 2000*).

Intertidal Flats

Intertidal flats include mudflats, sand flats, and salt flats. These flats occur between the highest high and lowest low tide zones, or generally between the lowest cordgrass and the highest eelgrass habitat areas, at approximately 3 to 0 feet MLLW in San Diego Bay. Within the Sweetwater Marsh Unit, intertidal mudflats occur along the margins of the historic Sweetwater River channel and the margins of the various tidal channels the wind through the Refuge's salt marsh habitat. Significant areas of intertidal mudflat habitat also occur immediately to the west of the Refuge boundary.

Several salt flats occur within Paradise Marsh, the largest in the northeast corner of the marsh. This area is inundated only during the higher high tides. These areas resemble mudflats, with a thin salty crust and little or no vegetation.

Within the South San Diego Bay Unit, intertidal mudflats are found to the south of the Chula Vista Marina, to the north of the salt ponds, and along the southwest margin of the bay. Pond 10A also functions as mudflat habitat because the water level in this primary pond is often so low that the muddy bottom of the pond is exposed and utilized for foraging and roosting by a number of shorebirds.

Intertidal flats can consist of various combinations of clay, silt, sand, shell fragments, and organic debris. The water levels on the flats are determined by the daily tidal cycles, which submerge or expose the surface approximately twice per day (*Goals Project 2000*). These mudflats contain abundant organic matter and microorganisms, but not at the level found in eelgrass beds or salt marsh habitat. Although generally thought of as unvegetated, mudflats often contain areas of microorganisms, including diatoms and blue-green algae, which provide food for various species of worms and other invertebrates. Seasonal growth of macroalgae, such as *Enteromorpha* sp., *Cladophora* sp., and sea lettuce (*Ulva* sp.), can also occur. The invertebrates found on these mudflats include organisms that feed on detritus and algae, as well as snails, crabs, and polychaete worms, that glean food from the mud substrate or capture prey in the shallow water.

Following the tides onto the mudflats are numerous bony fish species, sharks, and rays, all of which forage on the variety of organisms that live on the mudflats. Most of the fish observed can be found during the high tide; however, some fish remain on the mudflats

during low tide in shallow drainage channels. A few of these fish are year-round residents, while others, such as California halibut and California halfbeak are seasonal visitors that live on the tidal flats during juvenile life stages (*U.S. Navy 2000*). The presence of fish along the mudflats during high tide tends to attract various bird species including California least terns, black skimmers, and other tern species that forage for fish within the bay.

While larger fish move onto the mudflats during high tide, great numbers of shorebirds assemble on these same areas during low tide to forage on the many invertebrates available on the exposed flats. In addition to foraging, shorebirds also depend upon the mudflats for roosting and resting. Further, shorebirds represent a significant portion of the bird use on the mudflats during the nonbreeding period. The Southern Pacific Shorebird Conservation Plan (*Hickey et al. 2003*) states that intertidal flats are "the most important shorebird habitat within the coastal embayments of California." The most extensive mudflats within the South Bay are those that lie to the north of the salt ponds. The Service observed tens of thousands of birds, representing 67 species, in this area during 1993 and 1994. The majority of the birds observed were shorebirds and seabirds (*USFWS 1999*). Additional information regarding shorebird use on these mudflats is provided in section 3.4.4.1

Beach hoppers, sand fleas, and a few insects also utilize the drier upper edges of the intertidal mudflat habitat. Of particular interest is a population of mudflat tiger beetles (*Cicindela trifasciata sigmoidia*) that were identified along the fringe of the mudflat and low marsh habitat at the southern edge of the D Street Fill within the Sweetwater Marsh Unit (*Merkel & Associates, Inc. 2000*).

Coastal Salt Marsh

Coastal salt marsh is composed of salt tolerant vegetation and occurs in the upper intertidal zone above the mudflats and above MSL. It is within the range of regular (daily) to irregular (less than daily) tidal inundation and is exposed more than inundated. The region's semi-arid Mediterranean climate yields only limited rainfall; therefore tidal circulation is the most important water source for this habitat. The tides also carry necessary nutrients into this habitat (*Michael Brandman Associates, Inc. 1990*). In San Diego Bay, coastal salt marsh habitat occurs between approximately +7.8 feet to +2.3 feet MLLW (*U.S. Navy 2000*).

At lower elevations, salt marsh habitat overlaps with intertidal flats and is subject to regular inundation. At the higher elevations, tidal inundation may occur only during the highest spring tides. The vegetation types and patterns vary along the marsh plain as a result of these changes in condition. Vegetation patterns within the marsh plain are also influenced by other factors, such as salinity, temperature, nutrient levels, sediment characteristics, and past disturbance. The influence of these factors is apparent when comparing the appearance and plant species composition of the coastal salt marsh areas located within the South Bay. These variations can be attributed to past disturbance within the marsh itself, changes in historic tidal and seasonal freshwater circulation, and natural differences in the physical and topographic characteristics of the particular marsh. There are also visible similarities between the South Bay's marsh areas, most notably the similarities in the general distribution of specific plant species across the marsh plain. For instance, cordgrass, when present, occurs within the lower elevations of salt marsh habitat, while glasswort occurs at the upper elevations. The marshplain is often bisected by

estuarine channels and tidal creeks, which provide the pathways for tidal waters to enter the marsh. These channel and creek areas support a wide variety of organisms, including macroalgae, phytoplankton, invertebrates, fishes, and birds (*Zedler et al. 1992*). Although shorebirds use salt marsh to a lesser degree than tidal flats, the larger non-vegetated channels in salt marsh are used as foraging habitat by the same species that feed on tidal flats (*Hickey et al. 2003*). Additionally, the Southern Pacific Shorebird Conservation Plan (Hickey et al. 2003) indicates that some shorebird species such as the willet, least sandpiper, and long-billed dowitcher use salt marsh as diurnal and nocturnal roost sites "possibly to provide some protection from predators."

Coastal salt marsh habitat is most often described in terms of elevational zones (i.e. low, middle, and high marsh); however, some argue that zones based primarily on elevation inaccurately describe the overall plant species composition of the marsh plain, which is influenced by a number of other variables beyond elevation (*Zedler et al. 1999*). Zedler suggests that the various habitat designations within Southern California salt marsh be described as cordgrass habitat, marshplain, and high marsh dominated by glasswort.

Regardless of how they are described, there are three distinctive zones or subtypes within coastal salt marsh habitat. These zones are described below using the more typical elevational zone description.

Low Marsh. In San Diego Bay, low marsh occurs at the upper edges of the bay's intertidal mudflat habitat, along the tidally influenced portions of the Otay River, and within the lower marsh plain and along the tidal creeks of the Sweetwater Marsh Unit. The tidal range for cordgrass dominated low marsh in the South Bay is generally from +3.5 feet to +4.5 feet (+1.1 meters to +1.4 meters) MLLW. Other plant species typically classified as low marsh species include annual pickleweed and saltwort, which can also be found higher in the marsh plain. In addition, pickleweed, which occurs throughout much of the marsh plain, can also be found in all but the lowest elevations of the area defined as low marsh.

Middle Marsh. Middle marsh habitat, which is generally defined as occurring between approximately +6 feet and +5 feet (+1.8 meters and +1.5 meters) MLLW, is characterized by the presence of saltwort, pickleweed, estuary seablite (*Suaeda esteroa*), and arrow grass (*Triglochin concinna*) (*U.S. Navy 2000*). Powell and Collier (*1998*) also identified salt marsh dodder (*Cuscuta salina*), alkali heath (*Frankenia salina*) and Jaumea (*Jaumea carnosa*) within the middle marsh areas of Sweetwater Marsh.

High Marsh. High marsh, also referred to as upper salt marsh, can occur within the marsh plain on isolated areas of higher elevation, as well as along the upland edge of the marsh. The elevational range for this habitat in San Diego Bay is approximately +7.8 feet to +6 feet (+2.4 meters to +1.8 meters) MLLW. The high marsh in San Diego Bay is dominated by glasswort, but a variety of other plant species are also found in association with glasswort, such as the following species identified by Powell and Collier (1998) in Sweetwater Marsh: boxthorn (*Lycium californicum*), alkali weed (*Cressa truxillensis*), salt grass (*Distichlis spicata*), Coulter's Goldfields (*Lasthenia glabrata*), sea lavender (*Limonium californicum*), and shore grass (*Monanthochloe littoralis*). The Federally listed endangered plant, salt marsh bird's beak, also occurs within portions of the high marsh at Sweetwater Marsh Unit.

Upland Transition. The highest elevations of the high marsh zone are often referred to as upland transition or upland transition marsh. This habitat zone is not considered a distinct

community; rather it represents a gradient between the upper marsh and the native upland habitats of coastal sage scrub and maritime succulent scrub (*U.S. Navy 2000*). Unfortunately, native upland, as is discussed in detail below, is extremely scarce around San Diego Bay, having been all but eliminated due to a century of agricultural, industrial, and port related activities. Where it persists, the width of the transition area is narrow and the presence of native plant species, particularly native upland species, is limited.

In the upland transition areas that still exist within the Sweetwater Marsh Unit, Powell and Collier (*1998*) identified the following native plant species: fiddleneck (*Amsinckia spectabilis),* coyote brush (*Baccharis pilularis*), beach evening primrose, and salt heliotrope (*Heliotropium curvassavicum*). In the lower end of this transitional zone, surveys conducted in the South Bay have identified the presence of glasswort, salt grass, shoregrass, alkali heath, and alkali weed. In the upper transition zone, Watson's saltbush (*Atriplex watsonii*), flat-top buckwheat, and California sagebrush have been identified (*U.S. Navy 2000*).

Two remnant stands of yerba reuma (*Frankenia palmeri*) occur on Gunpowder Point at the fringes of the salt marsh habitat (*Pacific Southwest Biological Services, Inc. 1990*). This is the only known location for yerba reuma in the United States. As a result of many years of human disturbance, the majority of the transitional zone within the Sweetwater Marsh Unit consists of non-native plant species. The most common species include Australian saltbrush (*Atriplex semibaccata*), hottentot fig, spiny sowthistle (*Sonchus asper*), sand-spurreys (*Spergularia* spp.), ripgut brome (*Bromus diandrus*), soft chess (*Bromus mollis*), red brome (*Bromus rubens*), chrysanthemum, and wild radish (*Raphanus sativus*) (*Pacific Southwest Biological Services, Inc. 1990*) (*Powell and Collier 1998*) (*U.S. Navy 2000*).

Today, the largest remaining salt marsh habitat in San Diego Bay is preserved within the Sweetwater Marsh Unit. The other areas of salt marsh habitat within the South Bay as described in the INRMP (*U. S. Navy 2000*) are listed in Table 3-8.

Table 3-8
Remaining Salt Marshes in the South Bay

Salt Marsh[1]	Acreage	Inclusion in a NWR
Sweetwater Marsh (including the historic river channel)	121 acres	Sweetwater Marsh Unit
Paradise Marsh	44 acres	Sweetwater Marsh Unit
Marisma de Nacion (excavated from the D Street Fill)	27 acres	Sweetwater Marsh Unit
Connector Marsh (constructed to provide a hydrologic link between Paradise Marsh and Sweetwater Marsh)	17 acres	Sweetwater Marsh Unit
E Street Marsh (located southeast of Gunpowder Point)	27 acres	Sweetwater Marsh Unit
F&G Street Marsh	25 acres	Sweetwater Marsh Unit
J Street Marsh	25 acres	Not at present[2]
Chula Vista Wildlife Reserve (mitigation site created using dredge spoils to raise the site to elevations capable of supporting intertidal habitat)	32 acres	Not at present[2]
South End of Emory Cove (including the South Bay Biological Study Area)	27 acres	Not at present[2]
TOTAL SALT MARSH ACREAGE IN SOUTH BAY	345 acres	

[1] The locations of these salt marsh areas are indicated on either Figure 1-3 or Figure 1-6.
[2]These areas are currently included within the approved acquisition boundary for the South San Diego Bay Unit, but are not within the current Refuge management boundary.

Although no large areas of coastal salt marsh habitat are located within the current management boundary of the South San Diego Bay Unit, there are several significant linear areas that support this habitat. These areas include the narrow bands of salt marsh that occur on the slopes of some of the salt pond levees within the salt works, along the tidally influenced portions of a small drainage creek that extends between Ponds 15 and 28 refer to Figure 2-6), along both sides of the Otay River channel from the mouth of the river near Ponds 11 and 12 to approximately 500 feet upstream of the river mouth, and into the southern branch of Nestor Creek. The outer levee of Pond 11 supports a variety of salt marsh plants, including pickleweed, annual pickleweed, glasswort, saltwort, sea lavender, alkali heath, estuary seablite, and shore grass (*Collins pers. comm.*). Cordgrass also occurs at the upper edges of the mudflat along some of the outer levees, along the edges of the drainage creek that flows between Ponds 15 and 28, and along the edges of the lower reach of the Otay River. Pickleweed-dominated salt marsh habitat occurs along outer slopes of the Otay River channel, particularly to the east of the railroad bridge. This area of high marsh also includes include saltwort, sea lavender, boxthorn, and alkali heath.

The salt marsh habitat along the tidal channels and creeks within the Sweetwater Marsh Unit supports a variety of marine fish species that utilize these areas as nursery grounds. Within this Refuge Unit, the most abundant fish species include topsmelt, arrow goby, California killifish, and longjaw mudsucker. In addition, young round stingray and California halibut utilize this habitat for foraging and cover (*U.S. Navy 2000*). A variety of birds also utilize these tidal channels and creek for foraging; some feed on fish while others feed on invertebrates, Among them are the black skimmer, California least tern, great blue heron (*Ardea herodias wardi*), light-footed clapper rail, and belted kingfisher (*Ceryle alcyon*).

The salt marsh habitat on the Refuge also supports a diverse and abundant community of invertebrates. Comprehensive sampling of the invertebrates inhabiting the South Bay's coastal salt marshes has not been conducted to date; however, various assessments of specific areas within the bay provide some indication of the types of invertebrates expected to occur. For example, Scatolini and Zedler (*1996*) conducted an assessment of epibenthic (living on the bottom) invertebrates in natural and constructed coastal salt marsh habitat within the Sweetwater Marsh Unit. During this assessment, 45 species of invertebrates were collected in the study area, of which seven dominant invertebrates were identified. These included small dipteran larvae, *Pericoma* sp., a capitellid polychaete, an isopod, *Ligia occidentalis*, the amphipod, *Traskorchestia traskiana*, the mollusk, *Assiminea californica*, a species of biting midge, *Cluicoides* sp., and the yellow shore crab (*Hemigrapsis oregonensis*). Some of the more visible species of invertebrates in the Bay's salt marsh habitat include California horn snails (*Cerithidea californica*), fiddler crabs (*Uca crenulata*), and yellow shore crabs (*Hemigrapsus oregonensis*). Deposits of shells and active siphon jets within the marshes indicate an abundance of resident bivalves; the outer casings of marine polychaetes are also plentiful in this habitat (*Pacific Southwest Biological Services, Inc. 1990*).

Southern coastal salt marsh also supports a number of salt marsh dependent insect species, such as salt marsh water boatman (*Trichocorixia reticulata*), true flies (*Diptera* spp.), salt-marsh mosquitoes (*Aedes taeniorhynchus* and *A. squamiger*), tiger beetles of the genus *Cicindela*, and salt marsh skipper (*Panoquina errans*) (*Zedler 1982*). A comprehensive survey for insects in the South Bay has never been conducted; therefore, only limited information is currently available regarding species abundance and diversity.

The majority of the field investigations that have been completed have focused on determining the presence or absence of several special status insect species. Investigations conducted by Merkel & Associates, Inc. (*2000*) identified the following coastal salt marsh insects in and around the Sweetwater Marsh Unit: Gabb's tiger beetle (*Cicindela gabbi*), sand dune tiger beetle (*Cicindela latesignata latesignata*), haemorrhagic tiger beetle (*Cicindela haemorrhagica haemorrhagica*) and wandering skipper (*Panoquina panoquinoides errans*). The tiger beetle species were generally found in areas of hard-packed mudflat or salt flat interspersed with pickleweed, while the wandering skipper was associated with saltgrass located in high salt marsh habitat of the Sweetwater Marsh Unit.

Coastal salt marsh habitat within Sweetwater Marsh Unit and along the edges of the South San Diego Bay Unit provides nesting, foraging, and high-water refuge areas for many species of birds. Some notable species include the federally listed endangered light-footed clapper rail and the State endangered Belding's savannah sparrow. The clapper rail depends almost entirely on salt marsh habitat, and in particular dense patches of cordgrass, for feeding, resting, and nesting. Belding's savannah sparrows are found throughout the coastal salt marsh areas of the Sweetwater Marsh Unit and along the salt marsh vegetated edges of the salt works levees within the South San Diego Bay Unit. Savannah sparrows nest in patches of pickleweed and boxthorn and forage within salt marsh and intertidal mudflat habitat. This habitat also provides year-round foraging habitat for resident shorebirds, waders, and a variety of birds of prey, including northern harrier (*Circus cyaneus hudsonius*), osprey (*Pandion haliaetus carolinensis*), and an occasional peregrine falcon (*Falco peregrinus*). Other bird species characteristic of the South Bay's coastal salt marsh habitat include the great blue heron, great egret (*Ardea alba egretta*), black-crown night heron (*Nycticorax nycticorax hoactli*), willet, marbled godwit, and long-billed curlew .

Solar Salt Evaporation Ponds

Although not considered a natural habitat, the salt evaporation ponds located within the South San Diego Bay Unit provide relatively isolated nesting and resting habitat for a wide range of avian species, as well as some unique foraging habitat for several species of migratory birds.

Solar salt production has occurred in south San Diego Bay for over 100 years, although early in the 1900s the system of salt ponds was somewhat smaller than it is today. These salt ponds provide an important stopover point for numerous species of migratory and wintering birds, as described later in Section 3.4.4.1. In addition, the salt pond levees provide important nesting habitat for seven species of colonial seabirds (refer to Section 3.4.4.1 for details).

The salt works includes approximately 1,068 acres of diked salt evaporation ponds and about 100 acres of associated levees. Although the ponds and levees are currently maintained to facilitate the commercial production of salt through a solar salt evaporation process, the Refuge Special Use Permit that allows this operation to occur on the Refuge includes various conditions to ensure the protection of the migratory birds that utilize the site. Of the 32 ponds used in the current operation, 26 are included within the Refuge boundary (refer to Figure 2-6). The remaining ponds are leased to the salt operator by other parties.

The salt ponds consist of shallow, open water cells with different salinity levels. As the water flows through the pond system, the ponds become more saline until near the end of the process, sodium chloride and other salts precipitate out and either form crystals or stay in a heavy brine solution. These products are then harvested, processed, and sold for industrial, commercial, and residential uses. The salt making process is described in greater detail in Appendix F. Briefly, the ponds are divided into four categories based on their salinity levels with the lower salinity ponds referred to as primary ponds, followed by secondary ponds, pickling ponds, and crystallizer ponds, which have the highest salinity levels. The range of salinity levels in each pond within the Refuge, as well as the pond acreages are provided in Table 3-9.

Table 3-9
Salinity Range and Approximate Acreage for Each Salt Pond Within the Refuge

Pond Number	Salinity Range[1] (°Be)	(ppt)	Pond Acreage[2]
10	2.5 - 4.5	11.5 - 37.5	86
10A	no data	no data	35
11	3.0 - 4.7	18.0 - 40.1	112
12	5.0 - 9.0	44.0 - 96.0	101
13	6.0 - 9.5	57 - 102.5	67
14	6.8 - 11	67.4 - 122	45
15	7.1 - 11.5	71.3 - 128.5	90
20	7.5 - 15	76.5 - 174	35
21	7.5 - 13.5	76.5 - 154.5	28
22	8.0 - 22.5	83 - 271.5	64
23	13 - 21	148 - 252	72
24	15.5 - 24.5	180.5 - 297.5	58
25	16 - 25	187 - 304	21
26	9.0 - 17.0	96.0 - 200	23
27	11.0 - 24.5	122 - 297.5	57
28	17.0 - 26	200 - 317	32
29	15 -26	174 - 317	20
30	15.5 -26	180.5 - 317	15
41	25.5 - 29	310 - 356	18
42	25.5 - 29	310 - 356	9
43	25.5 - 29	310 - 356	5
44	25.5 - 29	310 - 356	18
45	25.5 - 29	310 - 356	17
46	25.5 - 29	310 - 356	6
47	25.5 - 29	310 - 356	13
48	25.5 - 29	310 - 356	13
Total Acreage	--	--	1,060

[1] Measurements taken between 1996 and 2002

[2] Pond acreages include the water area and adjacent berms

Source: (South Bay Salt Works 2002)

The primary ponds (Ponds 10A and 10 through 15) have the lowest salinity levels within the system, with salinities increasing from west to east. The salinity levels in Ponds 10A, 10 and 11 are low enough to support the fish taken into the system through the tide gates. Once in the system, these fish cannot escape. Many are either eaten by opportunistic

herons, egrets, and terns or die due to the lack of an adequate prey source and increased salinity levels. As salinities increase in Ponds 12 through 15, fish can no longer survive.

Ponds 10 and 10A offer foraging and roosting habitat for a variety of shorebirds and other waterbirds, particularly when fluctuating water levels are low. In addition, the western primary ponds provide rafting habitat for an array of migrating waterfowl, such as lesser scaup. During avian surveys conducted in 1993/1994 by the Service, thousands of scaup were observed rafting in Pond 11 in February and March of 1993 (*USFWS 1994*).

The lowest salinity ponds within the primary system (Ponds 10, 10A, and 11) are believed to support some of the same invertebrates found in the adjacent bay; however, based on the data available, these organisms appear to be absent from the remainder of the system due to their inability to tolerate the system's hypersaline conditions. While observations of the upper primary and secondary salt ponds indicate the presence of brine shrimp, brine flies, and water boatmen beetles (*Trichocorixa reticulata*), a comprehensive survey to determine the diversity and abundance of these organisms within this system has not been conducted. Some sampling of species composition in the salt pond water column and pond sediments was conducted by Terp (*1998*) as part of her study of the role of salt evaporation ponds in South San Diego Bay in the habitat use patterns of wintering shorebirds. Water column samples taken from Ponds 12, 13, 15, 20, 22, 27, 28, 29, and several crystallizer ponds included the following organisms: brine shrimp; adult, pupal, and larval forms of brine fly; water boatman in adult and nymph form; topsmelt in larval form; a copepod; one individual mosquito, and 12 individual larval Coleoptera. Sediment samples had virtually no specimens and where specimens were found, they were only present in samples taken from Pond 30. From the samples taken in Pond 30, only four contained specimens, consisting of from two to 36 individuals of Ephydra larvae and pupae. Based on this limited sampling, brine shrimp and water boatman beetles were the most abundant in the secondary ponds, with Ponds 20 and the eastern portion of Pond 27 supporting the highest prey densities. Water boatman beetles were most prevalent in the primary ponds. Topsmelt larvae were only present in the primary ponds and at low densities.

Brine flies appear to be particularly abundant along the eastern edge of Ponds 15, within the tidal channel that flows between Ponds 15 and 28 and throughout the secondary pond system (Ponds 20 through 27), with the greatest concentration of flies occurring near the shoreline. The highest concentrations of brine shrimp appear to be in the secondary ponds. No studies have been conducted of aquatic invertebrate consumption by the birds that frequent the salt pond, however, observations of these same avian species at other highly saline water bodies provides some insight into the feeding preferences at the salt works. Specifically, observations of eared grebes at Mono Lake by Jehl (*1988*) indicate that invertebrate consumption by eared grebes shift between brine shrimp and brine flies, depending upon the availability of these species. When brine flies became particularly abundant, Jehl noted that eared grebes would concentrate their foraging efforts on brine flies, which have been shown to have a higher caloric value than brine shrimp (*Herbst el al. 1983*). Jehl's (*1988*) observations of Wilson's phalaropes (*Phalaropus tricolor*) indicate a diet of both brine shrimp and brine flies, with females feeding primarily on brine shrimp and males feeding primarily on brine flies. Studies conducted at Mono Lake, the Great Salt Lake, and Lake Abert, Oregon indicate that red-necked phalaropes visiting these lakes appear to feed predominantly on brine flies (*Jehl 1986*).

The secondary ponds include Ponds 20 through 27. The salinity range among these ponds is substantial, with lower levels (76.5 – 174 ppt) observed in Pond 20 and levels as high as 297.5 ppt. observed in Pond 27. During the 1993/1994 avian surveys, the highest total abundance of birds observed within the ponds was in Pond 23. Red-necked phalaropes and eared grebes were the two species most responsible for this high abundance. On July 24, 1993, over 3,000 red-necked phalaropes were observed within this pond (*Stadtlander and Konecny 1994*). The high numbers of phalaropes and grebes within the secondary ponds is attributed to the presence of large numbers of brine invertebrates.

Ponds 28, 29 and 30 make up the pickling ponds. During the 1993/1994 avian surveys (note: when recording bird presence at a particular pond during these surveys, observations included bird presence both within the open water area of the pond and the pond's associated levees), Pond 28 had the highest avian species diversity observed at these three ponds. In addition, this pond supported a relatively high abundance of birds when compared to the other ponds in the system. The majority of the birds observed were shorebirds, which appeared to use the pond as a roosting site during high tides when the mudflats adjacent to the salt ponds were inundated. The other two pickling ponds also appear to be used primarily for roosting. Some sandpiper foraging was observed in Pond 30.

The crystallizer ponds include Ponds 40 through 48 and 50 through 54, although the latter ponds are not included within the Refuge's acquisition boundary. All of the crystallizer ponds have extreme salinities and provide little in the way of direct habitat support for wildlife species. Avian species diversity was extremely low during the 1993/1994 surveys. Those species that were observed consisted primarily of shorebirds that utilized these ponds for roosting particularly during high tides.

Other organisms of interest living in the crystallizer ponds are classified within the Kingdom Archaea. Discovered in 1977, this group of organisms was initially described as Archaeabacteria, but biochemically and genetically, these organisms are very different from bacteria. Some archaeans, such as those found in the crystallizer ponds, can survive the desiccating effects of extremely saline waters. Archaeans may be the only organisms that can live in extreme habitats, such as thermal vents or hypersaline water. It is the Archaeans, such as *Halobacterium*, that give the salt ponds their reddish hue.

Studies of the invertebrate communities present within San Diego Bay's salt ponds have not yet been conducted; however, investigations conducted in the salt ponds of San Francisco Bay provide some general information regarding the types of invertebrate communities that might be present in the San Diego Bay salt ponds. Siegel and Bachand (*2002*) found from their review of the literature that the composition of the invertebrate communities in the San Francisco Bay salt ponds was generally influenced by salinity. Brine shrimp are found in ponds with salinities ranging from 70 to 200 ppt, but appear to have an optimum range of 90 to 150 ppt. Brine shrimp abundance in the San Francisco Bay salt ponds is at its highest during the warm summer months. In the San Diego Bay salt ponds, brine shrimp have been observed primarily in the secondary ponds, although they can also be found in the channel that connects the primary ponds to the secondary system. According to the literature, the salinity range for water boatmen is slightly lower, tolerating a range of about 20 to 170 ppt, with 35 to 80 ppt representing the peak reproductive range. Salinity tolerances vary for the different species of brine flies known to occur in salt ponds. Some species can tolerate up to 42 ppt, while others prefer significantly higher salinities (*Goals Project 2000*).

Freshwater Wetlands

Freshwater wetlands that occur within the Sweetwater Marsh and South San Diego Bay Units include brackish and freshwater marsh and disturbed southern willow scrub habitat. The freshwater marsh areas provide habitat for waterfowl, particularly dabbling ducks, herons and other waterbirds, while the willow shrub habitat supports a diversity of passerine birds, raptors, and small mammals.

Freshwater/Brackish Marsh

Freshwater marsh habitat occurs at the eastern end of Sweetwater Marsh. Soil moisture in this area is sufficient to support tall emergent vegetation, such as cattails and bulrushes. A number of exotic plant species have also invaded this area, including giant reed, castor bean, and tamarisk. These invasive pests provide low habitat value and are occasionally removed to make room for the reestablishment of native wetland species.

Within the South San Diego Bay Unit, freshwater marsh and brackish marsh occur within the Otay River channel. Brackish marsh occurs within the Otay River channel where tidal influence and freshwater influence converge (approximately 1,500 feet upstream of the convergence of Nestor Creek and the Otay River). Beyond this point, the habitat transitions into freshwater marsh dominated by cattail (*Typha domingensis*) and bulrush (*Scirpus robustus*).

Riparian/Southern Willow Scrub

Southern willow scrub habitat is limited to the South San Diego Bay Unit, where it occurs along the lower slopes of the Otay River channel. This habitat is highly disturbed, with many nonnative invasive plants present, particularly castor bean and giant reed. The native plants found within this habitat include arroyo willow (*Salix lasiolepis*), black willow (*Salix nigra*), western cottonwood (*Populus fremontii*), and mulefat (*Baccharis salicifolia*). This area provides substantial opportunity for habitat enhancement and wetland restoration.

Uplands

On those lands located adjacent to San Diego Bay, upland habitat generally occurs above the areas influenced by tidal action, or above +7.8 feet MLLW. The majority of the native upland habitats that once occurred around San Diego Bay have long since been replaced by development. The few undeveloped areas that remain, particularly in the South Bay, have been severely impacted by years of disturbance largely related to agricultural activities. As a result, undeveloped uplands around the bay consist primarily of nonnative grasslands and disturbed, weedy areas. Historically, the upland habitats around the bay are believed to have consisted of maritime succulent scrub, coastal sage scrub, and native grasslands.

Maritime Succulent Scrub/Coastal Sage Scrub

Despite the extent of habitat disturbance that has occurred within the upland areas of the Sweetwater Marsh Unit, remnants of maritime succulent scrub and coastal sage scrub habitat persist in several areas. Two patches of maritime succulent scrub can be observed on Gunpowder Point; one along the northeastern bluff and the other at the southeastern tip. A thin ribbon of this habitat also persists along the southern edge of Sweetwater Marsh where it abuts the northern edge of the Mid-Bayfront property. These areas are dominated by flat-top buckwheat, coast cholla (*Opuntia prolifera*), and California sagebrush. Coastal barrel cactus (*Ferocactus viridescens*) and snake cholla (*Opuntia parryi serpentina*) are also present in these habitats. Another acre of disturbed maritime

succulent shrub is located along a bluff at the northwestern end of Paradise Marsh. This habitat is dominated by California sage brush, lemonade berry, California encelia, and flat-top buckwheat. Ladies' fingers (*Dudleya edulis*), coast prickly pear, and coast cholla also occur here (*City of National City 1998*).

The portion of Gunpowder Point located to the west of the Nature Center supports disturbed coastal sage scrub, consisting primarily of broom baccharis (*Baccharis sarothroides*) and California sagebrush. Merkel & Associates, Inc. (*2000*) also identified the vegetation at the eastern end of the D Street Fill as disturbed coastal sage scrub. The most conspicuous species in this area is broom baccharis. Other dominant species include coyote brush, fragrant everlasting (*Gnaphalium canescens beneolens*), and coastal goldenbush (*Isocoma menziesii*). A narrow band of disturbed coastal sage scrub, characterized by broom baccharis, coastal goldenbush, and flat top buckwheat, is also present along the western edge of Paradise Marsh. Numerous non-native grasses and annuals also occupy this area (*City of National City 1998*).

Within the South San Diego Bay Unit, a band of disturbed maritime succulent scrub occurs in the vicinity of the railroad right-of-way between Ponds 22 and 20A. The habitat in this area is dominated by goldenbush and cholla. A variety of weedy species also are present including California everlasting (*Gnaphalium californicm*), stinging nettle (*Urtica holosericea*), horehound (*Marrubium vulgare*), broom baccharis, and salt bush (*Atriplex lentiformis*) (*Tierra Environmental Services 2001b*).

Weedy, Nonnative Upland Habitat (Ruderal)

The natural upland areas within the San Diego Bay NWR consist primarily of nonnative grasses and weedy annuals. Natural upland areas, such as those found on portions of Gunpowder Point, provide important opportunities for restoration of native upland habitat. Disturbed upland vegetation also occurs on several fill areas within the Refuge including the D Street Fill and the north end of the F&G Street Marsh.

On the South San Diego Bay Unit, the upland portions of the Otay River floodplain consist of weedy fields that support wild mustard (*Brassica* sp.), castor bean, garland chrysanthemum, and various non-native grasses (*Tierra Environmental Services 2001b*). Opportunities for restoring native upland habitat are available within this portion of the Refuge.

Upland Fill Areas

D Street Fill. Approximately 55.5 acres of the D Street Fill (refer to Figure 1-3) are located within the Sweetwater Marsh Unit. This fill was created in 1969 when dredge material was deposited here as a result of port developments to the north. Prior to the creation of this fill, this area supported native mudflat and salt marsh habitat associated with the Sweetwater River Wetlands Complex. Today, this disturbed upland area provides habitat for several species of ground nesting birds including California least terns, horned larks, and killdeer (refer to Section 3.4.4.1 for more information about nesting activity in this area). Western snowy plover nests have also been documented here in the past. This area also provides high tide roosting opportunities for various shorebirds and other waterbirds, and supports several sensitive plant species, various species of invertebrates, and some mammals, including the San Diego black-tailed jackrabbit (*Lepus californicus bennettii*).

During surveys conducted on the D Street Fill in 2000, Merkel & Associates describe the habitat on the northwestern half of the fill as disturbed coastal dune. This area, which was created using dredge materials from the bay, is regularly cleared of vegetation to prepare the area for annual seabird nesting. In the eastern portion of this fill area, where maintenance is more sporadic, a number of species have colonized the site; including beach-bur (*Ambrosia chamissonis*), Lindley's saltbush (*Atriplex lindleyi*), woolly lotus (*Lotus heermannii heermannii*), and beach evening primrose. Merkel (*2000*) also noted an abundance of woolly-heads in some areas.

Salt Pond Levees. The salt pond levees, which occupy approximately 100 acres within the South San Diego Bay Unit, consist primarily of unvegetated upland habitat. The lack of vegetation on many of the levee tops is the result of ongoing maintenance activities associated with the salt operation, as well as the high salinities that exist in the vicinity of the levees. These levees provide relatively secluded nesting habitat for thousands of breeding terns and black skimmers, as well as black-necked stilts, American avocets, and western snowy plovers (refer to Section 3.4.4.1 for detailed information about nesting activity in this area).

3.4.3 Plants

3.4.3.1 Introduction

A comprehensive plant inventory has not been completed for the San Diego Bay NWR. Directed searches for rare plants are however periodically conducted on the Sweetwater Marsh Unit. The only endangered plant observed within the San Diego Bay NWR is the federally listed endangered salt marsh bird's beak, (discussed in detail in Section 3.4.5) and this species occurs only within Sweetwater Marsh Unit. Although common in some coastal marshes in Baja California, yerba reuma is only known to occur naturally in the United States within the Sweetwater Marsh Unit. The occurrence of other rare or sensitive plant species within the Refuge is discussed throughout Section 3.4.2.2.

3.4.3.2 Exotic and Invasive Plant Species

The exotic plant species that occur on this Refuge represent remnants of past human disturbance. Exotic trees and shrubs were planted as ornamental landscape specimens and do not appear to be spreading. On the Sweetwater Marsh Unit, these plants include California pepper tree (*Schinus molle*) and myoporum. On the South San Diego Bay Unit, several eucalyptus trees (*Eucalyptus sp.*) occur in the vicinity of a former home site and myoporum occurs in various locations within the Otay River floodplain.

Invasive plant species are those that spread into areas where they are not native, displacing the native species and/or changing species composition, community structure, or ecosystem function (*Bossard et. al. 2000*). Invasive plants represent a serious threat to biological diversity, directly impacting both native plants and wildlife. The freshwater habitats that occur on both of the Refuge Units are impacted by the presence of giant reed, castor bean, and tamarisk. Giant reed and tamarisk are of particular concern in the Otay River drainage because of the extent of infestation occurring within the Otay River watershed upstream of the Refuge. A study conducted for the City of Chula Vista (*Merkel & Associates, Inc. and KTU+A, Inc. 2000*) estimates that within the 145 square mile Otay River watershed, these two invasive species occupy a combined total of 410 acres (363.9 acres of tamarisk and 45.9 acres of giant reed). Because of the magnitude of this infestation, control of these invasive plants and the ultimate restoration of native riparian habitat will require a watershed-wide effort in order to be successful. Further, until the problem is

controlled upstream of the Refuge, continued invasion of the lower reaches of the Otay River is inevitable, despite routine localized control efforts on the part of the Service.

On the South San Diego Bay Unit, garland chrysanthemum invades the disturbed upland areas of Otay River floodplain, with fennel and tree tobacco present in significantly fewer numbers. Hottentot fig is also present near the Otay River channel and along the western edge of the western most salt ponds. On the Sweetwater Marsh Unit, these same species can be found along the edges of the marsh and at the D Street Fill. In addition, another Australian saltbush species, *Atriplex lindley,* has been observed near the eastern edge of the Sweetwater Marsh.

3.4.4 Wildlife

3.4.4.1 Birds

Migratory Birds

Coastal wetlands and aquatic habitats of southern California provide essential foraging and resting areas for a multitude of birds migrating in the Pacific Flyway. San Diego Bay, historically one of the largest coastal wetland ecosystems of California's coast, has been highly modified with shipyards, marinas, military and civilian ship terminals, and other waterfront development. Presently, one of the last remaining strongholds supporting significant numbers of water dependent birds is located in South San Diego Bay, providing a vital link in the Pacific Flyway.

The open waters of the bay, including areas within the South San Diego Bay Unit, provide important wintering and migratory stopover habitat for many species of waterfowl. The most common of these species are the surf scoter, greater scaup, and lesser scaup. The intertidal mudflats and coastal salt marsh habitats of the Sweetwater Marsh and South San Diego Bay Units are also important wintering areas for many species of shorebirds, such as long-billed curlews, whimbrels, and red knots (*Calidris canutus*). The salt ponds and associated levees provide resting, foraging, and/or nesting habitat for an array of avian species, including Federal and State listed endangered species and various species identified by the Service as Birds of Conservation Concern.

While there have been some avifaunal surveys of portions of San Diego Bay and some of the migrating bird groups (*Jurek 1974, Macdonald et al. 1990, and Page et al. 1992*), the Service completed the first comprehensive surveys of the South Bay in 1993 and 1994.

Migratory Bird Use of the Salt Ponds and Tidal Areas of South San Diego Bay

In 1993 and 1994, the Service's Coastal Program (*Stadtlander and Konecny 1994*) conducted the first comprehensive evaluation of migratory bird use at the salt works and adjacent tidal habitats of South San Diego Bay. (Breeding bird activity at the salt works and waterbird use of the Bay's water areas were studied separately and are discussed in the sections that follow.) During the migratory bird use study, which included the period from February 1993 to February 1994, weekly counts were conducted of water-associated bird use within a 1,728-acre area (1,219 acres of salt ponds and 508 acres of adjacent tidal habitats). In that year, a total of 522,552 birds of 94 species were observed. As illustrated in Figure 3-10, shorebirds dominated both species diversity (27 species) and abundance (366,596 individuals or 70% of all birds observed). Species richness of the waterfowl and terns/gulls group followed with 22 and 18 species, respectively. The abundances of each of the other bird groups contributed much smaller portions of the total birds observed (gulls/terns 9.7%, waterfowl 8.3%, and grebes/loons 8.2%).

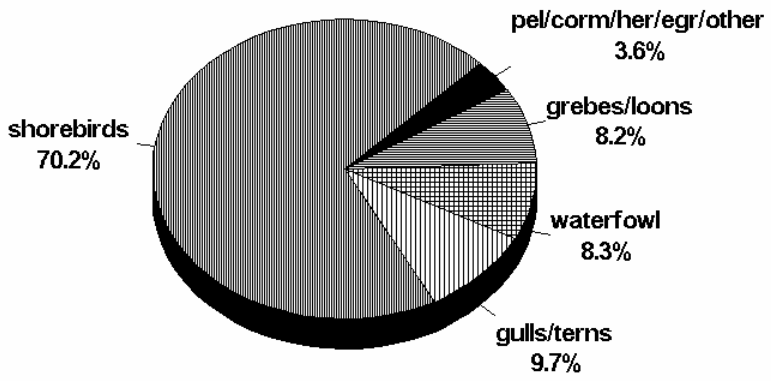

Figure 3-10

The migratory movements of birds in the Pacific Flyway follow a general trend of southerly movement away from breeding areas in the fall and northerly movement from overwintering areas back toward the breeding areas. Among individual species of birds there is great variation in distances traveled between breeding and overwintering areas, as well as the actual timing of their movements. For example, some western sandpipers or red-necked phalaropes breeding in northern Alaska typically pass through the San Diego Bay region in peak numbers in late summer, August and September. Most waterfowl numbers, such as black brant from Alaska or northern pintail from the Canadian plains, peak in November/December. Probably due to relatively mild winters, Southern California may be the overwintering destination for some birds, staying in the region until they begin their northward migration in February and March. Other species continue south into Central and South America. Some species, moving in large flocks (sandpipers and scaup, for example), may contribute to swings in bird abundance at one place as they move into and out of the survey area. Also, total bird abundance in the San Diego Bay region is typically at its lowest in May and June, when most shorebirds and waterfowl are to the north at their breeding locations. As discussed below, several species of terns and black skimmer arrive from the south to breed in the San Diego Bay region, with their numbers peaking in the summer, but declining during the winter.

This rise and fall in abundance of the different water associated bird groups at South San Diego Bay was evident during the year-long study (*Stadtlander & Konecny 1994*). On a monthly average, between 12,000 and 14,000 birds were present in the salt ponds and adjacent tidal habitats between August 1993 and February 1994, and between 2,000 and 3,000 birds in May and June 1993. From 1999 to 2001, the Service counted birds in portions of the salt ponds and adjacent mudflats during parts of the migratory season (*M.*

Alfaro unpubl.). When plotted together, as illustrated in Figure 3-11, these two discontinuous data sets confirm the pulse of bird migration, but are not completely comparable, due to somewhat different survey areas and duration. Shorebird peaks in August 1993 and September 2000 are due to the presence of many thousands of phalaropes in the salt ponds.

Within the shorebird group, western sandpipers (*Calidris mauri*) were most abundant. Due to the difficulty of separating other similar small shorebirds such as red knot, sanderling (*Calidris alba*), semipalmated plover, dunlin (*Calidris alpine*), least sandpiper

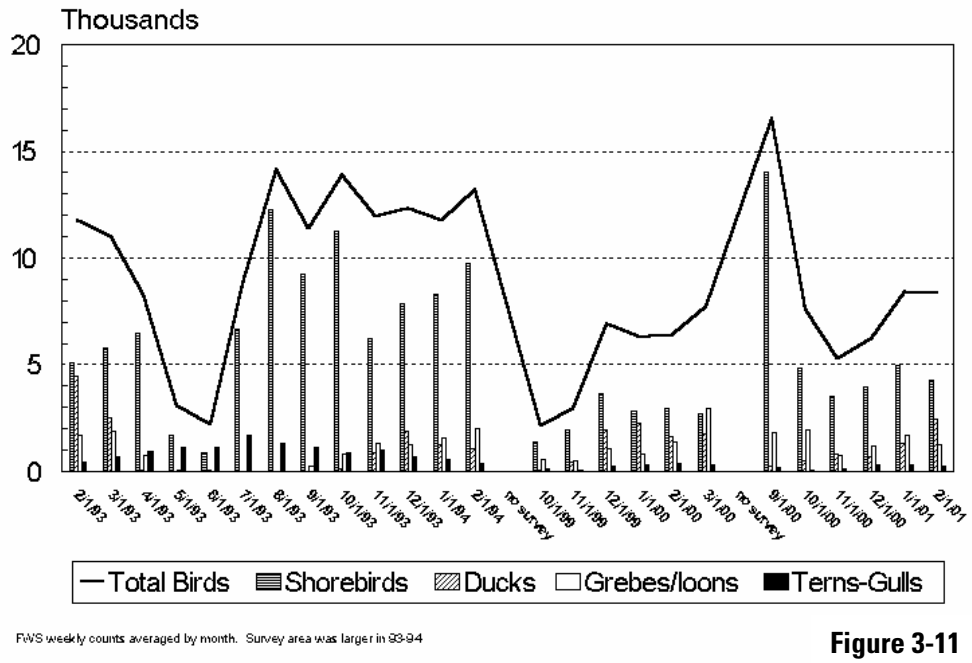

Figure 3-11

(*Calidris minutilla*), that rest and forage in large mixed flocks, these birds are sometimes considered in a group known as "peeps". Peeps accounted for the largest shorebird presence in South San Diego Bay (49% of all shorebirds). Phalaropes, in very large numbers (7,000 –11,000) usually move into and out of the salt ponds between July and September, but are largely absent the rest of the year. Their northward migration pulse is much less or altogether absent, perhaps because the brine shrimp densities are reduced in late winter and early spring. Because of the large summer pulse, phalarope numbers constitute about 20% of all shorebird observations. Other shorebirds are present but in much less relative abundance, marbled godwit (9%), willet (8%), black-bellied plover (5%), and black-necked stilt (4%). Within the waterfowl group, lesser scaup (46% of all waterfowl) and bufflehead (19%) were most abundant, followed by surf scoter (8%), ruddy duck (*Oxyura jamaicensis*) (8%), American wigeon (*Anas americana*) (5%), and black

brant (5%). Eared grebes dominated the grebe/loon group while elegant terns dominated the tern/gull group, primarily due to their large summertime breeding population.

Of the 44 survey subareas, 70% of all birds used about 51% of the total study area. Total bird abundance per pond is presented in Table 3-10 and the percent distribution of birds per pond type is illustrated in Figure 3-12 (refer to Figure 2-6 for pond locations and type). Pond 23 had the highest total abundance, closely followed by Pond 22, due largely to two species, the red-necked phalarope and eared grebe. Pond 28, a pickling pond, was heavily used by shorebirds, probably roosting there when the tidal mudflats were inundated and unavailable for foraging. The tidal mudflats of the bay were used heavily by foraging shorebirds when exposed during low tides and by waterfowl (scaup, surf scoter, and brant) during high tides.

Table 3-10
Bird Abundance in the Salt Ponds

Pond #	Bird Abundance	Habitat Type
23	48025	secondary
28	46093	pickling
22	44279	secondary
Bay 2	37780	tidal
Mudflat 1	33016	tidal
10	30999	primary
14	23452	primary
15	23073	primary
26	21416	secondary
20	20451	secondary
27	19249	secondary
Mudflat 2	18924	tidal

With respect to species diversity, the tidal areas to the north of the salt ponds had the highest number of species (67) observed. Pond 10, a primary pond where bay water is taken into the salt works system, has fluctuating water levels and slightly elevated salinities. The characteristics of this pond attract foraging shorebirds and fish eating birds, as well as roosting pelicans and gulls. Primary Ponds 14 and 15 attracted roosting gulls, terns, cormorants, bufflehead, wigeon, ruddy ducks, and especially foraging

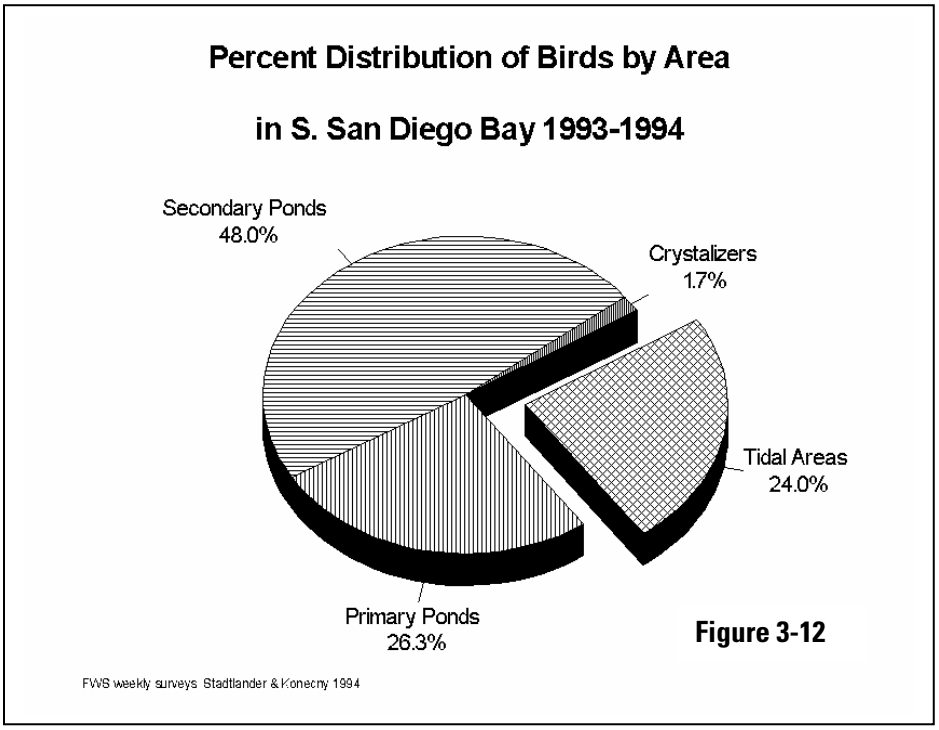

Figure 3-12

phalaropes. Secondary Ponds 26, 20, and 27 were used mostly by roosting shorebirds, gulls, terns, pelicans, cormorants, and when water levels were low, creating a thin layer of hypersaline water, by foraging shorebirds.

With the exception of pickling Pond 28, ponds with the least number of birds included all ten of the crystallizing ponds (about 127 acres). This is probably due to the extreme saline conditions, which eliminates any potential prey base for avian species, and high levels of disturbance related to salt harvesting activities.

Among the different bird groups that are present in South San Diego Bay at one time or another, each species makes its own use of the area to fulfill one or several essential life requirements (breeding, feeding, and/or resting). Several tern species use the salt pond levees for breeding and resting. However, as fish eaters, they must go outside the salt ponds to find food since the salt ponds support relatively little or no fish community. Conversely, phalaropes, which are only present during late summer while migrating, are probably storing energy for migration by consuming the densely abundant brine shrimp and brine flies present in some of the salt ponds.

Both red-necked phalaropes and Wilson's phalaropes are present on the salt ponds during migration. The red-necked phalarope has been observed during the months of July through October with the highest numbers occurring in August. On August 18, 1993, over 11,000 individuals were observed at the salt works *(Stadtlander and Konecny 1994*). During the 1993/1994 avian surveys, the ponds most frequented by this species were Ponds 14, 15, 21, and 22. In 1993, approximately 370 Wilson's phalaropes were observed at the salt works during the month of July *(Stadtlander and Konecny 1994)*, while Jehl (*1988*) reported that in July 1986, a count of 5,000 to 10,000 individuals was made at the salt works, all of which were female.

Eared grebes are documented winter residents of the salt ponds and, with the exception of a few nonbreeders (less then 35 individuals in 1993), are virtually absent from the salt ponds during the summer months (*Stadtlander and Konecny 1994*). During the 1993/1994 avian surveys, eared grebes were observed within 33 of the 44 survey units and exceeded over a thousand birds for much of the fall and winter months (*Stadtlander and Konecny 1994*). The highest number of individuals observed in the ponds occurred on March 17, 1993 during migration, when approximately 2,360 eared grebes were counted. Of this total, approximately 1,080 individuals were observed in Ponds 22 and 23. Approximately 700 to 2,000 eared grebes were observed during the months of December 1993 and January 1994. The main wintering areas for this species are believed to be the Salton Sea, where approximately 1.5 million individuals occur in mid-winter, and the Gulf of California (*Jehl 1988*).

Observations made during the 1993/1994 survey indicated that many shorebird species rest in the safety of the salt pond complex while the nearby tidal mudflats that are their primary feeding area are inundated by the high tide. Other shorebirds, such as American avocet and black-necked stilts, forage both in and out of the ponds and nest within the secondary pond system. Ponds 10 and 10A are probably exceptions to these generalities since they are subject to the lowest salinities of all the salt ponds. This combines with the irregularly fluctuating water level within these ponds and creates shallow water depths similar to those occurring in adjacent tidal areas, thus providing foraging areas for shorebirds.

The importance of the wetlands in South San Diego Bay to shorebirds is also evident from the data provided by the Pacific Flyway Project, the first ever attempt to establish baseline data on the abundance and distribution of shorebirds in wetland habitats along the Pacific Flyway from Alaska to Baja California. The shorebird migration/wintering data for the South San Diego Bay that is provided in Table 3-11 was gathered during surveys conducted between April 1988 and August 1995.

Table 3-11
Shorebird Migration/Wintering Data for South San Diego Bay

Species Observed	Number of Individuals Observed During Various Seasons		
	Spring	Fall	Winter
Black-bellied Plover[1]	200	600	600
Black-necked Stilt	200	300	200
Willet	300	900	700
Long-billed Curlew[2]	<50	100	<50
Marbled Godwit[1,2]	700	1,400	1,600
Black Turnstone[2]	100	<50	<50
Red Knot[1]	600	600	500
Sanderling[2]	500	300	300
Western Sandpiper[1,2]	6,600	5,500	3,500
Dunlin[1,2]	200	0	300
Dowitcher spp. [1,2]	1,900	1,100	1,100
Red-necked Phalarope[2]	0	7,400	0

[1] Species that uses the mudflats extensively on migration and during the winter

[2] Species that is either a Bird of Conservation Concern or Highly Imperiled or of High Concern in the U.S. Shorebird Conservation Plan

Some waterfowl (such as scaup) rest in floating groups (rafts) either inside the salt ponds or on calm, undisturbed water areas of the bay. The salt ponds offer relatively little food for most waterfowl, therefore, species such as black brant, greater scaup, redhead, ring-necked duck, and common merganser were observed most often outside the confines of the salt works in the bay. American widgeon, gadwall, mallard, northern pintail, cinnamon teal, northern shoveler, bufflehead, ruddy duck, red-breasted merganser, and American coot were recorded both within the bay and within the salt pond complex. Lesser scaup and surf scoter, although observed both within and outside the salt ponds, were found in the highest concentrations outside the salt pond system and within the lowest salinity ponds (Ponds 10 and 11).

Migratory Bird Use of the Water Areas of South San Diego Bay

San Diego Bay contributes more protected, shallow, bay habitats to the Pacific Flyway waterbird populations that any other bay or estuary situated along the 180-mile coastal region of southern California. The Central and South Bays make up approximately 65% (7,130 acres) of the entire open water habitat of the bay. The water areas of South San Diego Bay (from approximately the Sweetwater River mouth south to the outer levees of the salt ponds) are less dredged and relatively less industrialized than the Central and North Bay regions where Navy and port wharves and small boat marinas abound. Most of the South Bay water area is less than 10 feet deep (MLLW) and supports extensive

eelgrass beds and intertidal mudflats. A wide variety of waterbirds have previously been documented using the bay's habitats *(MacDonald et al. 1990).*

A second study conducted by the Service in 1993 and 1994 focused on avian use of the water areas in the Central and South bay. The Service's Coastal Program conducted weekly waterborne surveys (*Manning 1995*) between April 15, 1993 and April 14, 1994 to characterize species richness, relative abundance, and spatial distribution of the waterbird community in the Central and South San Diego Bay. A cumulative total of 149,553 individual birds of 52 species were observed in during these surveys. Species richness peaked during the winter at 35 species and was lowest during the summer at about 15 species. Abundance follows the same pattern of higher abundances during migration (November to March) with a peak single day count of 12,006 birds in December 1993. April to September waterbird abundance in the Central and South Bay was typically fewer than 1,000 birds. Of the cumulative total number of birds observed, 66% were seen in the South Bay and 34% in the Central Bay.

Surf scoters composed the largest proportion (64%) of all birds observed, followed by scaup (11%), bufflehead (6%), and brant (5%). Together, brown pelicans, grebes, and cormorants represented about 8% of the total, while all other species were about 6% of the total. The highest single day total of surf scoters was 7,458 in December 1993 in Central and South San Diego Bay. The highest single day total for scaup was 1,937 in December 1993, bufflehead numbered 715 in December 1993 and brant numbered 714 birds in March 1994. About 61% of all surf scoters and virtually all brant observed during the surveys occurred within the South Bay. While scoter, scaup, and brant populations using San Diego Bay may have declined since the 1970s, about 40% of all California surf scoters and 30% of all brant using California's waters can be found in San Diego Bay during winter (*Bartonek 1994, USFWS 1995, and U.S. Navy 2000*). The results of the surveys also showed that the greatest abundance of waterbirds within the Central and South San Diego Bay occurred in "areas with relatively low water recreational intensity" (*Manning 1995*).

Breeding Birds

Nesting Seabirds

The natural breeding habitats for the ground nesting seabirds that nest within the San Diego Bay NWR include salt marshes, sandy beaches, and barrier islands. Although these habitats were plentiful in coastal San Diego County in the past, the vast majority of these areas have either been lost to urban and recreational development or now experience significant levels of disturbance. There are a few natural nesting areas remaining along the southern coast of San Diego County, however, even these areas are actively managed to control disturbance and predation.

With the loss of historic breeding grounds, many seabirds are now nesting on manmade landforms that resemble in some way their preferred native habitats. These landforms include nonvegetated or lightly vegetated flat, open ground; manmade sand islands; levees; and berms. Two important seabird nesting areas within San Diego Bay are located within the San Diego Bay NWR: the D Street Fill and the levees around the salt ponds.

D Street Fill. Within the Sweetwater Marsh Unit, the D Street Fill provides nesting habitat for the federally listed endangered California least tern. This area is currently managed to provide about 35 to 40 acres of unvegetated, sandy substrate on both Refuge and Port lands to support least tern nesting. Least terns were first discovered nesting at

this location in 1973 (*USFWS 2000a*). Although some 20 to 25 pairs nested here in 1973, fledging success was poor due to unregulated human disturbance. Similar conditions occurred until 1978, when 47 breeding pairs produced 15 fledglings. Initial nesting attempts in 1980 were disrupted by off-road vehicles. In 1988, the Biological Opinion for the Combined Sweetwater River Flood Control and Highway Project defined the historic nest site acreage on the D Street Fill as 44 acres (*USFWS 1988b*), which included 12 acres on the western end of the fill that is owned by the Port.

The colony abandoned the area in the mid-1980s and did not return in substantial numbers until 1992, when 135 nesting pairs were observed. Unfortunately, fledging success during 1992 was limited due to severe weather associated with an El Niño event, as well as harassment by avian predators. Since 1994, least terns have regularly nested here, with nesting pair numbers fluctuating between six and 38 pairs. In 2001, the site supported 3.6 percent of the least tern breeding pairs around San Diego Bay, with fair reproductive success (*USFWS 2001*). Data from 1998, 1999, and 2003 through 2005 indicates that least tern nesting activity is generally confined to a ten-acre area near the western end of the fill (Figure 3-13). The number of least tern nests at the D Street Fill between 1999 and 2005 is provided in Table 3-12 and additional discussion is included in Section 3.4.6.1.

Table 3-12
Numbers of California Least Tern and Snowy Plover Nests at the D Street Fill
(1999 – 2005)

	1999	2000	2001	2002	2003	2004	2005
California Least Tern	36	34	32	24	91	111	101
Western Snowy Plover	2	1	0	0	0	0	0

Salt Pond Levees. Various levees within the salt works provide nesting habitat for a diverse and abundant array of colonial nesting seabirds, including the federally endangered California least tern, Caspian tern, elegant tern, royal tern (*Thalasseus maximus*), gull-billed tern, Forster's tern (*Sterna forsteri*), and black skimmer. Of these species, the gull-billed tern, elegant tern, and black skimmer are listed by the Service as Birds of Conservation Concern. Based on observations of these nesting colonies and the nesting colonies of these species elsewhere, it appears that the qualities that attract ground nesting seabirds to the salt pond levees include limited human disturbance, the isolated nature of the area, the availability of exposed or lightly vegetated open ground, and unrestricted visual access from the levees into the surrounding area.

The pond levees, which cover about 100 acres, vary in width from 2 to 10 meters and range about 1 to 2.5 meters in height above the water level. Depending on the amount of erosion, the levee banks may be vertical or gently sloping. The substrate of the perimeter road is gravel over compacted soil, while the inner levees are composed of soft powdery silt. The substrate on some levees has recently been enhanced to improve nesting conditions by topping the levees with several inches of clean, light sand. Salt crystals can also be found along the tops of some levees, particularly within the secondary and pickling ponds.

Little data is available on the early (1900 through 1970) use of the salt works by nesting seabirds. A statewide survey of California least tern nesting areas documented the presence of least tern nests at the salt works between 1968 and 1970 (*Craig 1971*).

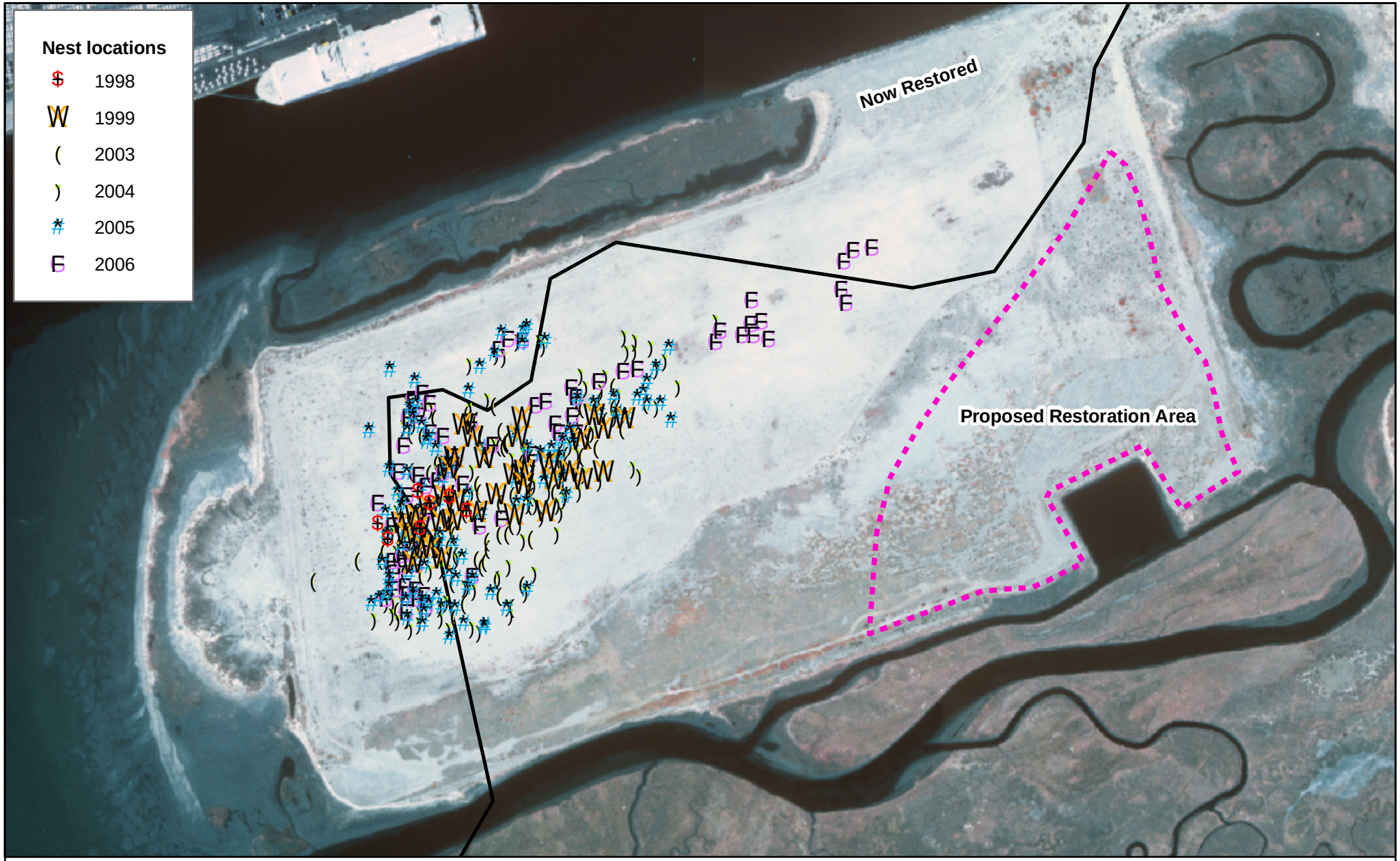

Figure 3-13
Least Tern Nesting on the D Street Fill

Refuge boundary

0 250 500 Feet

Sources: 1998-2005 - Unified Port of San Diego, 2006 - R. Patton pers. comm., USFWS, Local Agency Partnership 2000

Carlsbad Field Office - 2003
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Monitoring of avian populations at the salt works was also conducted by Elizabeth Copper in the late 1970s and early 1980s. In 1987, Pacific Southwest Biological Services, Inc. conducted a survey of the birds occurring on portions of the salt works in order to understand the potential effects of proposed alterations to the existing levees. It was not until 1993 that a comprehensive investigation of the avian species in the South Bay was undertaken by the Service (*Manning 1993, Stadtlander 1994, Konecny 1995*). The Service's Coastal Program initiated these studies to obtain information regarding species diversity, abundance, and habitat use at the salt works. Yearly monitoring of the nesting activities on the salt works has followed this initial effort.

During the 1998 nesting season, the Service monitored nesting activity at the salt works every three to four days from April 3 to September 11, for a total of 44 visits (*Terp and Pavelka 1999*). Monitoring results showed that seabird nesting generally occurred on the levees of the primary ponds located to the east of the Otay River, as well as on the levees in and around Ponds 23, 24, 25, and 27, and between Ponds 25 and 30 and 27 and 41.

Since 1999, the levees have been routinely monitored during the nesting season. The numbers and locations of nests per species that have been documented as a result of this monitoring are provided in Tables 3-13 and 3-14. This data illustrates the variation in numbers and locations of nests within the salt works from year to year. These variations could be affected by conditions within the site, but are more likely the result of changing conditions in adjacent areas, particularly the ocean, that cannot be controlled by management actions on the Refuge. A brief description of nesting activity within the South San Diego Bay Unit per species is provided in the following paragraphs.

Table 3-13
Number of Waterbird Nests at the South San Diego Bay Unit
(1999 – 2005)

	1999	2000	2001	2002	2003	2004	2005
Seabird Nesting							
California least tern	25	44	45	39	62	49	34
Gull-billed tern	29	27	47	39	59	49	73
Caspian tern	280-370	500-575	365-450	379	332	313	357
Royal tern	36	1-2	3	1-3	28-31	38	52
Elegant tern	3,100	86	107-110	37-100	10,300-10,500	1,020	3,050-3,200
Forster's tern	174-188	325-327	419-438	390+	266	275	415
Black skimmer	395-410	224-231	419-430	443+	541	496	752
Other Nesting Waterbirds							
Western Snowy Plover	0	1	3	3	0	2	4
Double-Crested Cormorants	80-84	41	39-53	49+	74-77	49	77

Source: (Patton 2006b)

California Least Tern. The California least tern, which is discussed in greater detail in Section 3.4.6.1, is present in South San Diego Bay only during the breeding season. In

Table 3-14
Locations[1] of Waterbird Nest Sites at the Salt Works Between 1999 – 2005

	1999	2001[2]	2002	2003	2004	2005
Nesting Seabirds						
California least tern	dike IX, X, XII	dike IV, IX, X	dike IV, IX, spit 6, berm A	dike IV,VII, IX, X, XII, spit 4, 6	dike IV, VII, spit 4, berm b	dike IV, VI, VII, IX, X, XII
Gull-billed tern	dike I, II, III, IV, V	dike II, III, IV, V	spit 5, dike III, VIII	dike II, III, IV, V	dike II, III, IV, V, VIII, berm C	perimeter road (w), dike II, III, VI, VII, XIII
Caspian tern	dike II, III, VIII	dike V, spit 3	dike II, V	dike II, V, spit 3	dike II, V, VIII	dike II, V, VIII
Royal tern	dike III	dike V	dike V	dike II,III,V	dike II, IV	dike II, V
Elegant tern	dike III	dike II, V, spit 1	dike V, spit 1	dike I,II, III, IV, V	dike II, III, IV	dike II, V
Forster's tern	perimeter roads (n, w), dike I, III, IV, V, spit 1	perimeter roads (n, w), spit 1, dike I-VI, XIII	perimeter roads (n, w), dike I, II, III, V, VII, spit 1	perimeter roads (n, w), dike I, II, III, V, VI, VII, spit 1	perimeter roads (n, w), dike I, II, III, V, VI, VII	perimeter roads (n, w), dike II, III, V, VI, spit 1
Black skimmer	dike II, III, IV, V, VI, VII, spit 1	perimeter road (n), dike II, III, IV, V, XIII, spit 1, 7	perimeter road (n, w) dike I, II, III, IV, V, XIII	perimeter roads (n, w), dike III, IV, VI, VII, XIII, spit 4	perimeter roads (n, w), dike II, III, IV, V, VI, VII, XIII	perimeter roads (n, w), dike II, III, VI, VII, XIII
Other Nesting Waterbirds						
Western Snowy Plover	none observed	dike XII	dike IV, spit 6	none observed	dike VIII, berm D	dike IV
Double-crested cormorant	dike II, III, barge	dike III, VIII, barge	barge	dike I, II, V, barge	dike II, barge	dike I, V, barge
American avocet	dike I, III, IV, V	all major dikes	all major dikes	all major dikes	all major dikes	all major dikes
Black-necked stilt	perimeter road (w), dike I, III, IV, V,VIII	all major dikes	all major dikes	all major dikes	all major dikes	all major dikes
Other Nesting Birds[3]						
Mallard	dike II	dike I, II	perimeter road, dike II	dike I, II, III,V	perimeter road, dike III	Locations not noted
Gadwall	dike I, V	dike I, II, III,V	dike II, V,	dike III	perimeter road (n)	Locations not noted
Killdeer	none observed	perimeter road	perimeter road (w)	perimeter road (w)	perimeter road (w)	Locations not noted
Horned Lark	dike III	dike XII	not observed	dike III	dike VII	Locations not noted
Belding's savannah sparrow	dike I, II	dike III, V	dike I, III	dike I, III	Dike III, VI	Locations not noted

[1]These locations are illustrated in Figure 3-14.
[2]No data is available for 2000.
[3]One to a few nest observations; not specifically searched for, but encountered during monitoring for other species.
Source: (Patton 1999, 2004a, 2004b, 2004c, 2006a, 2006b)

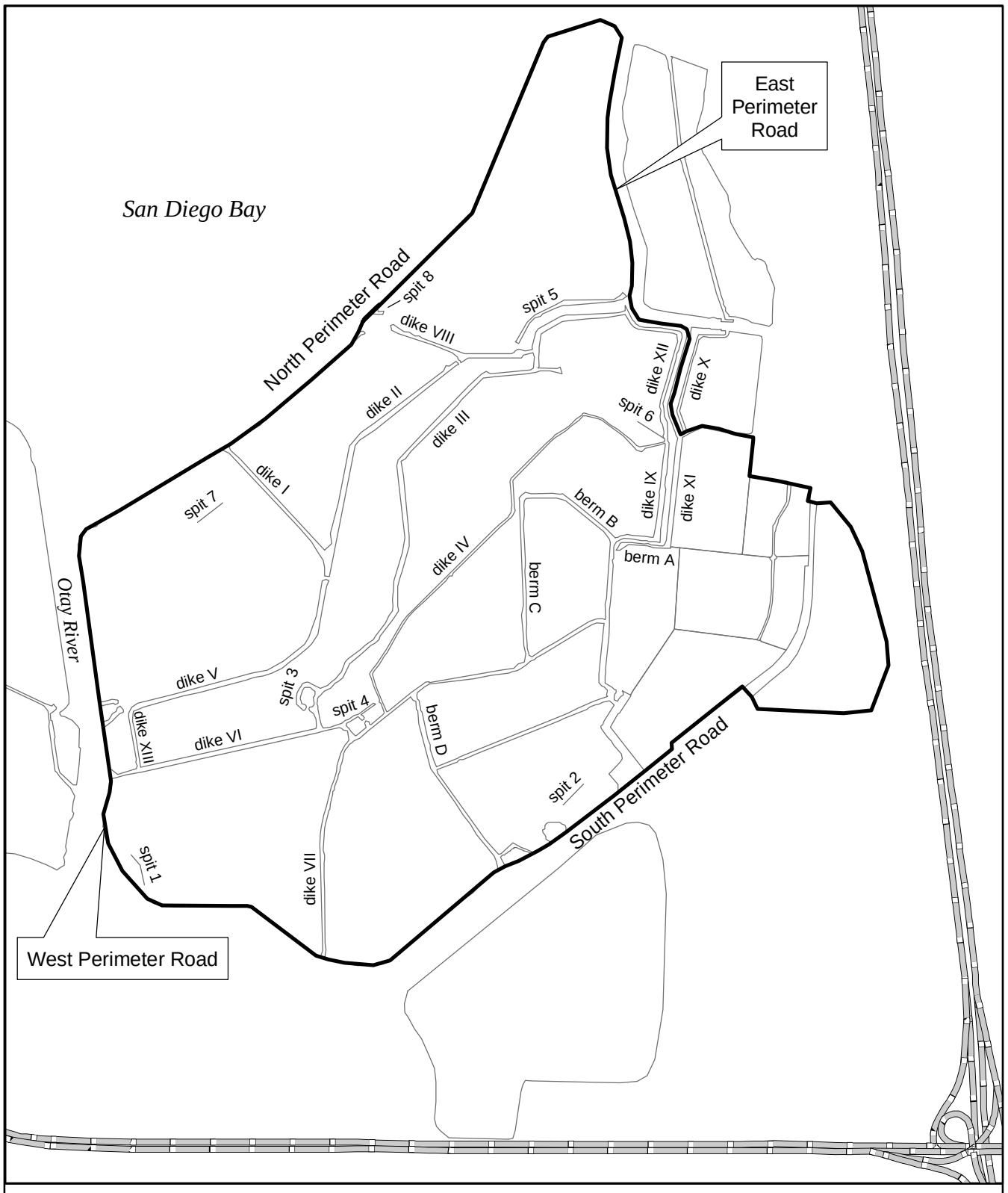

Figure 3-14
Nesting Locations as Described in Table 3-14

0 500 1,000
Feet

Source: USFWS

Carlsbad Field Office - 2003
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1970 limited surveys were initiated in the San Diego to document nesting locations and population status for this species. At that time the salt works was identified as one of two nesting sites within San Diego Bay. California least tern breeding populations at the salt works have ranged from a high of 62 pairs in 1993 to two pairs in 1970, with no known nesting during 1982 and 1983. Between the 1978 and 2001 nesting season, least tern nesting use at this site has been confirmed for 22 out of the 24 years. In 2002, 39 nests were observed, of which only two were estimated to have fledged from the site (*Patton 2004a*) and in 2005, 34 nests were observed with two to three assumed to have fledged from the site (*Patton 2006b*). Poor least tern reproductive success at the salt works is partially attributed to high levels of predation of chicks and eggs.

Since 1999, least terns have nested in several locations within the salt works. Until 2003, the terns tended to nest on the eastern levees of Ponds 25 and 27 and the western levee of Pond 30. In 2003, use of the eastern levees of Ponds 25 and 27 decreased, but new nesting areas on dikes IV and VII were established. In 2004, nesting was almost exclusively limited to dikes IV and VII and spit 4 (refer to Figure 3-14). A similar nesting distribution occurred in 2005, although limited nesting was once again observed in the vicinity of Ponds 25, 27, and 30.

Gull-billed Tern. The western subspecies of the gull-billed tern, which is discussed in greater detail in Section 3.4.7.1, was recorded in South San Diego Bay in 1985. The first western gull-billed tern nest was observed at the salt works in 1987 (*Terp and Pavelka 1999*). Approximately eight to 10 nesting pairs were observed at the salt works between 1993 and 1998. In 2003, at least 59 nests were established by 32 to 37 pairs (*Patton 2004b)* and in 2005, 73 nests were observed (*Patton 2006b*). This tern is only present during the breeding season (March through July) and the salt works is one of only two locations in the western U.S. where this tern breeds. The other location is the Salton Sea, California.

The location of gull-billed tern nests within the salt works has been documented since 1999. In 1999, these terns nested in various locations within the center of the salt works, primarily the south end of dike I, the northeast end of dike V, the center portion of dike IV and an adjacent portion of dike III. In 2002, the nests were concentrated primarily around the eastern end of Pond 13. In 2005, nests were observed along a significant portion of dike III, as well as in smaller patches along dikes II, VI, VII, and XIII, and two small spits located immediately to the east of the western perimeter road.

Caspian Tern. Based on the high abundance of Caspian terns during the nesting season and few observations from November through February, Caspian terns are believed to use the salt works primarily as a breeding site. Nesting Caspian terns were first recorded at the salt works in 1941. Based on observations in 1993, 1994, 1997, and 1998, the breeding colony of Caspian terns at the salt works ranges from 200 to 300 breeding pairs per year (*Terp and Pavelka 1999*). In 2005, approximately 350 Caspian tern nests were observed at the salt works (*Patton 2006b*). Although the specific location of Caspian tern nests vary from year to year, in general, the nests tend to be located along the interior levees of the eastern primary ponds.

Royal Tern. At one time the royal tern was considered the most abundant large tern in California; however, during the 1900s their numbers declined throughout the state (*Unitt 1984*). This tern, which was first discovered nesting at the salt works in 1959, is present in the South Bay in small numbers throughout the year. Since 1959, one or two pairs have occasionally nested in South San Diego Bay. In 2002, two single egg nests were observed

(*Patton 2004a*), while 52 nests were observed in 2005 (*Patton 2006b*). In 1999, royal tern nests were observed at the northeastern end of dike III, however, in subsequent years, royal tern nests generally have been located among active elegant tern nests. The exception was in 2002, when the two to three nests observed at the site were located among Caspian tern nests.

Elegant Tern. The elegant tern can be observed in the South Bay between March and October. Over the years, surveys have documented the presence of more non-breeding migratory elegant terns than breeding pairs. In 1998, approximately 100 breeding pairs of elegant terns were documented, while about 1,000 non-breeding birds were observed in June, over 3,000 in late July, and 500 by late August. The first documented nesting of this species at the salt works occurred in 1959. The salt works is one of only a few nesting locations for elegant terns in the United States. The number of breeding pairs at the salt works has fluctuated significantly over the years, with over 800 pair observed in 1981 (*Unitt 1984*), none in 1990 (*Terp and Pavelka 1999*), 511 nests in 1993, and 3,100 nests in 1999 (*Patton 1999*). Only two nesting pairs were observed in 1997 (*Horn and Dahdul 1998*), 37 to 100 in 2002, and as many as 10,500 nests in 2003 (*Patton 2004a*). In 2005, it was estimated that 3,050 to 3,200 nests were established (*Patton 2006b)*.

The nest locations within the salt works for elegant terns have varied from year to year, just as the number of nests has varied. In 1999, elegant terns nested exclusively on dike III. However, in 2001 and 2002, these terns were observed nesting slightly to the west on dike II (2001 only), V, and spit 1. In 2003, when the number of nests at the salt works was significantly higher than in previous years, these terns nested along dike II, including the intersection of dike I and II, dike III and V, and small portion of dike IV. In 2004, nesting was more centralized, occurring on dike II, III, and IV. In 2005, nests were limited to dike II and V.

Forster's Tern. Forster's terns are present in the South Bay throughout the year, but their numbers peak in May and November. This species primarily breeds in the interior of North America with a few colonies located on the Pacific, Atlantic, and Gulf coasts. The first reported nesting at the salt works occurred in 1962 and the colony size has increased substantially since that time. Stadtlander (*1993*) reported 510 Forster's tern nests in 1993, 345 nests were observed in 1994 (*Konecny 1995*), 225 nests were counted in the 1998 surveys (*Terp and Pavelka 1999*), and during the 2005 breeding season, at least 415 nests were observed (*Patton 2006b*). The location of Forster's tern nests vary from year to year, however, nests are routinely observed along the north and west perimeter road and dike II and III. Various other dikes and small spits may also be used for nesting in a given year.

Black Skimmer. Approximately 280 pairs of black skimmers were observed nesting at the salt works during the 1998 investigations. This species is generally present in the South Bay between April and September and in recent years has most often nested on the spit within Pond 23. The first reported nesting of black skimmers at the salt works was a single breeding pair in 1976 (*Stadtlander 1994*). The number of breeding pairs has increased significantly since that time. During the 2005 nesting season, approximately 752 black skimmer nests were observed at the salt works (*Patton 2006b*). The distribution of black skimmer nests within the salt works is similar to that of the Forster's tern, with nesting occurring on the north and west perimeter roads in 2001, 2003, 2004, and 2005.

Other Nesting Birds

Sweetwater Marsh Unit. The federally listed threatened western snowy plover is another ground nesting species that has historically nested on the D Street Fill. Although snowy plovers have nested here in the past, nesting attempts have been limited and sporadic (refer to Table 3-12). Two nests were identified in 1999 and one in 2000. No nests have been observed here since 2000 (*Patton 2006b*). The reason for plover abandonment of this site may be due in part to inadequate chick and adult access to adjacent foraging areas (*Patton pers. comm.*). Plover nests observed on the D Street Fill in 1998 and 1999 were located in the same general area as the tern nest sites depicted in Figure 3-12.

The federally listed endangered light-footed clapper and State listed endangered Belding's savannah sparrow both nest within the salt marsh habitat of the Sweetwater Marsh Unit. Additional information regarding these species is provided in Sections 3.4.6.1 and 3.4.6.2 respectively.

The upland areas on the Sweetwater Marsh Unit also provide nesting habitat for various hummingbird species, as well as horned larks (*Eremophila alpestris*), loggerhead shrikes (*Lanius ludovicianus*), and various other passerine species. Both horned larks and killdeer have been observed nesting on the D Street Fill.

Salt Pond Levees. In addition to providing habitat for nesting seabirds, as described above, the South San Diego Bay Unit also provides suitable nesting habitat for a variety of other avian species. Western snowy plovers were first documented nesting on the levees of the salt ponds in 1978, when 16 pairs nest were observed. The population of snowy plovers in South San Diego Bay has declined substantially since then. In 1993, an estimated seven breeding pairs were present at the salt works. Only one nest was located in 1994, five in 1997, and three in 1998 (*Terp and Pavelka 1999*). In 2005, four nests were identified at the salt works and it was estimated that three fledglings were produced (*Patton 2006b*).

American avocets and blacked-necked stilts also nest on the salt pond levees. In fact, the only recent nesting of these two species in San Diego Bay has been within the salt works (*Patton 2004a*). Nests tend to be abundant and distributed throughout the salt pond levees. In May 2002, at least 30 avocet nests and 24 stilt nests were recorded. Some of the other species observed nesting within the salt works in 2004 were killdeer (*Charadrius vociferous vociferous*), horned lark, gadwall, and mallard (*Anas platyrynchos*).

Belding's savannah sparrows nest in the pickleweed salt marsh vegetation that occurs along the outer levees of the salt ponds, within the lower reach of the Otay River, and along the edges of the South Bay in remnant patches of salt marsh vegetation. The light-footed clapper rail has also been detected nesting within the Otay River channel, upstream of the salt works.

Double-crested cormorants (*Phalacrocorax auritus*) annually nest within the salt works on a dredging barge anchored in the salt ponds and in a few locations along the salt pond levees. This nesting activity has been noted since the late 1980s. Nesting begins in April and continues through late July. During the 1998 colonial seabird nesting study, 34 cormorant nests were observed on the barge, with over 70 adults and about 42 young were present at the time of observation (*Terp and Pavelka 1999*). A total of 77 cormorant nests were observed at the salt works during the 2005 nesting season (*Patton 2006b*).

Birds of Prey

The northern harrier is the most common bird of prey observed on the Sweetwater Marsh Unit where it occurs year round, hunting over salt marsh and upland areas within the Refuge. Other birds of prey frequently observed include the Cooper's hawk (*Accipiter cooperii*), red-tailed hawk, American kestrel, and osprey (*Pandion haliaetus*). Less common, but predictable visitors to the Refuge include the American peregrine falcon, sharp-shinned hawk (*Accipiter striatus*), red-shouldered hawk (*Buteo lineatus*), white-tailed kite (*Elanus leucurus*), and prairie falcon (*Falco mexicanus*). Occasional visitors include the Swainson's hawk (*Buteo swainsoni*) and merlin (*Falco columbarius*). The short-eared owl is a rare winter visitor to salt marsh habitat (*Unitt 1984*) and is occasionally sighted at Sweetwater Marsh. Although rare, there are also documented sightings of ferruginous hawk (*Buteo regalis*), long-eared owl (*Asio otus*) and golden eagle (*Aquila chrysaetos*).

During the 1993-1994 avifauna surveys, as well as during subsequent monitoring by Service staff, kestrels, ospreys, red-tailed hawks, and northern harriers were frequently observed in the area. Other common species observed within the South San Diego Bay Unit include the short-eared owl, Cooper's hawk, merlin, and sharp-shinned hawk. White-tailed kites, red-tailed hawks, and Cooper's hawks are also frequently sighted within the Otay River floodplain. During a survey of the railroad right-of-way in 2000, a golden eagle was sighted in the vicinity of the Otay River (*Tierra Environmental Services 2000*). Peregrine falcons are occasionally observed in the vicinity of the salt works. Burrowing owls have been recorded in this area in the past, but were absent from the area for several years. Recent observations by Refuge staff indicate that two pairs have reestablished a presence on the Sweetwater Marsh Unit.

Passerines and Other Birds

Some of the passerines commonly observed on both the Sweetwater Marsh and South San Diego Bay Units include the Belding's savannah sparrow, western kingbird (*Tyrannus verticalis*), northern mockingbird (*Mimus polyglottos*), western meadowlark (*Sturnella neglecta*), and California towhee (*Pipilo crissalis*). In addition, a number of nonpasserines, including mourning doves (*Zenaida macroura*) and a variety of hummingbirds, are commonly observed on these Refuges. At the Sweetwater Marsh Unit, it is not uncommon to observe a belted kingfisher (*Ceryle alcyon*) in the marsh to the southwest of the Nature Center. Tree swallows (*Tachycineta bicolor*), cliff swallows (*Petrochelidon pyrrhonota*), barn swallows (*Hirundo rustica*),and rough-winged swallows (*Stelgidopteryx serripennis*) have also been observed feasting on the swarms of brine flies that occasionally occur along the tidal channel between Ponds 15 and 28 in the South Bay.

Although several surveys have been conducted at the salt works and within the open waters of the bay to document waterbird and shorebird use in these areas, a comprehensive survey has not been completed of all of the birds supported by the habitats of the Sweetwater Marsh and South San Diego Bay Units. Appendix C includes lists of those birds that have been observed in and around the Sweetwater Marsh and South San Diego Bay Units. Note that these lists are not intended to represent a complete listing of the species supported on the Refuge.

3.4.4.2 Mammals

A comprehensive survey of the various mammals occurring on the Refuge has not been completed to date; however, private consultants have previously conducted limited studies (*Jones & Stokes*

Associates, Inc. 1983, Butler/Roach Group, Inc. 1987, Pacific Southwest Biological Service, Inc. 1990, and Tierra Environmental Services 2001) for portions of the Refuge for reason unrelated to Refuge activities. A list of the mammal previous observed on the Refuge is provided in Table 3-15. It is likely that all of these species, as well as several others, occur on both Refuge Units, but have not yet been officially recorded.

Table 3-15
Mammals Observed on the San Diego Bay NWR

Common Name	Scientific Name	Where Observed
Virginia opossum	*Didelphis virginiana*	Sweetwater Marsh Unit
Brush rabbit	*Sylvilagus bachmani*	Sweetwater Marsh Unit
Desert cottontail	*Sylvilagus audubonii*	Both Refuge Units
San Diego Black-tailed Jackrabbit	*Lepus californicus bennettii*	Sweetwater Marsh Unit
California ground squirrel	*Spermophilus beecheyi*	Both Refuge Units
Botta's pocket gopher	*Thomomys bottae*	Sweetwater Marsh Unit
San Diego pocket mouse	*Perognathus fallax*	Sweetwater Marsh Unit
California pocket mouse	*Perognathus californicus*	Sweetwater Marsh Unit
Pacific kangaroo rat	*Dipodomys agilis*	Sweetwater Marsh Unit
Deer mouse	*Peromyscus maniculatus*	Sweetwater Marsh Unit
Dusky-footed woodrat	*Neotoma fuscipes*	Sweetwater Marsh Unit
Black rat	*Rattus rattus*	Sweetwater Marsh Unit
House mouse	*Mus musculus*	Sweetwater Marsh Unit
Coyote	*Canus latrans*	Both Refuge Units
Gray fox	*Urocyon cinereoargenteus*	Sweetwater Marsh Unit
Domestic dog	*Canus familiarus*	Both Refuge Units
Raccoon	*Procyon lotor*	Both Refuge Units
Long-tailed weasel	*Mustela frenata*	Gunpowder Point, Sweetwater Marsh Unit and South San Diego Bay Unit
Striped Skunk	*Mephitis mephitis*	Sweetwater Marsh Unit
Domestic Cat	*Felis domesticus*	Both Refuge Units

3.4.4.3 Reptiles and Amphibians

A comprehensive survey of the reptiles and amphibians is not currently available for the San Diego Bay NWR, however, some limited data is provided in survey reports prepared by private consultants for various properties in and around the Refuge. One previous survey, conducted in 1990, included the uplands within and adjacent to the Sweetwater Marsh Unit (*Pacific Southwest Biological Services, Inc 1990*). This survey identified one native amphibian, the Pacific treefrog (*Hyla regilla*) and one exotic amphibian, the African clawed frog (*Xenopus laevus*). The African clawed frog was located in a brackish marsh, located near I-5. In addition, twelve native reptiles and one introduced lizard were identified. There were two notable reptiles, the California legless lizard (*Aniella pulchra*) and the coast horned lizard (*Phrynosoma coronatum blainvillei*). On the Sweetwater Marsh Unit, suitable habitat for the horned lizard is limited to Gunpowder Point; however, none have been observed there in recent years.

3.4.4.4 Terrestrial Invertebrates

Very little information is available regarding the variety of terrestrial invertebrates (e.g. insects and spiders) occurring within the Refuge. The observations that have been recorded resulted from

directed searches for sensitive invertebrates within and surrounding the Sweetwater Marsh Unit. The results of these surveys are presented in Section 3.4.2.2.

3.4.4.5 Exotic Wildlife Species

Terrestrial exotic species occurring on the Refuge include rats, house mice (*Mus musculus*), European starlings (*Sturnus vulgaris*), house sparrows (*Passer domesticus*), opossum, and feral cats and dogs.

3.4.5 Species Assemblages in the Bay's Marine Community

3.4.5.1 Plankton and Algae

Details regarding the various forms of plankton and algae observed in San Diego Bay are presented in sections 2.5.1 – 2.5.2 of the INRMP (*U.S. Navy 2000*). This information is incorporated into this CCP/EIS by reference.

3.4.5.2 Marine Invertebrates

The marine invertebrate population of these two Refuge Units is not well documented and additional research is needed. However, aquatic invertebrates of the bay and intertidal mudflats are generally well known. Invertebrates are considered an essential prey item for all species of shorebirds (*de Szalay no date*). Collectively, shorebirds forage in a wide variety of aquatic and terrestrial invertebrates, with different species relying on different feeding methods. Marine invertebrates are also an essential food source for marine fishes, waterfowl and other birds, and other invertebrate animals. Within the South Bay, there are a number of marine invertebrate communities, including benthic invertebrates, which are found primarily in the bottom sediments; epiphytic invertebrates, which are found on plant stems; and nektonic invertebrates, which are found swimming in the water column.

A study, conducted by the Pacific Estuarine Research Laboratory in June and October of 1989, identified 27 taxa of benthic (muddy bottom dwelling) invertebrates within the intertidal areas of the Sweetwater Marsh Unit. The dominant benthic invertebrate fauna observed during this survey were species of gastropods, polychaetes, and bivalves, of which the most abundant species were barrel shell (*Acteocina incluata*), a species of polychate worm (*Polydora* sp.), and the jackknife clam (*Tagelus californianus*). Some additional discussion regarding the marine invertebrates observed within the Refuge is provided in Section 3.4.2.2. For a more detailed presentation about the invertebrates present within the different habitats of San Diego Bay, refer to section 2.5.3 (Invertebrates) of the INRMP (*U.S. Navy 2000*), which is incorporated by reference into this document.

3.4.5.3 Fishes

The San Diego Bay NWR includes areas identified as Essential Fish Habitat for various life stages of fish species managed under the Coastal Pelagics and the Pacific Groundfish Fishery Management Plans, as defined in the Magnuson-Stevens Fishery Conservation and Management Act (the Magnuson-Stevens Act). The waters within or adjacent to the Refuge are utilized by six species addressed in these Fisheries Management Plans (FMPs), including four of the five fish managed under the Coastal Pelagics FMP (northern anchovy (*Engraulis mordax*), pacific sardine (*Sardinops sagax*), pacific mackerel (*Scomber jacponicus*), and jack mackerel (*Trachurus symmetricus*)) and two of the three species managed under the Pacific Groundfish FMP (California scorpionfish (*Scorpena guttatta*) and English sole (*Parophrys vetulus*)).

When Congress amended the Magnuson-Stevens Act in 1996, it asserted in the Findings section of the Act that "one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine, and other aquatic habitats. Habitat considerations should receive increased attention for the conservation and management of fishery resources of the United States (16 U.S.C. 1801 (A)(9))." The Magnuson-Stevens Act, as amended, requires federal agencies undertaking permitting or funding activities that may adversely affect EFH to consult with the National Marine Fisheries Service (NMFS). The Act also requires Fishery Management Councils to amend all of their FMPs to describe and identify EFH for the fishery based on guidelines established by NMFS, to minimize to the extent practicable adverse effects on such habitat caused by fishing, and to identify other actions to encourage the conservation and enhancement of EFH.

An overview of the types of fish present within the tidal and intertidal areas of the San Diego Bay NWR was provided is Section 3.4.2.2.

3.4.5.4 Exotic and Invasive Marine Species

The introduction of exotic wildlife species, particularly benthic or epibenthic marine species, represents a serious threat to the health of San Diego's coastal ecosystem (*U.S. Navy 2000*). Exotic marine species are transported into the bay environment on the exterior of ships, within ballast water that is discharged into the bay, and through illegal aquarium dumping. Some of the exotic species found in San Diego Bay include fishes such as sailfin mollies (*Poecilia latipinna*) and yellowfin goby (*Acanthogobius flavimanus*), which are believed to compete with native species for food and habitat. Another exotic, invasive species is the Japanese mussel (*Musculista senhousia*), which forms dense mats on substrata that alters sediment properties and may displace native bivalves. An exotic species that has invaded the salt marsh habitat of the Sweetwater Marsh Unit is the Australasian isopod *Sphaeroma quoyanum*. This organism burrows into the banks of the marsh's tidal channels and along marsh edge habitat often in very high densities, resulting in increased bank erosion and loss of salt marsh habitat (*Talley et. al. 2001*).

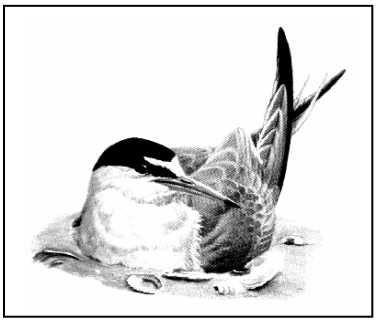
3.4.6 Endangered and Threatened Species

3.4.6.1 Federally-Listed Species

The federally-listed endangered and threatened species that utilize the habitats within the San Diego NWR are described below. This Refuge includes no Critical Habitat areas.

California Least Tern (*Sternula antillarum*)

The California least tern is the smallest of the tern species, measuring less than ten inches (about 23 centimeters) in length and weighing 45 to 55 grams. The total wing length is approximately four inches (110 millimeters) (*Massey 1976)*. This subspecies has a short, forked tail, and a long, slightly decurved, tapered bill (*Sibley 2000*). Males and females are both characterized by a black cap, gray wings with black wingtips, white underbody, orange legs, and a black-tipped yellow bill.



California Least Tern

The California least tern breeds in the United States only along the immediate coast of California from San Francisco Bay south to the Mexican border. Unfrequented sandy beaches close to estuaries and coastal embayments had historically served as nesting sites for this species, but by the 1960s, suitable nesting

areas were severely reduced due primarily to coastal development and intense human recreational use of beaches. As a result, the tern's numbers diminished from uncountable thousands to several hundred by 1970, when the least tern was added to the Federal Endangered Species List.

Only a few beaches continue to support least tern nesting, including the Tijuana Estuary, Naval Amphibious Base Coronado, Naval Base Coronado (NAB Coronado, NBC), Santa Margarita River mouth, Huntington Beach, and Venice Beach. Terns have also recently returned to nest along a portion of beach in Ocean Beach near the mouth of the San Diego River. The majority of the least tern nesting areas now occur on manufactured substrates or fills, some of which were intentionally created to support tern nesting, while others were created for different reasons and inadvertently attracted nesting terns. Since 1970, nesting sites have been recorded from San Francisco Bay to Bahia de San Quintin, Baja California. The nesting range in California has apparently always been widely discontinuous, with the majority of birds nesting in southern California from Santa Barbara County south through San Diego County.

The loss of historic undisturbed "natural" breeding sites has forced least terns to adapt to a wide variety of alternatives; however, these alternative sites share several basic ecological requirements. Specifically, alternative sites must be relatively flat, open areas, with a sandy or dried mud substrate; relatively secluded from disturbance and predation; and in proximity to a lagoon or estuary with a dependable food supply (*Longhurst 1969, Craig 1971, Swickard 1971, Massey 1974*).

The California least tern is migratory, usually arriving in its breeding area in April and departing again in August. Least terns are colonial but do not nest in as dense a concentration as many other tern species. The nest is a simple scrape or depression in the sand, in which one to four eggs are laid, usually two. There is one breeding season, from May through August and only one brood is raised. However, the birds will renest if eggs or chicks are lost. Re-nesting often occurs from mid-June to early August, a time when 2-year-old birds also nest for the first time (*Massey and Atwood 1981*). Parents continue to feed their young even after they are strong fliers.

This tern species is an exclusive fish-eater, typically feeding on topsmelt, northern anchovy, gobies, and jacksmelt (*Massey 1974, Atwood and Kelly 1984*). Studies on fish dropped at nesting sites suggest that fish size, rather than species, is the essential requirement of suitable prey for the least tern. Feeding is carried out in the calm waters of narrow estuaries or large bays and for a short distance (i.e., usually within two miles [three kilometers] of the beach) in the open ocean. The hovering and plunging habits of this species are conspicuous. Adults that are not feeding young tend to go farther and feed on larger fish. After the eggs have hatched, however, the parents make shorter trips, bringing back smaller fish for their chicks. This need to locate smaller fish appears to result in the increased use of freshwater marsh systems, lagoons, and estuarine areas during the post-breeding dispersal phase, suggesting the importance of such habitats when juveniles are learning to fish.

Around San Diego Bay, there are six areas where least terns nest: Lindbergh Field, Naval Air Station North Island, NBC (NAS North Island, NBC), NAB Coronado, NBC (delta beach and ocean beach), D Street Fill (Sweetwater Marsh Unit), Chula Vista Nature Reserve, and the salt pond levees within the South San Diego Bay Unit (Figure 3-15).

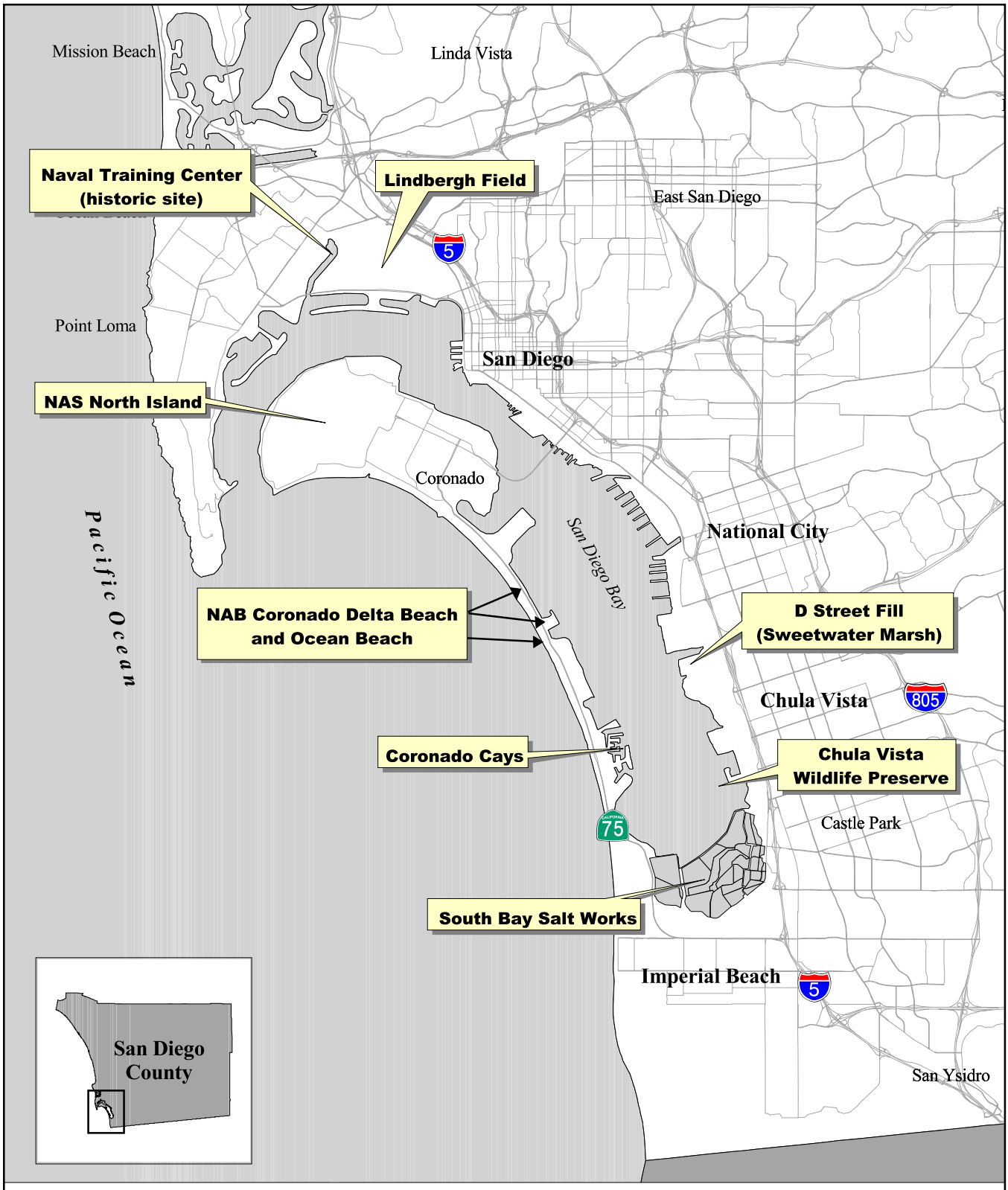


Figure 3-15
California Least Tern Nesting Locations in San Diego Bay

Source: California Spatial Information Library, SANDAG, Tele Atlas, USFWS

Carlsbad Field Office - 2003
/stem/stacey/ssdbay/fig_4-03/fig3-15.apr

Least tern nesting occurred at the salt works for many years before there was any attempt to determine the total nesting population. The first documented count of tern nests occurred in 1968 when 60 pairs were observed nesting on the salt pond levees (*Craig 1971*). These nests were located primarily between Ponds 14 and 15, 13 and 25, and 24 and 27. Over the next two years, the numbers declined, with only two pairs observed in 1970.

Use of the nesting sites within the San Diego Bay NWR is regular; however, the number of least tern pairs utilizing the D Street Fill and salt pond levees has varied over the years (Figure 3-16). Despite increasing nest numbers, fledgling production at both sites has been fair to poor. In recent years, gull-billed terns nesting at the salt works have been observed preying upon least tern and snowy plover chicks at the salt works and elsewhere along the southern San Diego County coast line. Additional information regarding least tern nesting on the D Street Fill and the salt pond levees is provided in Section 3.4.4.1.

The least tern is vulnerable to a long list of predators, some of which are very abundant in urban environments, such as feral cats and dogs, crows, loggerhead shrikes, American kestrels, and other birds of prey. In San Diego Bay, young least tern chicks also fall prey to adult gull-billed terns which have been successfully nesting on the salt pond levees. To protect least tern nest sites from disturbance, ground access is typically controlled by fences or other obstructions. Nest site management involves three essential elements that if implemented may improve least tern reproductive success. These elements include protection from disturbance, management of predators, and surface preparation where weeds or excessive plant growth is a problem.

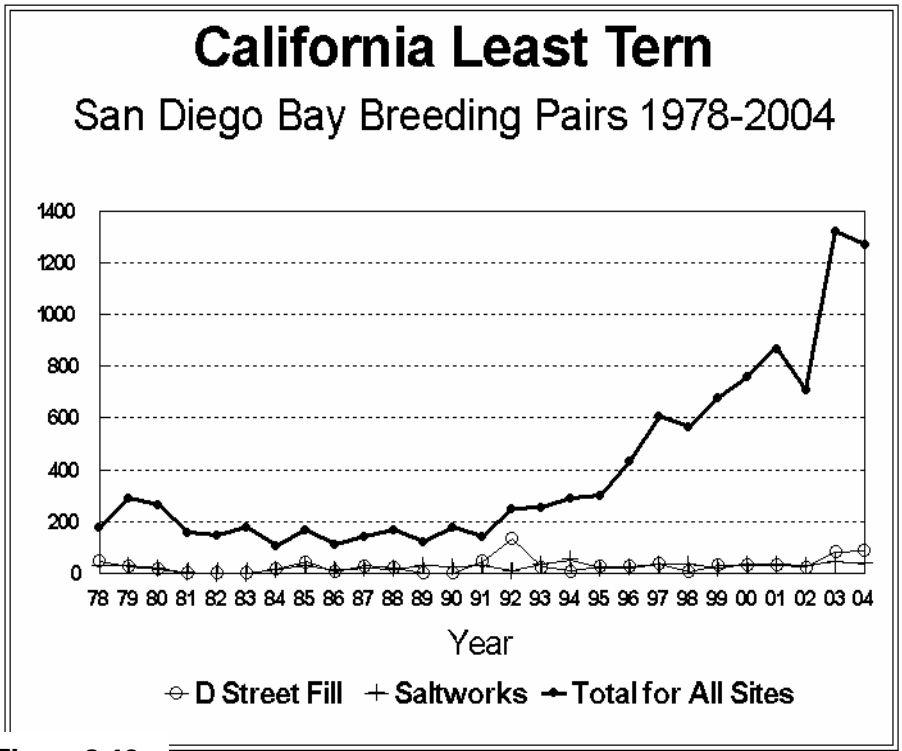


Figure 3-16

Light-footed Clapper Rail (*Rallus longirostris levipes*)

The light-footed clapper rail is a hen-sized marsh bird that is long-legged, long-toed, and approximately 14 inches (36 centimeters) long. It has a slightly down-curved beak and a short, upturned tail. Males and females are identical in plumage. Their cinnamon breast contrasts with the streaked plumage of the grayish brown back and gray and white barred flanks.

Light-footed Clapper Rail
Shari Erickson USFWS

The light-footed clapper rail uses southern California coastal salt marshes, lagoons, and their maritime environs. The birds nest in the lower littoral zone of coastal salt marshes where dense stands of cordgrass are present. They also occasionally build nests in pickleweed. Light-footed clapper rails have also been known to reside and nest in freshwater marshes, although this is not common. They require shallow water and mudflats for foraging, with adjacent higher vegetation for cover during high water (*Massey et al. 1984*).

Light-footed clapper rails inhabit coastal marshes from the Carpinteria Marsh in Santa Barbara County, California, to Bahia de San Quintin, Baja California, Mexico. It is believed that most salt marshes along the coastline at one time supported clapper rails. However, recent census data indicate that less than 50 percent of the coastal wetlands in California are currently occupied. Southern California's largest subpopulation of these rails, located in the Upper Newport Bay, has been successfully reproducing since 1980. In contrast, the second and third largest subpopulations at Tijuana Marsh and Seal Beach NWR, are known to have undergone significant and episodic decreases in their numbers. At Seal Beach predation by mammalian and avian predators has periodically reduced the rail population. At Tijuana Slough, predation is also an important factor but the closing of the river mouth and subsequent cordgrass die-off was an environmental event that significantly affected the rail population present in the estuary at the time. All of the other subpopulations have exhibited more vulnerability to fluctuations in environmental conditions.

Very limited evidence exists for intermarsh movements by light-footed clapper rails. This subspecies is resident in its home marsh except under unusual circumstances. Movement within the marsh is also confined and generally of no greater spread than 1,300 feet (400 meters) (*Zembal 1989*). Minimum home range sizes for nine clapper rails that were radio-harnessed for telemetry at Upper Newport Bay varied from approximately 0.8 to 4.1 acres. The larger areas and daily movements were by first year birds attempting to claim their first breeding territories.

Light-footed clapper rails forage in all parts of the salt marsh, concentrating their efforts in the lower marsh when the tide is out, and moving into the higher marsh as the tide advances. Foraging activity is greatest in the early morning, while vocalizing shows a strong peak just before dark. Activities are also tide-dependent. The rails are omnivorous and opportunistic foragers. They rely mostly on salt marsh invertebrates, such as beetles (*Coleoptera*), garden snails (*Helix* spp.), California hornsnails, salt marsh snails (*Melampus olivaceus*), fiddler and hermit crabs (including *Pachygrapsus crassipes*, *Hemigrapsus oregonensis*, and probably *Uca crenulata*), crayfish, isopods, and decapods. This species may also forage on frog tadpoles (*Hyla* spp.), California killifish, and even

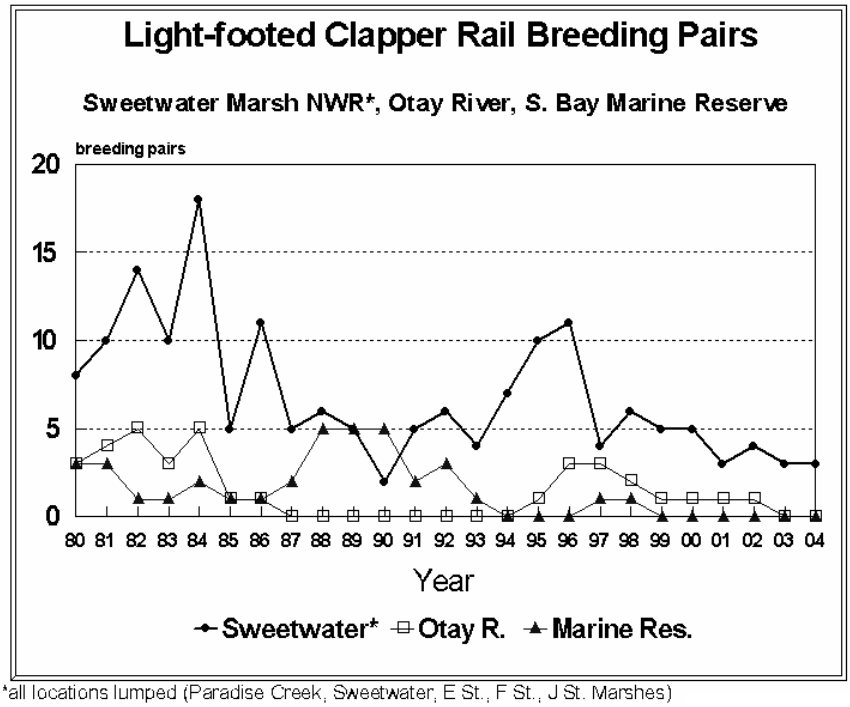
California meadow mice (*Microtus californicus*). The rails ingest some vegetable matter, including cordgrass stems and pickleweed tips, but this is uncommon.

The pair bond in light-footed clapper rails endures throughout the season, and often from year to year. Nesting usually begins in March and late nests have usually hatched by August. Nests are placed to avoid flooding by tides, yet in dense enough cover to be hidden from predators and support the relatively large nest. Females lay approximately four to eight eggs, which hatch in 18-27 days. Both parents care for the young. While one adult is foraging, the other adult broods the chicks. By the age of two days, chicks will accompany adults on foraging trips; however, adults have been observed feeding fully grown chicks of at least six weeks of age within 82 feet (25 meters) of their incubation nest.

Destruction of coastal wetlands in southern California has been so extensive that many estuaries where light-footed clapper rails were once abundant have been reduced to remnants. Although salt marsh habitat loss, degradation, and fragmentation are the leading threats to these rails, they are also threatened by disturbance, diseases, contaminants, and predation by non-native red foxes, feral cats, crows, and some raptors. The light-footed clapper rail was federally listed as endangered in 1970.

The light-footed clapper rail has been able to sustain a regular breeding presence in one or several of the pieces of tidal salt marsh that are near or part of the Sweetwater Marsh Unit and the South Bay Biological Study Area, and only sporadically in the lower reaches of the Otay River.

Surveys of the Otay River channel have periodically located nesting pairs of clapper rails between 1984 and 1998. In 1984, five nesting pairs were identified, while in 1998 only two pairs were located (Figure 3-17). The last clapper rail survey of the Otay River occurred in 2000, when only one nesting pair was detected.



*all locations lumped (Paradise Creek, Sweetwater, E St., F St., J St. Marshes)

Figure 3-17

California Brown Pelican (*Pelecanus occidentalis californicus*)

The California brown pelican, which is one of six recognized subspecies of brown pelican, occurs along the Pacific Coast of the U.S. and Mexico, including the Gulf of California (*USFWS 1983*). Adults weigh approximately nine pounds (4 kilograms), and have a wingspan of over six feet (1.8 meters). They have long, dark bills with big pouches for catching and holding fish. Unlike other brown pelican subspecies, the California brown pelican typically has a bright red gular pouch during the courtship and egg-laying period. The California subspecies also has larger eggs.

California Brown Pelican

The California brown pelican is still found in its original range, but California breeding colonies located in the Channel Islands National Park at West Anacapa Island and the Santa Barbara Islands continue to decline. This pelican also breeds on several islands off the coast of Acapulco, Guerrero, Mexico. Pelicans are ground nesting birds that typically build their nests with sticks. Nesting materials are brought to the female who builds the nest. All courtship takes place at the nest site. Normal clutch size is three eggs, which are laid in March or April. Both parents take turns incubating the eggs and rearing the chicks.

Brown pelicans can often be observed alternately flapping and gliding just over the tops of the breakers in a single file formation. They dive from flight to capture surface-schooling marine fishes and frequently plunge-dive from heights of up to 20-60 feet to capture fish. In California, brown pelicans feed primarily on Pacific mackerel, Pacific sardine and northern anchovy. Anchovies comprise 90 percent of their diet during the breeding season. Unfortunately, the northern anchovies and Pacific sardines on which the pelicans are so dependent have declined over the years due to overfishing.

The California brown pelican was listed as endangered in 1970 because of widespread pollutant-related reproductive failures. They are extremely sensitive to bioaccumulation of the pesticide DDT, which causes reproductive failure by altering calcium metabolism and thinning eggshells. Although California breeding populations have rebounded since the elimination of DDT use, DDT is still manufactured for export and its effects in the environment linger.

Adequate food availability is now a major concern for the long-term recovery of this species. Commercial over-harvesting of Pacific mackerel, Pacific sardine, and the northern anchovy has resulted in less food availability for these birds, particularly during the breeding season. Pelicans are also threatened by human development along the coast, which increases disturbance to these birds in their breeding and resting habitats. Pelicans are also at risk from discarded fishing gear, which can result in these birds becoming entangled in fishing line, and disease outbreaks resulting from overcrowding at roosting sites. Breeding populations and nesting productivity vary dramatically from year to year depending on El Niño events and other climatic changes.

The availability and quality of roosting and loafing areas also influence the energy budgets and reproductive potential of these birds (*Jaques and Anderson 1987*). These essential habitat areas are declining in California as development continues along the coast. This habitat is important for both breeding and non-breeding birds during the breeding season and particularly for the thousands of wintering migrants that occupy the coastal areas of the Southern California Bight during late summer and early fall (*Jaques and Anderson*

1987). Research suggests that roosts, like nesting areas, are selected to maximize the possibility of successful foraging while expending minimal energy (*USFWS 1983*). Floating objects in South San Diego Bay typically provide loafing locations for a few to many brown pelicans (*USFWS 1995*).

The San Diego Bay NWR provides year-round foraging and roosting habitat for non-breeding pelicans. These birds can occasionally be observed foraging along the tidal channels within the Sweetwater Marsh Unit, and more often foraging over the open waters of the South Bay. The salt pond levees on the South San Diego Bay Unit, particularly the levee that separates Ponds 10 and 11, appear to provide important roosting areas for non-breeding pelicans. Other roosting sites include the levee between Ponds 12 and 14 and the spit located just to the north of Pond 15. During the Service's 1993/1994 South Bay avian surveys, pelicans were occasionally observed foraging in the primary ponds (*Stadtlander 1994*).

Salt Marsh Bird's Beak (*Cordylanthus maritimus maritimus*)

Salt marsh bird's beak is an annual plant that typically grows in the upper elevations of tidal salt marsh habitat, but can also occasionally be found in nontidal salt marsh. Three bird's beak subspecies grow in the saline marshes of the western United States and Baja California, with the subspecies *Cordylanthus maritimus maritimus* occurring in the coastal marshes of northern Baja California and southern California from San Diego to Santa Barbara Counties.

Salt Marsh Bird's Beak
K.Morris

Salt marsh bird's beak has an upright, branched growth form with an abundance of purple pigment in its tissues. The plants of San Diego County have bare pale cream-colored flowers. A hemiparasitic plant, salt marsh bird's beak is believed to derive water and perhaps nutrients through specialized root connections with other species (*USFWS 1985*). It is often found in association with pickleweed, shore grass, salt grass, Frankenia, and sea lavender. The plant occurs in well-drained/well-aerated soils that dry during the summer and where the only freshwater input is rainfall. Studies indicate that freshwater influence in the spring encourages germination and that salinities at the time of germination usually cannot exceed 12 ppt. Germination and flowering usually spans May to October but can sometimes occur during the winter. Pollination by upland, native bees is considered important to seed production, and yearly population numbers depend directly on seed dispersal and a site that provides the precise conditions required for germination.

Colonies of salt marsh bird's beak are found in only a few scattered salt marsh habitats between Santa Barbara and San Diego Counties. It is currently surviving at Carpinteria Marsh, Mugu Lagoon/Ormand Beach, Upper Newport Bay, Sweetwater Marsh, Naval Radio Receiving Facility (YMCA Surf Camp site),and Tijuana Slough. This species was listed as endangered in 1970 due to destruction and degradation of southern California's coastal salt marsh systems.

Within the Sweetwater Marsh Unit, salt marsh bird's beak has been observed in Paradise Marsh and Sweetwater Marsh. This species has not however been observed in the South San Diego Bay Unit. A directed search within Paradise Marsh for nine sensitive plant

species was conducted in 1998 for the City of National City. Salt marsh bird's beak, which was the only listed plant encountered during the survey, was identified in nine locations within Paradise Marsh, occurring primarily within the southwestern end of the marsh (*City of National City 1998*). The subpopulation also occurs within Sweetwater Marsh proper.

Pacific Pocket Mouse (*Perognathus longimembris pacificus*)

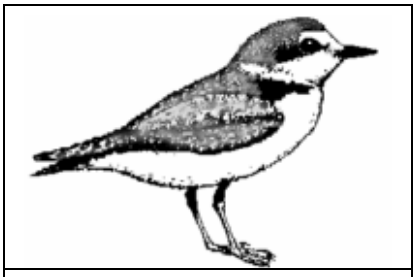
The Pacific pocket mouse is a small brownish rodent endemic to coastal southwestern California. It is a member of the rodent family Heteromyidae, which includes seed-eating kangaroo rats, kangaroo mice, and pocket mice. The Pacific pocket mouse is the smallest of the *Perognathus* genus and has a combined body and tail length of 120 millimeters and weighs between 6 and 10 grams. Only found only within 4 kilometers of the coast on fine-grained sandy substrates in coastal sage scrub, coastal strand, and river alluvium, this mouse once occurred from Los Angeles County south to the Mexican border. Now known from only three locations, the Pacific pocket mouse is one of the most endangered animals in the United States. In February 1994, this species was federally listed as endangered throughout its entire range.

Historically, the Pacific pocket mouse's range included the coastal areas from the Tijuana River north to Los Angeles County. However, due to habitat loss associated with development and ongoing human disturbance on many of the remaining open areas within its range, the distribution of the Pacific pocket mouse has been severely reduced. Although the upland areas within the San Diego Bay NWR are included within the historic range of this species, there is no recent record of its existence on the Refuge. In 1998, Tierra Environmental Services (*2001*) conducted a survey in the vicinity of the railroad right-of-way in proximity to the South San Diego Bay Unit to determine the suitability of the habitat for the Pacific pocket mouse. The site visit revealed the presence of compacted, silty soils that are not considered suitable habitat for this species. The potential for this species to occur within the Otay River floodplain or on Gunpowder Point is extremely low due to past agricultural activities, the proximity of urban development, and the presence of feral cats and exotic rodent species.

Western Snowy Plover (*Charadrius alexandrinus nivosus*)

The western snowy plover is a sparrow-sized, white and tan colored shorebird with dark patches on either side of the neck, behind the eyes, and on the forehead (*Page et al. 1995*). The coastal western snowy plover population is defined as those individuals that nest adjacent to or near tidal waters and includes all nesting colonies on the mainland coast, peninsulas, offshore islands, adjacent bays, and estuaries. The breeding range of the western snowy plover extends along coastal beaches from the southern portion of Washington State to southern Baja California, Mexico (*USFWS 1993*).

The breeding season of the western snowy plover extends from March 1 through September 15. Generally, 3 eggs are laid in a nest, which consists of a shallow depression scraped in sandy or saline substrates. Some nests are lined with plant parts, small pebbles, or shell fragments. Both sexes incubate the eggs for an average of 27 days (*Warriner et al. 1986*). Snowy plovers will renest after loss of a clutch or brood. Snowy plover chicks are precocial and leave the nest within hours of hatching in search of food. The tending adult(s) provide



Western Snowy Plover

danger warnings, thermo-regulation assistance, and guide the chicks to foraging areas, but do not provide food to their chicks. Broods rarely stay in the immediate area of the nest. Young birds are able to fly within approximately 31 days of hatching (*Warriner et al. 1986*). Double brooding and the practice of one female having several mates have been observed. In addition, snowy plover females may abandon a nest before the chicks have fledged in search of another mate, leaving the male to care for the brood. Adults and young forage on invertebrates along intertidal areas, along beaches in wet sand and surf cast kelp, in foredune areas of dry sand above the high tide, on salt pans, and along the edges of salt marshes and salt ponds. The snowy plover is primarily a run and glean type of forager.

Human disturbance, predation, and inclement weather, combined with the loss of nesting habitat to urban development and the encroachment of introduced beachgrass (*Ammophila arenaria*), have led to an overall decline in the breeding and wintering population of the western snowy plover along the Pacific Coast. In southern California, the very large human population and resulting recreation activities have precluded the western snowy plover from breeding on historic beach strand nesting habitat. As a result of these factors, the Pacific coast population of the western snowy plover was federally-listed as threatened in 1993.

There are only a handful of snowy plover breeding locations currently used in southern California. Well used locations include Bolsa Chica (Orange County), Camp Pendleton, Batiquitos Lagoon, NAB Coronado, Silver Strand State Beach, Naval Radio Receiving Facility, and Tijuana Estuary in San Diego County. Within the San Diego Bay NWR, snowy plover nesting occurs most years at the salt works, but typically in very low numbers and with poor success (Figure 3-18). Snowy plover nesting has also been documented on the D Street Fill in the past; however, plover nesting has not occurred

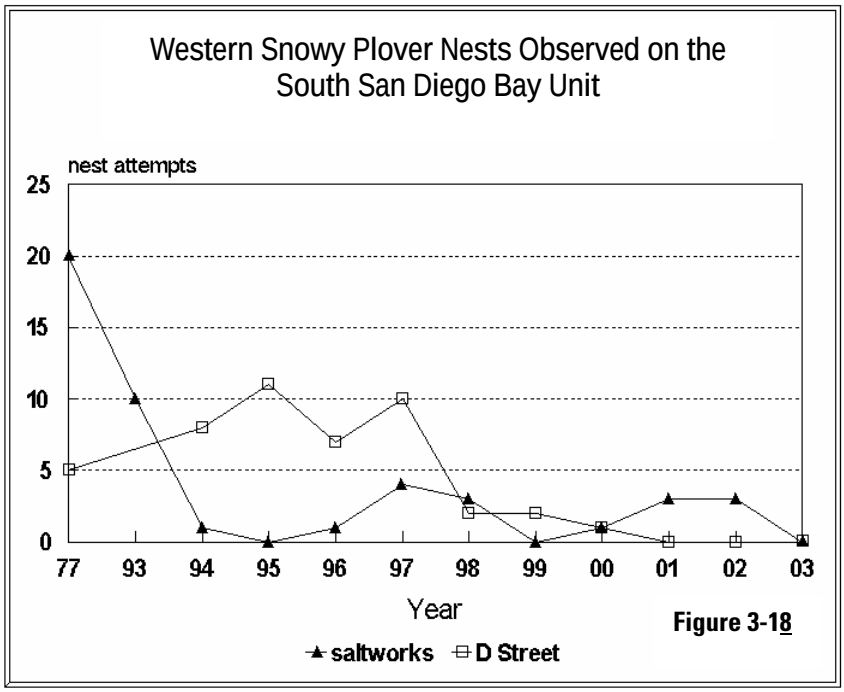


Figure 3-18

there since 2000, when one nest was identified. Disturbance, predation, and inadequate access to foraging areas are the most likely reasons for this history of low nesting numbers and poor reproductive success. Additional information about plover nesting on the Refuge is provided in Section 3.4.4.1.

As with least terns, the list of potential predators of snowy plover eggs and chicks is long. Due to high densities in surrounding urban areas, corvids (crows and ravens), kestrels, and shrikes are likely to be significant threats to plovers on this Refuge. Gull-billed terns have also become a threat to this species during the nesting season.

Pacific Green Sea Turtle (*Chelonia mydas*)

The Pacific green sea turtle is one of six species of sea turtles found in the oceans in and around the United States. This species grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. Hatchlings generally have a black carapace, white underbody (plastron), and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling, with whitish to light yellow plastron. Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Populations of the Pacific green sea turtle have seriously declined due primarily to direct take of turtles and eggs. The Pacific green sea turtle was federally listed as threatened in 1978 throughout its Pacific Range, except for the federally endangered population nesting on the Pacific coast of Mexico, which is covered under the Recovery Plan for the East Pacific green turtle. Increasing human populations and continued development along the coast, particularly development on or in proximity to nesting beaches, are serious threats to green turtle populations throughout the Pacific.

The green sea turtle has a worldwide distribution in tropical and subtropical waters and is generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. Open beaches with a sloping platform and minimal disturbance are required for nesting. Green turtles apparently have strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches.

Pacific green sea turtles appear to reside in the bay year round, although it is believed that individual turtles migrate in and out of the bay at various times. Although some believe the turtles are present in the Bay due to elevated water temperatures associated with the South Bay Power Plant, several researchers who have studied the bay's turtles since the 1980s concur that the bay's population of sea turtles is a natural population occurring at the northern end of their range (*Dutton and Stinson pers. comm.*). These researchers propose that the turtles are not present because of the warmer water, but because the eelgrass available in the bay represents the only foraging area within their range in which they are not at risk of being taken by poachers.

California Gnatcatcher (*Polioptila californica californica*)

The California gnatcatcher is a small, long-tailed bird that is a member of the thrush family (Muscicapidae). Its plumage is dark blue-gray above and grayish-white below. The tail is mostly black above and below. The male has a distinctive black cap that is absent during the winter. The coastal California gnatcatcher is one of three subspecies of the California gnatcatcher and is restricted to coastal southern California and northwestern Baja California, Mexico, from Los Angeles County (formerly Ventura and San Bernardino

Counties) south to El Rosario. The coastal California gnatcatcher occurs almost exclusively in the coastal sage scrub, although it is also occasionally found in chaparral.

The decline of this subspecies due primarily to habitat loss and fragmentation associated with development prompted the submittal of three petitions to list this species as endangered. A Final Rule was made on March 25, 1993 when the species was listed as threatened throughout its range.

Over the past two years, one to two California gnatcatchers have been observed vocalizing in the disturbed coastal sage scrub habitat occurring on Gunpowder Point within the Sweetwater Marsh Unit. No nests have been observed and no recent observations of this species have been made within the South San Diego Bay Unit.

3.4.6.2 State-Listed Species

Four of the federally listed endangered species supported by these Refuges, including salt marsh bird's beak, California least tern, light-footed clapper rail, and California brown pelican, as also listed as endangered by the State of California. The salt marsh habitat within these Refuges also supports the Belding's savannah sparrow, another species listed by the State of California as endangered.

Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*)

The Belding's savannah sparrow (Belding's) is one of four subspecies of savannah sparrows that are otherwise widely distributed and occur in a variety of habitat types, including grassland, high-elevation meadow, and marshes (*AOU 1983; James and Stadtlander 1991*). The Belding's savannah sparrow is unique in that it represents one of only two wetland-dependant avian species that reside year-round in the coastal salt marshes of southern California (*Powell and Collier 1998*). This salt marsh species is therefore reliant upon coastal salt marsh habitat for all of its life history requirements. This subspecies ranges along the southern California coast from Santa Barbara County (Goleta Slough) in the north to El Rosario, Baja California, Mexico in the south (*James and Stadtlander 1991*).

The Belding's savannah sparrow is a small brown sparrow with fine streaking on the head and face, pale beige to white belly, and often shows a dark central breast spot. As with most ground dwelling species, this bird is inconspicuous and blends well with its environment. The most distinguishing characteristic is the yellowish color of the lores (area between the bill and eyes) (*Massey 1979*). This subspecies generally nests within dense stands of pickleweed. Breeding territories can be very small and the birds nest semi-colonially or locally concentrated within a larger block of habitat (*Zembal and Hoffman 2002*).

The main factors that influence the long-term survivability of this subspecies are the health and security of its habitat. In southern California, the long-term protection of coastal salt marsh habitat is closely tied to ownership and use of the land. While threats to salt marsh habitat loss or degradation due to the direct impacts of urban development have slowed, the indirect impacts of intensifying development adjacent to areas of coastal salt marsh continue to increase. Human impacts, such as trespassing into closed areas, off-trail use in areas open to the public, and domestic and feral pets entering the marsh, continue to represent a serious threat to the long-term survivability of the Belding's savannah sparrow.

This subspecies was listed as endangered by the State of California in 1974 due to the development, degradation, and fragmentation of coastal salt marsh habitat as numbers of Belding's savannah sparrows were observed to have decreased dramatically (*Zembal et al. 1988*). The subspecies has no status under the Federal Endangered Species Act. Since State listing, many research studies have been completed on this species, including a life history study (*Massey 1979*), studies on habitat requirements (*USFWS 1986, Johnson 1987, Powell 1993*), research on the effects of habitat loss and fragmentation (*Powell and Collier 1998*), and various localized (e.g., *Zembal 1986, Kus 1990*) and rangewide surveys (e.g., *Bradley 1973, Zembal et al. 1988, James and Stadtlander 1991*).

Because of the secretive nature of this sparrow, it can be difficult to obtain accurate population estimates (*Zembal et al. 1988*). Census techniques consist of searching for territorial males in suitable habitat during the breeding season (late March through early July). Territorial behavior is ascertained through detection or observation of singing, scolding, aerial chases, nest-building, feeding young, or extended perching of individuals or presumed mates perching together in an area.

The Belding's savannah sparrow population estimate in California increased from 1,084 pairs in 1973, 1,610 pairs in 1977, 2,274 pairs in 1986, 1,844 pairs in 1991, 2,350 pairs in 1996, and 2,902 pairs in 2001 (*Zembal and Hoffman 2002*). However, statewide censuses of Belding's savannah sparrows reveal wide fluctuations in local population sizes, with local extirpations occurring in some years.

Belding's surveys conducted every five years since 1986 show a regular presence, but fluctuating numbers, within the San Diego Bay NWR (Table 3-16). Habitat fragmentation, disturbance/predation, and changing conditions within the marsh are contributors to these fluctuations. During the 2001 survey (*Zembal and Hoffman 2002*) identified 109 territories within the Sweetwater Marsh Unit, including seven in Paradise Marsh, 93 in Sweetwater Marsh, and nine at the F&G Street Marsh.

Table 3-16
Results of Five Breeding Pair Surveys
for Belding's Savannah Sparrow on the San Diego Bay NWR

Location	Number of Pairs				
	1977	1986	1991	1996	2001
Sweetwater Marsh Unit					
Paradise Marsh	16	19	14	6	7
Sweetwater Marsh	40	118	141	78	93
F&G Street Marsh	18	8	15	12	9
Total for the Unit	74	145	170	96	109
South San Diego Bay Unit					
Otay River Channel/Salt Works	100	70	29	71	102
South Bay Biological Study Area[1]	25	15	42	31	26
Total for the Unit	125	85	71	102	128

[1]The South Bay Biological Study Area is located within the approved boundary of the South San Diego Bay Unit, but outside the current management boundary.

Source: (Zembal and Hoffman 2002)

Ninety-eight territories were identified within the current management boundary of the South San Diego Bay Unit, with Belding's concentrated along the Otay River Channel, where 58 territories were observed. Another 27 territories were identified within the ribbon of pickleweed that grows along the outer levees of the salt works. Thirteen territories were identified within the drainage channel that flows through the salt works between Ponds 15 and 28. Within the approved acquisition boundary for the South San Diego Bay Unit, four territories were identified at the J Street Marsh, located just south of the Chula Vista Marina, and 26 territories were found at the South Bay Biological Study Area (*Zembal and Hoffman 2002*).

3.4.7 Species of Concern and Other Special Status Species

3.4.7.1 Birds of Conservation Concern

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the Service to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." The most recent effort to carry out this proactive conservation mandate is the approval of the Service's report, Birds of Conservation Concern 2002. The overall goal of the report is to accurately identify bird species at each geographic scale that represent Service conservation priorities and draw attention to species in need of conservation action. The bird species identified are primarily derived from prioritization scores from three major bird conservation plans: The Partners in Flight, U.S. Shorebird Conservation Plan, and North American Waterbird Conservation Plan (Kushlan et al. 2002). Birds included in the Birds of Conservation Concern 2002 report are deemed priorities for conservation action. These lists are to be consulted in accordance with Executive Order 13186 "Responsibilities of Federal Agencies to Protect Migratory Birds."

The 2002 report encompasses three distinct geographic scales: the Bird Conservation Regions (BCR) of the United States and Canada, and the cross-border BCRs agreed on with Mexico as part of the North American Bird Conservation Initiative; the USFWS Regions, which each consist of several states in the same geographic area, and the National List, which encompasses the United States, including U.S. island "territories" in the Caribbean and Pacific. Birds of Conservation Concern supported by the San Diego Bay NWR are included in the BCR 32 (Coastal California) List, USFWS Region 1 List, and the National List. Table 3-17 lists the Birds of Conservation Concern that are known to occur within this Refuge.

Western Gull-billed Tern (*Gelochelidon nilotica vanrossemi*)

The western gull-billed tern, which nests on the salt pond levees, is a species of particular concern both for its own status and for its choice of prey, which includes California least tern and western snowy plover chicks and eggs (*Densmore 1990, Patton 2001, 2002, 2004b, and Molina and Marschalek 2003*). The gull-billed tern is designated as a Bird of Conservation Concern at the national, regional (USFWS Pacific Region), and local scale (Southern Coastal California Bird Conservation Region). This tern was identified as a Bird of Conservation Concern because of declining population trends and threats to breeding birds. At the subspecific level, the western gull-billed tern is of increased concern due to its extremely small population size (less than 600 known nesting pairs range-wide), limited distribution (only 10 nesting sites range-wide), suspected population declines, and threats during the breeding season.

Over the past few years, gull-billed terns have benefited from the various recovery actions implemented on the Refuge to benefit the least tern and western snowy plover. These actions include protection of existing habitat areas, enhancement of nesting substrate,

Table 3-17
Birds of Conservation Concern Occurring within the San Diego Bay NWR

Common Name	Scientific Name	Foraging Habitat(s)	Abundance	Included on BCC List		
				BCR 32	Region 1	U.S.[1]
Reddish egret	*Egretta rufescens*	Wetlands	Rare	No	No	Yes
Northern harrier	*Circus cyaneus*	Salt Marsh	Common	No	No	Yes
Swainson's hawk	*Buteo swainsoni*	Uplands	Rare	Yes	Yes	Yes
Ferruginous hawk	*Buteo regalis*	Uplands	Uncommon	No	No	Yes
Peregrine falcon	*Falco peregrinus*	Uplands, Salt Marsh	Occasional	Yes	Yes	Yes
Prairie falcon	*Falco mexicanus*	Uplands	Occasional	Yes	Yes	Yes
Pacific golden plover	*Pluvialis dominica fulva*	Intertidal	Rare	No	No	Yes
Whimbrel	*Numenius phaeopus hudsonicus*	Intertidal, Salt Ponds	Seasonally Common	Yes	Yes	Yes
Long-billed curlew	*Numenius americanus*	Intertidal	Common	Yes	Yes	Yes
Marbled godwit	*Limosa fedoa fedoa*	Intertidal, Salt Ponds	Common	Yes	Yes	Yes
Black turnstone	*Arenaria melanocephala*	Intertidal, Salt Ponds	Common	Yes	Yes	Yes
Red knot	*Calidris canutus*	Intertidal, Salt Ponds	Seasonally Common	Yes	Yes	Yes
Short-billed dowitcher	*Limnodromus griseus*	Intertidal, Salt Ponds	Common	Yes	Yes	Yes
Wilson's phalarope	*Phalaropus tricolor*	Salt Ponds, Intertidal	Common in July	No	No	Yes
Gull-billed tern	*Gelochelidon nilotica vanrossemi*	Intertidal, Uplands	Nests at Salt Works	Yes	Yes	Yes
Elegant tern	*Thalasseus elegans*	Open Water, Intertidal	Nests at Salt Works	Yes	Yes	No
Black skimmer	*Rynchops niger niger*	Open Water, Intertidal	Nests at Salt Works	Yes	Yes	Yes
Burrowing owl	*Athene cunicularia hypugaea*	Uplands	Historically Present	Yes	Yes	Yes
Short-eared owl	*Asio flammeus*	Uplands	Rare	No	No	Yes
Rufous hummingbird	*Selasphorus rufus*	Uplands	Common	No	No	Yes
Olive-sided flycatcher	*Contopus cooperi*	Uplands	Very Rare	No	Yes	Yes
Loggerhead shrike	*Lanius ludovicianus*	Uplands	Uncommon	Yes	Yes	Yes
Bewick's Wren	*Thryomanes bewickii*	Uplands	Common	No	No	Yes
Grasshopper sparrow [2]	*Ammodramus savannarum*	Grasslands	Uncommon	No	No	Yes
Tricolored blackbird	*Agelaius tricolor*	Wetland	Uncommon	Yes	Yes	Yes
Lawrence's goldfinch	*Carduelis lawrencei*	Uplands	Occasional	Yes	Yes	Yes

[1]National List [2] In Spring 2000, grasshopper sparrows were identified just to the east of the Sweetwater Marsh Unit in the disturbed uplands (Merkel & Associates, Inc. 2000).
Source: (USFWS 2002)

control of human disturbance, and removal of mammalian and avian predators that forage on the adults, chicks, and eggs of birds that nest on the salt pond levees. The benefits of these actions to the gull-billed tern appear to be reflected in the increase in the number of nesting pairs of this species that has been observed at the salt works since 1999.

An estimated 11 to 20 breeding pairs of gull-billed terns were present in 1999 (*Patton 2001*) and in 2004 approximately 40 breeding pairs were observed at the salt works (*Patton pers. comm.*). During this same period, the number of least tern and snowy plover chicks observed taken by gull-billed terns within the South San Diego Bay Unit, other sites around San Diego Bay, and the nesting areas at the Tijuana Estuary has also increased. The documented losses ranged from 10 in 1999 to at least 37 in 2003 (*Patton 2004b*). In 2004, a total of 43 least tern and snowy plover chicks were documented as lost to gull-billed tern depredation (*Patton pers. comm.*). Biologists monitoring the nesting populations around the bay and at the Tijuana Estuary infer that depredation by gull-billed terns on snowy plover and least tern chicks is ongoing when observers are not present, therefore, only a fraction of the predation is being observed. Based on the data, the impacts that gull-billed terns have had on the productivity of nesting sites throughout San Diego Bay and the Tijuana Estuary are not insignificant (*Brian Collins pers. comm.*).

Gull-billed terns are opportunistic feeders, preying on lizards, fish, insects, and on the chicks of shorebirds and other tern species. The first documented observation of gull-billed tern predation on a least tern chick occurred in 1988 in Mississippi (*Densmore 1990*). The loss of least tern and western snowy plover chicks by gull-billed terns has been documented at the San Diego Bay NWR since 1999 (*Patton pers. comm.*).

Gull-billed terns have been observed foraging along shoreline, dune, mudflat, and marsh edge habitats adjacent to San Diego Bay, including sites managed by the Refuge and the Navy, and within the Tijuana Estuary (*Patton 2004b*). In 1999, the primary prey of these birds appeared to be side-blotched lizards (*Uta stansburiana*) (*Patton 1999*), while observations made in 2001 and 2002 indicated that mole crabs (*Emerita analoga* and *Lepidopa californica*) and side-blotched lizards were the predominant prey items (*Molina and Marschalek 2003 and Patton 2001*). Observation of this species continued in 2003 in an effort to increase our understanding of gull-billed tern foraging ecology around the bay.

During the 2003 nesting season, monitors documented a significant increase in least tern chick predation by gull-billed terns at the salt works and within the Tijuana Estuary (*Patton 2002*). A number of damaged least tern eggs were also attributed to suspected depredation by gull-billed terns. Of the prey observed taken by gull-billed terns at least tern and snowy plover sites adjacent to San Diego Bay and the Tijuana Estuary during the 2003 nesting season, 33 percent were chicks, 30 percent were crabs, 15 percent were lizards, and eight percent could not be identified, seven percent were insects, and seven percent were fish (*Patton 2004b*). These observations differ from the observations made during previous years. These differences may be attributed to the total number of chicks available in a given season or could relate to differences in the timing and location of data collection (*Patton 2004b*). In any event, at least 37 incidents of least tern and snowy plover chick predation by gull-billed terns were observed in 2003 (*Patton 2004b*).

The current situation has raised concerns that the gull-billed tern may be impeding the recovery of least terns and snowy plovers in San Diego Bay. Various programs within the

Service, including the Division of Migratory Birds Management, Refuges, and Ecological Services, are currently working together to identify and implement actions that will provide a better understanding of the current situation and its implications to all three species. Actions that are already being implemented include scientifically based monitoring on a limited scale at the salt works of gull-billed tern foraging activities. Limited monitoring of gull-billed tern nesting and reproductive success will also be implemented at the salt works during the 2005 nesting season.

The Service and biologists in Mexico are continuing to conduct surveys of gull-billed terns throughout its range. The initial results of the surveys completed in Mexico in 2003 were reported in Palacios and Mellink et al. (*2003*). Upon completion of the surveys, the results will be consolidated into a summary of the status and conservation needs of the western gull-billed tern. This information will not only help determine the population size of the western gull-billed tern, but will also provide insights into their habitat preferences and foraging needs. It will also assist the Service in determining the types of management actions, if any, that are necessary to conserve this species. Additionally, the data will permit a better assessment of how conservation of the gull-billed tern can be coordinated with endangered species recovery actions in Southern California.

3.4.7.2 Species Covered by the Multiple Species Conservation Program (MSCP)

The Multiple Species Conservation Program (MSCP) is a comprehensive habitat planning program for approximately 900 square miles in southwestern San Diego County. The MSCP addresses the potential impacts of urban growth, loss of natural habitat and species endangerment, and creates a plan to mitigate for the potential loss of species covered by the program. The intent of the MSCP is to protect interconnected blocks of different vegetation communities and habitat types in order to maximize protection of the region's most sensitive species. To achieve this goal, various habitat areas and connecting corridors were identified in a preserve. The need to consider the habitat requirements of 85 species of plants and animals (*City of San Diego 1998*) was essential to the design of the preserve.

It is the intent of the MSCP that local jurisdictions and special districts implement their respective portions of the MSCP through subarea plans, which describe specific implementing mechanisms for the MSCP. The combination of the subregional MSCP Plan and the required subarea plans serve as a multiple species Habitat Conservation Plan (HCP) pursuant to Section 10(a)(1)(B) of the Federal Endangered Species Act and a Natural Community Conservation Plan (NCCP) pursuant to the California Natural Community Conservation Planning Act of 1991 and the State Endangered Species Act. These subarea plans, which are intended to contribute collectively to the conservation of vegetation communities and species in the MSCP study area, form the basis for the contract, or "Implementing Agreement," between the local jurisdiction/special district and wildlife agencies (the Service and the California Department of Fish and Game).

In accordance with the MSCP, the City of San Diego has adopted a MSCP Subarea Plan. This plan established a Multi-Habitat Planning Area (MHPA) that is designed to address the needs of the indicator species described in the MSCP Plan and delineate core biological resource areas and corridors targeted for conservation. The southeastern portion of the South San Diego Bay Unit, specifically the salt ponds within the jurisdictional boundary of the City of San Diego and the Otay River floodplain, are included within the City of San Diego's MHPA (*City of San Diego 1997*).

The City of Chula Vista has also developed a MSCP Subarea Plan (*City of Chula Vista 2003*) that is intended to implement the MSCP Subregional Plan, including the habitat and species conservation goals and requirements. With the exception of Paradise Marsh, which is located

outside of the City of Chula Vista's jurisdictional boundary, the lands and waters within the Sweetwater Marsh Unit are included within the Chula Vista Subarea Plan's Habitat Preserve. Service approval of this Subarea Plan is still pending.

Of the 85 species covered by the San Diego and Chula Vista MSCP Subarea Plans, 29 have been observed or have the potential to occur within the San Diego Bay NWR (Table 3-18). For more information regarding the MSCP and the Subarea Plans, refer to Section 3.6.1.3.

Table 3-18
MSCP Covered Species Observed or Could Be Expected to Occur within the San Diego Bay NWR

Common Name	Scientific Name	Habitat	Observed or Potential
Aphanisma	*Aphanisma blitoides*	Southern foredunes, southern coastal bluff scrub	Unlikely potential for occurrence (SWM, SSDB)
Salt marsh bird's-beak	*Cordylanthus maritimus maritimus*	Coastal salt marsh	Observed (SWM)
Coast wallflower	*Erysimum ammophilum*	Southern foredunes, southern coastal bluff scrub	Unlikely potential for occurrence (SWM, SSDB)
San Diego barrel cactus	*Ferocactus viridescens*	Coastal sage scrub	Observed (SWM)
Nuttall's lotus	*Lotus nuttallianus*	Southern foredunes	Observed (SWM)
Snake cholla	*Opuntia parryi* var. *serpentina*	Maritime succulent scrub	Observed (SWM) Potential for occurrence (SSDB)
Salt marsh skipper	*Panoquina errans*	Coastal salt marsh (salt grass)	Observed at the D Street Fill (SWM), Potential for occurrence (SSDB)
San Diego horned lizard	*Phrynosoma coronatum blainvillei*	Coastal sage scrub, riparian scrub	Potential for occurrence (SWM, SSDB)
California brown pelican	*Pelecanus occidentalis*	Open water	Observed (SWM, SSDB)
Reddish Egret	*Egretta rufescens*	Coastal salt marsh	Observed (SWM, SSDB)
White-faced ibis	*Plegadis chihi*	Freshwater marsh, salt marsh	Observed (SWM, SSDB)
Canada goose	*Branta canadensis*	Wetlands, grasslands	Potential for occurrence (SWM, SSDB)
Bald eagle	*Haliaeetus leucocephalus*	Wetlands, open water	Potential for occurrence (SWM, SSDB)
Northern harrier	*Circus cyaneus*	Coastal salt marsh, coastal scrub, grasslands	Observed (SWM, SSDB)
Cooper's hawk	*Accipiter cooperii*	Coastal sage scrub	Observed (SWM, SSDB)
Ferruginous hawk	*Buteo regalis*	Grasslands	Rare Visitor (SWM, SSDB)
Golden eagle	*Aquila chrysaetos*	Uplands	Occasional Visitor (SWM, SSDB)
American peregrine falcon	*Falco peregrinus*	Coastal salt marsh, coastal sage scrub	Observed (SWM, SSDB)
Light-footed clapper rail	*Rallus longirostris levipes*	Coastal salt marsh	Observed (SWM, SSDB)

Table 3-18 (continued)			
Common Name	Scientific Name	Habitat	Observed or Potential
Western snowy plover	*Charadrius alexandrinus nivosus*	Salt pan, beaches, salt works levees	Observed (SWM, SSDB)
Long-billed curlew	*Numenius americanus*	Coastal salt marsh	Observed (SWM, SSDB)
Elegant tern	*Thalasseus elegans*	Open water, beaches, salt pans	Observed (SSDB)
California least tern	*Sternula antillarum*	Open water, beaches	Observed (SWM, SSDB)
Burrowing owl	*Speotyto cunicularia*	Grasslands	Potential for occurrence, historically present (SWM, SSDB)
California gnatcatcher	*Polioptila californica californica*	Coastal sage scrub	Observed (SWM) Potential for occurrence (SSDB)
Western bluebird	*Sialia mexicana*	Oak woodland, grasslands	Potential for occurrence (SSDB)
Belding's savannah sparrow	*Passerculus sandwichensis beldingi*	Coastal salt marsh	Observed (SWM, SSDB)
Large-billed savannah sparrow	*Passerculus sandwichensis rostratus*	Coastal salt marsh	Observed (SWM, SDDB)
Tricolored blackbird	*Agelaius tricolor*	Freshwater marsh, riparian scrub	Observed (SWM) Potential for occurrence (SSDB)
Townsend's western big-eared bat	*Plecotus townsendii*	Mesic habitats	Potential for occurrence (SWM, SSDB)
Mule deer	*Odocoileus hemionus fuliginata*	Uplands	Limited potential for occurrence in the Otay River floodplain (SSDB)

3.5 CULTURAL RESOURCES

3.5.1 Introduction

Cultural resources have been identified within the boundaries of both the Sweetwater Marsh and South San Diego Bay Units. One of these sites, the salt works, has been determined to be eligible for listing in the National Register of Historic Places (NRHP), while other sites have yet to be evaluated. In addition, other cultural resources may be present within the Refuge that have not yet been identified.

Requirements for Federal agencies to identify, evaluate, and protect cultural resources are outlined in several Federal regulations (described in greater detail in Section 5.1.3 of this document), including the National Historic Preservation Act (NHPA) of 1966, as amended (PL 89-665; 50 STAT 915; 16 USC 470 et seq. 36 CFR 800). The NHPA sets inventory, nomination, protection, and preservation responsibilities for federally-owned cultural properties and directs Federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing in the NRHP. The criteria used to evaluate eligibility to the NRHP, as contained in 36 CFR 60.4, include, among others, consideration of the quality of the property's significance in American history, architecture, archaeology, and culture and the property's known or likely ability to yield information important in prehistory or history. An historical property must also retain

the integrity of its physical identity that existed during the resource's period of significance. Integrity is evaluated with regard to the retention of location, design, setting, materials, workmanship, feeling, and association.

In accordance with the applicable cultural resource regulations, a preliminary overview of cultural resources within the Sweetwater Marsh and South San Diego Bay Units was prepared by the Service's Cultural Resources Team (*Speulda 2002*). This overview was prepared to assemble known information about the cultural resources located within and near the Refuge, to identify gaps in the existing data base, and to establish procedures for ensuring compliance with all applicable cultural resource regulations in the context of the CCP process. The findings of this overview are summarized in the sections that follow.

In February 2002 and June 2004, the federally recognized Tribes in San Diego County were contacted about the CCP process. Comments regarding the process and any concerns related to Tribal interests were solicited. No responses from the Tribes were received including any comments regarding traditional uses or the potential existence of sacred sites. Therefore, it is assumed that there are no known sites of interest to the Tribes within the Refuge boundary.

3.5.2 Overview of the Native American History and Landscape in San Diego County

The earliest recognized period of California prehistory is referred to as Paleo-Indian. In the San Diego region this period is usually considered to date from at least 10,000 years before present until 8,500 to 7,200 years before present (*ASM Affiliates, Inc. 2003*). The sites that have been documented from this period are identified as belonging to the San Dieguito complex (*Tierra Environmental, Inc. 2001*). Flaked stone tools, such as knives, blades, and scrapers, suggest a hunter-gatherer society and the apparent absence of milling implements and ceramic from these sites suggests little or no use of seed grinding technology.

The Archaic period began at least 7,200 years ago, possibly as early as 9,000 years before present time (*ASM Affiliates, Inc. 2003*) and lasted until about 2,000 years ago. Sites from this time period are identified by some as belonging to the La Jolla Complex. This cultural tradition appears to have two distinct subdivisions in southern California. The first, found along the coastal areas of southern California, had an economy that relied largely on gathering wild resources, such as shellfish and seeds, along the coast, while further inland, hunting and gathering techniques were replaced with horticultural and agricultural techniques. During this phase, a reliance on seed and nut resources is suggested by the presence of grinding implements, such as manos and metates. Coastal sites from this period are frequently characterized by shell midden and fire hearths (*Tierra Environmental 2001*).

The Late Archaic, also referred to as the Late Prehistoric Period, is defined as about 2,000 years before present to Spanish contact (1769). This period is represented by the Yuman-speaking people from the Colorado River region, who migrated into southern California. This period is recognized archaeologically by small pressure-flaked projectile points and the use of mortars and pestles for grinding seeds and acorns. Archaeological evidence indicates that the manufacture and use of ceramic vessels for cooking, storage, and other uses began about 1,000 years ago.

At the time of European contact, a fairly large, stable population of Kumeyaay people occupied the region of southern California; they were direct descendants of the early Yuman hunter-gathers of the Late Archaic period. The Kumeyaay people lived in small groups within territories where they claimed only minor plant resources and eagle aeries. Acorns were an important food source for the Kumeyaay, along with upland game in the hills and fish and shellfish in coastal areas. The

Kumeyaay also practiced resource management and were proficient in many plant propagation methods. According to Kumeyaay Elder Delfina Cuero, as described in her autobiography, local Native Americans also gathered salt near the southern end of San Diego Bay for cooking and preserving fish and as a trade good for other tribes (*Gustafson and Gregory 2001*).

Displacement of Kumeyaay culture and society began at European contact. The introduction and development of the Mission system, and later the establishment of ranchos under the Mexican land grant program, all contributed to the disruption and break down of many Kumeyaay cultural institutions.

3.5.3 Early Euro-American History

The first recorded exploration of San Diego Bay was conducted in 1542 by Portuguese explorer Juan Rodriguez Cabrillo, sailing under the Spanish flag. Sixty years later in 1602, Sebastian Vizcaino sailed into what is now known as San Diego Bay. It was not until 1769, however, that an overland party of missionaries, traveling north from Baja California, began the exploration and settlement of the region. This period, which extended from 1769 to 1821, is referred to as the Spanish Period. It is during this time that the San Diego Presidio and San Diego and San Luis Rey Missions were established.

In the 1770s, the land now included within the Refuge boundaries was part of La Purisima Concepcion, a grazing area for the mission herds. In 1795, the area was taken from the Mission by soldiers at the San Diego Presidio and renamed El Rancho del Rey. The land was then used to graze the horses and cattle for the presidio garrison.

In 1821, control of California passed from Spain to Mexico. This period, referred to as the Mexican Period, extended to 1848, when Mexico ceded California to the United States after the Mexican-American War of 1846-48. Following Mexico's independence from Spain, the missions were secularized and the large missions were divided and granted to individuals and families loyal to Mexico. This process became known as the rancho system of land distribution. The lands within the Sweetwater Marsh Unit were included within El Rancho de la Nacion, an area encompassing some 26,630 acres.

In 1848, Mexico ceded California to the United States and under the provisions of the Treaty of Guadalupe Hidalgo, residents of California were guaranteed property rights to land held in accordance with Mexican law. Acquiring title to these lands, however, was difficult. In 1851, Congress established procedures that would assist individuals in gaining clear title (a "patent") to these lands (*Crane 1991*). In 1866, President Andrew Johnson granted a land patent for the El Rancho de la Nacion (listed as National Ranch), and on June 15, 1868, the Kimball brothers purchased the National Ranch for $30,000 (*Phillips 1962*). This land patent included six miles of bayfront in the vicinity of what is now National City (*EDAW 2001*).

Development of National City began slowly. In 1869, many individuals came to National City in hopes of working for the Memphis and El Paso Railroad, a project that did not materialized as promised. Between 1869 and 1873, the road connecting National City to the border was improved, a post office was established, and a wharf was constructed along the bayfront. Following a financial crash in 1873, which ended the current hopes for a railroad boom, the Kimball brothers turned to agriculture. Much of the area was used to raise sheep, grow wheat, and cultivate oranges, lemons, grapes, and olives (*Phillips 1962*).

In 1885, the vision of a railroad line connecting National City to other parts of California and beyond was realized with the completion of a line that connected National City to San Bernardino

(*Bevil 1996*). This was followed by the incorporation of National City in 1887. During that same year, the San Diego Land and Town Company, the syndicate controlled by the Santa Fe Railroad began construction of the Sweetwater Dam in order to promote land sales in National City and Chula Vista (*Pourade 1964*). Early in its history, Chula Vista was an agricultural center, known for its flowers, as well as its citrus and celery. Later, Chula Vista became a residential and industrial area and a center for aircraft parts manufacturing.

The Coronado Belt Line was completed in 1888. This railroad provided service from 5th and L Streets in San Diego, through National City and Chula Vista around the south end of the bay, and up the Silver Strand to Coronado. The railroad, which was originally owned by Elisha S. Babcock, Jr., H.L. Story, and associates, was built as part of the Coronado Beach development (*Phillips 1956*). The railroad was used to transport freight and passengers to and from Coronado. Regular passenger service on this line ended in 1896, but special excursion trains continued to operate for several years thereafter.

In addition to the community and agricultural development occurring in the mid to late 1800s in the vicinity of the area now included within the Sweetwater Marsh Unit, agricultural and industrial development was also occurring in and around lands and waters now included in the South San Diego Bay Unit. The history of solar salt production in the South Bay began in 1871 with the development of the La Punta Salt Works. This small-scale salt production facility was initially constructed on about 60 acres in the extreme southeast corner of San Diego Bay (*Union Tribune, May 17, 1897*). This facility subsequently closed and in 1902, Graham Babcock established the Western Salt Company approximately a quarter mile northeast of the extant La Punta Salt Works (*Gustafson and Gregory 2001*).

In 1911, when E.S. Babcock took over the Western Salt operation, he began purchasing much of the land along the south end of the bay in order to expand the facility. As the facility expanded, the historic salt marsh and intertidal mudflats were eliminated by the formation of diked evaporation ponds. By 1916, the facility extended across the entire end of the South Bay. A major flood severely damaged the facility in early 1916, but reconstruction began immediately and continued through 1918. In 1922, the facility was purchased by H.G. Fenton and remained under the ownership of H.G. Fenton Company until the majority of the salt works was incorporated into the South San Diego Bay Unit in 1999. Until recently, H.G. Fenton Company retained ownership over the southeastern-most bittern ponds within the salt works. These ponds, which were not included within the Refuge acquisition boundary, were subsequently sold to another property and will soon be removed from the existing salt works system.

During World War I, San Diego Bay became a Navy training ground and industrial complex. On Gunpowder Point, within the current boundaries of the Sweetwater Marsh Unit, the Hercules Powder Company built a 30-acre industrial complex to produce potash and acetone from sea kelp. The plant, which was constructed in 1916 and remained in operation until 1920, included 156 redwood "digestive" tanks, each eight meters in diameter and five meters tall. These tanks were used to ferment raw kelp for the primary purpose of producing potash, an ingredient of black powder, and acetone, an essential component used in the extrusion of cordite, a smokeless gunpowder used by the British armed forces (*Nueshul 1991*). The fermentation process also produced other marketable by-products including ethyl acetate and a number of solvents used for wartime purposes. When the war ended, the need for these products dwindled and the plant was closed.

Several of the powder company structures were later used by the Pacific Cottonseed Products Corporation to produce cottonseed oil. According to aerial photographs from 1936 and 1944, cottonseed oil production continued on the site until the mid 1940s.

From 1946 to 1986, Gunpowder Point was leased for agricultural purposes. During that time, the land was used to produce row crops, as well as hothouse tomatoes. Also during this same time period, the portion of the Otay River floodplain located within the South San Diego Bay Unit was in agricultural production. Although tomatoes were one of the primary crops grown in this area, the crop types did change as the market demand changed and as a result, over time a wide variety of irrigated row crops were produced at this site.

3.5.4 Archaeological Resources

The Service conducted a review of the records at the South Coastal Information Center and determined that archaeological investigations have taken place within the boundaries of and on parcels adjacent to both the Sweetwater Marsh and South San Diego Bay Units. Of the surveys and testing projects completed, there have been 15 archaeological sites recorded within or adjacent to these Refuge Units. The results of the surveys indicate that a variety of site types are present in the study area, including archaeological remains in the form of habitation sites, lithic scatters (stone flakes left behind from the process of making stone tools), shell middens, and temporary camps. The age of the prehistoric sites seem to relate to the early Archaic period through the ethnographic period.

Three recorded prehistoric archaeological sites are located within the Sweetwater Marsh Unit. These sites consist of a temporary camp (CA-SDI-4958), a lithic scatter (CA-SDI-5512), and shell midden (CA-SDI-7454). These sites were previously tested and evaluated for significance. None of the sites were determined to be eligible for the NRHP (*Speulda 2002*).

Six prehistoric sites and two sites containing both prehistoric and historic-period artifacts have been recorded on or near the South San Diego Bay Unit. Of the three sites that occur within the Refuge boundary, one site (CA-SDI-5513) has been determined not to be eligible for the NRHP, one site (CA-SDI-7455) has not yet been evaluated, and portions of another site (CA-SDI-4360) have been previously tested, but the resource as a whole has never been evaluated in accordance with Section 106 (*Pigniolo and Murray 2001*).

In the Historic Property Survey Report prepared for the Bayshore Bikeway Project, Pigniolo and Murray (*2001a*) provided the following comments regarding CA-SDI-4360:

> *"Native American values have not been identified at the site but testing and data recovery efforts under CEQA [California Environmental Quality Act] at portions of the site have identified a variety of prehistoric cultural material (Apple 1982). This cultural material can address research questions related to subsistence, chronology, and environmental change. Portions of the site . . . still retain this research potential . . . CA-SDI-4360 is felt to be eligible for listing on the National Register under Criterion D at the local level of significance. No other National Register criteria are felt to apply to CA-SDI-4360."*

In a letter to the Federal Highway Administration, dated May 28, 2002, the State Historic Preservation Office (SHPO) concurred that archaeological site CA-SDI-4360 is eligible for inclusion on the NRHP under Criterion D, as defined in 36 CFR 60.4.

A recent archaeological investigation conducted for the City of San Diego in association with the Otay River Pump Station and Conveyance System project identified site deposits considered to be

an extension of previously recorded site CA-SDI-7455. Based on artifacts and ecofacts recovered from a series of corings, three spatially distinct subsurface deposits were identified, including two dating to the Late Prehistoric period and one dating to the Archaic period (*ASM Affiliates, Inc. 2003*). These deposits were located at various depths below the surface, with the shallowest extending from about 70 to 150 centimeters below the surface and the deepest identified at a depth of approximately 500 centimeters below the surface. Based on the information gathered from this investigation, it is possible that additional cultural deposits exist below the surface that have not yet been located (*ASM Affiliates, Inc. 2003*). The features identified during this recent investigation have been recorded, but have not been evaluated for eligibility to the NRHP.

3.5.5 Historic Resources

Historic research included an examination of various repositories and a review of the current listings for San Diego County on the National Register of Historic Places' website. Additionally, the California Inventory of Historic Resources (State of California), California Point of Historical Interest, and the California Historical Landmarks were consulted and historic photographs, historic maps, and vertical files of the San Diego County Historical Society Museum were examined.

Within the Sweetwater Marsh Unit, two sites containing historic artifacts have been recorded on Gunpowder Point. One of these sites contains both prehistoric and historic-period artifacts. Both sites have been tested and have been determined not to be eligible for the NRHP. The Hercules Gunpowder Company site, another site located on Gunpowder Point, has not yet been evaluated. Although the primary structures associated with this historic facility were dismantled many years ago, there are a number of historic features still remaining, including eight structural remnants.

Another historic site, the Coronado Belt Line Right-of-Way (CA-SDI-13,073H), occurs just outside of the Refuge boundary. This line when completed in 1888 extended for about 20 miles from central San Diego, through National City and Chula Vista, around the south end of the bay, and up the Silver Strand to Coronado. About 7.5 miles of the Belt Line remains today. Remnants of the original rail line exist along the east edge of the Sweetwater Marsh Unit and along the south edge of the salt works in the South San Diego Bay Unit, where the line was constructed on a berm, or elevated railroad bed, that crossed coastal salt marsh and mudflats. Although in disrepair, the two low trestles that were constructed to cross the channels of the Otay River can still be observed to the south of the salt works. The Coronado Belt Line right-of-way is not included within the approved acquisition boundary of the South San Diego Bay Unit; instead the right-of-way bisects the Refuge, with Refuge lands located to the north and south from about Saturn Boulevard in the City of San Diego to 12th Street in Imperial Beach.

In 1994, Caltrans with subsequent concurrence from the SHPO concluded that the railroad line did not possess the qualities necessary to be considered eligible for inclusion on the NRHP, nor was it determined appropriate for listing on the California Register of Historical Resources (*King 1994*). The eligibility of the line was reevaluated in 2001 by Dr. Karen Weitze as part of the environmental review process for the Bayshore Bikeway proposal. Once again, the line was determined to be ineligible for the NRHP due to the lack of integrity and lack of clarity of association (*Weitze 2001*). Also in 2001, Save Our Heritage Organization (SOHO) submitted a 7.5-mile segment of the Coronado Belt Line Right-of-Way (the segment that extends from National City to Imperial Beach) to the California State Historical Resources Commission (Commission) for consideration as a nominated resource to the California Register of Historical Resources (California Register). On February 2, 2002, the Commission voted to list the Coronado Belt Line Right-of-Way in the California Register. Following this decision, the Cities of San Diego, Imperial Beach, and Chula

Vista and the Port of San Diego sent letters to the State expressing their disagreement with the action to list the facility on the California Register and requesting that the Commission reconsider its prior determination. On November 8, 2002, the Commission considered the requests for redetermination and reversed their previous action. As a result of this action, the Belt Line Right-of-Way will not be included in the California Register.

The City of San Diego's Historical Resources Board (HRB) also considered this matter on several occasions and in December 2003 designated the Coronado Belt Line as a historic resource within the City of San Diego. The HRB concurred that the site was historically significant for its archaeological value. Among other factors, the HRB found that the Belt Line provided an example of the private capitalization of infrastructure and was representative of railroad construction in the late 1800s. The HRB's designation was appealed to the San Diego City Council in September 2004 at which time the Council approved the appeal and overturned the previous decision. This 2004 decision was once again reversed by the Council in 2005, resulting in the designation of the Belt Line as a historical site within the City of San Diego.

The other historic resource located within and adjacent to the South San Diego Bay Unit is the Western Salt Company Salt Works. Most, but not all, of the salt works site is located within the Refuge. The historic site includes the evaporation and crystallization ponds, as well as all of the buildings, structures, levees, and land necessary for the operation of the salt works. A Historic Resources Evaluation Report (*Gustafson and Gregory 2001*) was prepared for the Western Salt Company Salt Works in association with the Bayshore Bikeway proposal. The report includes the following statements regarding the significance of the site:

> *"The Western Salt Company Salt Works has operated for nearly one hundred years. The unique location provides the Salt Works the elements that are necessary for successful solar salt production. The site consists of a grouping of related resources that are united by design and function. The Salt Works satisfies the requirements for a district under the National Register of Historic Places. The National Register defines a district as a site that "possesses a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development."*

The report further states that the salt works, which retains a high degree of integrity, is eligible for inclusion on the NRHP under Criteria A and C of the National Register of Historic Places (36 CFR 60.4) because the facility played an important role in the solar salt industry in Southern California from 1916 to 1949 and the Salt Works embodies the distinctive characteristics of a solar salt processing facility.

The State Office of Historic Preservation in a letter to the Federal Highway Administration, dated May 28, 2002, concurred with the conclusions of the report and determined that the Western Salt Company Salt Works is eligible for inclusion on the NRHP. The contributing elements to the historic district include: the main processing plant, the pump house between Ponds 21 and 44, the electrical, generator and compressor buildings, the maintenance shop, the 18 condensing or evaporator ponds, the 14 crystallization salt ponds, the levees separating the condensing and crystallization ponds, the short section of narrow-gauge rail line as it crosses the San Diego & Arizona Eastern Railroad tracks, and the salt pile used for storage of salt after harvesting.

3.6 Social and Economic Environment

The San Diego Bay NWR is included within the corporate boundaries of five cities: the Cities of National City, Chula Vista, Coronado, San Diego, and Imperial Beach. The portion of the

Sweetwater Marsh Unit situated to the north of the Sweetwater flood control channel is located within the City of National City, while the area to the south is located within the City of Chula Vista. The corporate boundaries within the South San Diego Bay Unit are somewhat more complicated, as illustrated in Figure 3-19.

3.6.1 Land Use

This section presents an overview of the existing land uses that occur within and immediately surrounding the San Diego Bay NWR. Also presented are the relevant land use policies of the five municipalities that surround the Refuge and the other regional policies that affect land use in the immediate vicinity. Figure 3-20 illustrates the uses that occur within and adjacent to the Refuge.

3.6.1.1 Current Uses on Each Refuge Unit

Sweetwater Marsh Unit

The uplands within the Sweetwater Marsh Unit historically supported industrial and agricultural uses and the area in and around Paradise Marsh was the site of a municipal landfill where discarded waste was routinely burned. Today, however, the primary use on this Refuge Unit is open space/wildlife habitat. All of the lands and waters within the approved Refuge boundary for the Sweetwater Marsh Unit have been acquired as Federal land for inclusion in the National Wildlife Refuge System.

In addition to wildlife habitat, Gunpowder Point, located in the southwestern portion of the Refuge Unit, supports several wildlife-dependent recreational uses (described in more detail in Section 3.6.1.1), a 1,500 square-foot Refuge office, and the Chula Vista Nature Center. A gated road, which extends from the terminus of E Street through undeveloped private land, and onto the Refuge, provides access to the Refuge office and the Chula Vista Nature Center. This roadway crosses through the marsh on a narrow berm. No public access is permitted on the road except via a shuttle bus operated by the Nature Center. The shuttle bus transports visitors from a parking lot located near the E Street/I-5 interchange to the Nature Center, where they can explore the Nature Center and access the series of trails that extend across Gunpowder Point to the edge of the bay.

The Chula Vista Nature Center is situated on a 3.33-acre easement that was granted to the Redevelopment Agency of the City of Chula Vista in 1986 by the Santa Fe Improvement Company (the previous landowner of Gunpowder Point) for the purpose of constructing, operating, and maintaining a nature interpretive center. A license was also granted for access and utility purposes on the levee road. In 1988, as part of the Stipulated Settlement, the Court acknowledged the existing easement and license and required that the Santa Fe Improvement Company to convey Gunpowder Point to the Service subject to the easement and license previously granted to the City of Chula Vista.

The Nature Center includes indoor and outdoor exhibits that provide visitors with a better understanding of the history, geology, ecology, and natural history of San Diego Bay and the Sweetwater Marsh Unit. Interactive exhibits describe the biodiversity of the marsh, surrounding wetlands, and the bay, from intertidal mudflats to uplands. Interior exhibits are provided within a 12,000-square-foot facility. Exterior exhibits include a burrowing owl aviary, bird of prey enclosures, and an enclosed shorebird exhibit that includes two breeding pairs of light-footed clapper rails. The center also includes bird-watching platforms and gardens that focus on drought-tolerant plants. An eagle enclosure and a shark and ray exhibit are recent additions to the Center.

Figure 3-19
City Corporate Boundaries within the South Bay

City boundaries

South San Diego Bay Unit
Existing Management Authority

N

0 0.25 0.5 Miles

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

Carlsbad Field Office - 2003
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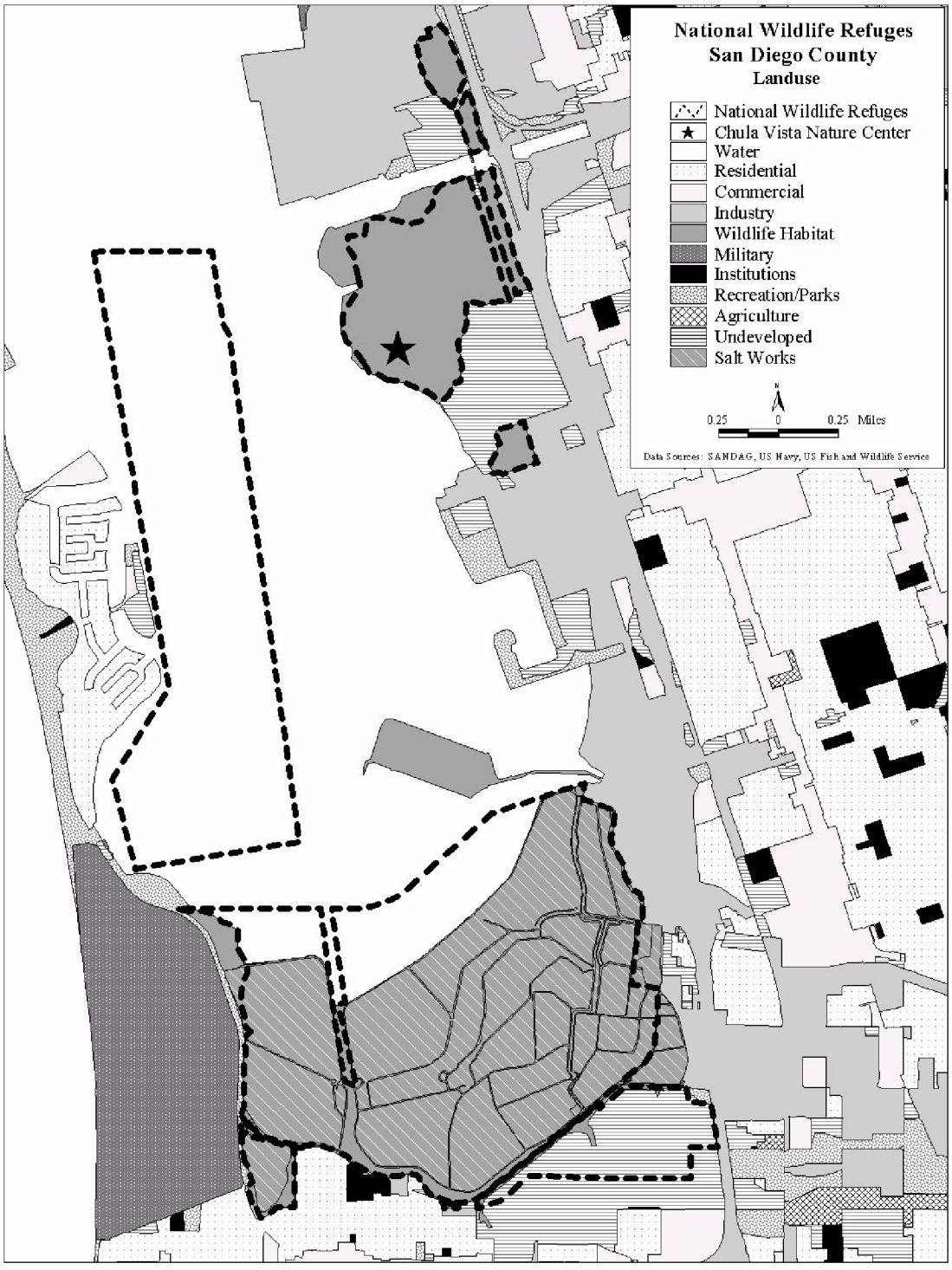

Figure 3-20
Land Use within and Surrounding the Sweetwater Marsh and South San Diego Bay Units of the San Diego Bay NWR

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/stacey/fig_4-03/fig3-20.mxd

South San Diego Bay Unit

Existing Uses within the Current Refuge Boundary

Approximately 3,940 acres of land and water are included within the approved acquisition boundary of the South San Diego Bay Unit, of which approximately 2,300 acres are currently managed as part of the National Wildlife Refuge System. Of the areas already incorporated into the Refuge, the majority consists of open water within the southern end of San Diego Bay. This area provides habitat for wildlife, while also accommodating commercial and recreational water uses, such as boating, fishing, parasailing, and windsurfing. These open water areas, as well as the other submerged lands and tidelands within the Refuge's management area, are leased to the Federal government from the State Lands Commission, acting by and through the Service, for the creation and continued maintenance of a National Wildlife Refuge.

The portion of the South San Diego Bay Unit that is referred to as the Otay River floodplain is owned in fee title by the Service and is located within the southeastern portion of the Refuge. The primary use in this area is wildlife habitat. Public access is restricted to a recreational trail that traverses the area from north to south within a City of San Diego unimproved, dedicated street right-of-way (Saturn Boulevard). The majority of the trail is located outside the current Refuge boundary on land owned by the City of San Diego. A variety of underground and overhead public utilities also extend across the property, as described in Section 3.6.3.2. Some of these utilities are located within easements that were conveyed prior to the establishment of the Refuge, while others are included within dedicated street rights-of-way owned in fee title by another entity and are not included within the Refuge boundary (Figure 3-21).

The other major use within this Refuge Unit is the South Bay Salt Works, which occupies approximately 1,068 acres at the south end of San Diego Bay. The South Bay Salt Works is an active solar salt production facility that is operated in accordance with a Special Use Permit issued by the Service to the Airport Authority. The current operation produces between 60,000 and 80,000 tons of salt per year. In addition to salt production, the Special Use Permit also allows brine shrimp to be harvested from Pond 23; however, no brine shrimp harvesting has occurred in the past several years.

Although the majority of the salt works, particularly the salt ponds, are located within the Refuge, some elements of the salt operation are located on lands that were excluded from the approved Refuge acquisition boundary (refer to Figure 3-21). The excluded areas, which are owned by the Airport Authority, include Pond 40, a portion of Pond 42, and the land on which the salt processing plant and salt storage area are located. The Airport Authority also owns the processing equipment for the salt operation including the salt processing plant, conveyor, salt grinder, and other associated facilities. South Bay Salt Works currently has a lease with the Airport Authority to continue to operate the salt works until 2007. There is language in the Cooperative Agreement between the Port and Service that could permit the continuation of this use until at least 2009. The current operation also extends onto privately held lands, which are leased to the South Bay Salt Works by the private property owner. These privately held lands consist of the property currently occupied by Ponds 50 through 54, as well as property immediately to the east of the plant across Bay Boulevard. The lease on this property expires at the end of 2004 and will not be renewed. All salt works operations must be removed from this privately held property by June 2005.

Figure 3-21
Existing Ownerships Around the South San Diego Bay Unit

South San Diego Bay Unit
Existing Management Authority

Undeveloped streets owned in fee title
by the City of San Diego

N

0 0.25 0.5 Miles

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

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Existing Uses Occurring Outside the Current Refuge Boundary, But Within the Approved Acquisition Boundary

The Port has the responsibility for administering much of the area that is included within the approved acquisition boundary, but not currently included within the management boundary of the Refuge. In addition, the U.S. Navy owns property within the acquisition boundary and currently retains administrative authority for this area (refer to Figure 3-21).

Uses occurring within the acquisition boundary, but outside the current Refuge boundary include the South County Biological Study Area (Biological Study Area) and the Chula Vista Wildlife Reserve (Figure 3-22). The land occupied by the Biological Study Area is owned by the U.S. Navy and managed by the County of San Diego Parks and Recreation Department as a wildlife preserve and nature interpretive area. A parking lot, a segment of the Bayshore Bikeway, and coastal salt marsh habitat are included within the Biological Study Area. In 2003, the County of San Diego completed repairs to the parking lot and bikeway and installed new interpretive elements, an overlook, and benches along the edge of the marsh.

The Chula Vista Wildlife Reserve is a 55-acre habitat mitigation site that was built from dredged material obtained during the development of the Chula Vista Harbor. The Port retains management authority for this area and the Port Master Plan designates the site as a Habitat Replacement area. Public access to this area is prohibited.

Although the Port manages much of the land within the South Bay that is not located within the current Refuge boundary, these tidelands are owned by the State of California in trust for the residents of the state. The Port Master Plan (*SDUPD 1998*), which describes the uses permitted within this tidelands, designates the marshlands located to the south of J Street for preservation as wetlands (refer to Figure 3-20). The upland area immediately to the east of this marshland is designated Marine Related Industrial; however, the site is currently leased to Duke Energy for uses associated with the South Bay Power Plant. The Port also controls an area of shallow water and approximately 8.5 acres of vacant upland located immediately to the north of the Biological Study Area. This area is not currently leased for any use and is proposed in the Master Plan to be set aside and possibly enhanced for conservation purposes. The Port Master Plan recommends that limited water use associated with boating and fishing be permitted in the South Bay, and discourages the development of any other uses within the South Bay's shallow open water areas.

Another area included within the acquisition boundary, but not managed by the Service, is a 48-acre area of vacant land located at the southern end of the Otay River floodplain. This property is owned by the City of San Diego and is subject to the land use goals presented in the Otay Mesa Nestor Community Plan (*City of San Diego 1997*). This city parcel, as well as those salt ponds located to the east of the Otay River (with the exception of Ponds 15, 28 and 29 and the northern portion of 14), were incorporated into the Otay Mesa Nestor Community Plan area when the plan was adopted in 1997. These salt ponds are designated in the plan as open space, while the area to the south, including the Otay River floodplain and the City owned parcels to the south of the Refuge, are designated as a Special Study Area (SSA). The SSA overlay designation requires that all development proposals that are not consistent with the existing zoning on the property must include a Special Study that addresses biological resources, habitat value, and hydrology within the SSA. This information would then be used as a basis for determining appropriate land uses.

Figure 3-22
Land Uses Within and Around the South San Diego Bay Unit

South San Diego Bay Unit
Existing Management Authority

N

0 0.25 0.5 Miles

Source: USFWS, Local Agency Partnership 2000 (2 ft imagery)

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Although the Otay Mesa Nestor Community Plan also serves as the Local Coastal Plan for this area, the State Coastal Commission has designated the salt ponds and Otay River floodplain as a deferred certification area. As a result, a Coastal Development Permit must be obtained directly from the California Coastal Commission before any development can occur on the property.

3.6.1.2 Surrounding Land Uses

Sweetwater Marsh Unit

Existing Uses Surrounding the Sweetwater Marsh Unit

Uses surrounding the Sweetwater Marsh Unit occur within the jurisdictional boundaries of the cities of National City and Chula Vista, while the Port is responsible for administrating some of the areas immediately adjacent to the Refuge. In addition, the lands and waters in and around the bay, including those within the Refuge boundary, are included within the California Coastal Zone. Uses occurring in the immediate vicinity of the Sweetwater Marsh Unit include a container and bulk-handling port terminal, various industrial uses, and public recreation to the north and west; transportation corridors (a railroad right-of-way and I-5) to the east; and recreational boating and other bay related uses to the west. Paradise Marsh, which extends to the north of the main Refuge area, is situated between I-5 to the east and an existing railroad right-of-way to the west. Surrounding Paradise Marsh to the north and west are industrial and public recreation uses within National City.

The majority of this Refuge Unit is located to the south of the Sweetwater Channel in the City of Chula Vista. The lands located immediately to the east and southeast of Sweetwater Marsh are currently vacant, as is the property to the north and west of the F&G Street Marsh. Industrial uses abut F&G Street Marsh to the south and east and vacant land and marine related industry occurs to the southwest.

Potential Future Development around the Sweetwater Marsh Unit

Future development and/or redevelopment adjacent to the Paradise Marsh portion of the Refuge would occur in accordance with the City of National City's Harbor District Specific Area Plan (*City of National City 1998*). This Specific Area Plan, which encompasses both the General Plan recommendations for the area and Local Coastal Program requirements, covers the lands located between 24th Street in National City south to the Sweetwater Channel and west from I-5 to the Burlington Northern Santa Fe Railroad. Although Paradise Marsh is not under National City coastal development permit authority, it is included within the boundaries of the plan and the plan incorporates development standards intended to protect the visual and biological quality of this resource. The approved land use designations for the other properties within this area include tourist commercial use for the 8.3 acres located on the bluff immediately to the north of Paradise Marsh and tourist commercial use and a limited area of medium industrial use to the west.

The mudflats that border the western edge of the Refuge, as well as the western and northern edges of the D Street Fill, are located outside of the Refuge boundary and are managed by the Port. The Port Master Plan (*SDUPD 1998*) designates the western end of the D Street Fill, the area located beyond the Refuge boundary for Habitat Replacement, while the northern edge is designated for Marine Services. The Master Plan states that the mudflats that extend from the Sweetwater Flood Control Channel to about G Street will be preserved as wetlands.

The private lands to the south and southeast of Sweetwater Marsh are regulated by the City of Chula Vista in accordance with the Chula Vista General Plan, Chula Vista Local Coastal Program Bayfront Specific Plan, and Bayfront Redevelopment Plan. The Chula Vista General Plan (*Chula Vista 1995*) currently designates the vacant property immediately to the south and southeast for park and recreation. Beyond this parkland designation, the General Plan designates multi-family use with visitor-serving commercial located adjacent to I-5. The area immediately to the north of the F&G Street Marsh is designated for retail development. In September 2002, a development proposal was submitted to the City of Chula Vista for this area that would require the approval of an amendment to the General Plan, Local Coastal Plan, and Redevelopment Plan. This proposal, as originally submitted, envisioned the construction of 6.4 million square feet of mixed-use development in a series of multiple story buildings, including several high-rise residential structures. These plans are currently on hold, as the developer works with the City of Chula Vista and the Port on proposals for the City of Chula Vista Bayfront Redevelopment Project. Preliminary land use proposals for this area as a result of the current redevelopment planning effort include office and resort hotel use. The specific land uses ultimately approved for the area immediately adjacent to the Refuge will depend upon which development proposal is ultimately adopted by the City of Chula Vista and the Port for the Bayfront redevelopment area.

Immediately to the south of the F&G Street Marsh is the Goodrich industrial site. The uses on the Goodrich site are not expected to change in the near future. Most of the properties to the south and west of the Goodrich site are included within the Bayfront redevelopment area and are currently designated as Industrial Business Park in the Port Master Plan (*SDUPD 1998*). The Industrial Business Park allows industrial, commercial retail, hospitality, and related uses in a planned development concept. However, the future use of this area is currently being reevaluated as part of the Bayfront redevelopment planning process. It is likely that following the adoption of a Redevelopment Plan, development intensities in this area will be significantly greater than currently permitted in the Port Master Plan.

In 2001, the Port approved an amendment to the Port Master Plan that redesignated the area located to the southwest of the F&G Street Marsh, a total of 15.4 acres, from Marine Related Industry to 10.9 acres of Commercial Recreation and 4.5 acres to Habitat Replacement Conservation. The new Habitat Replacement Conservation designation abuts the F&G Street Marsh to the southwest and provides a buffer between the Refuge land and the Commercial Recreation area further to the southwest (*SDUPD 2001*). As a condition of this Port Master Plan Amendment, the Port was required to enter into a cooperative agreement with an appropriate agency or organization, which would be designated to protect and/or enhance, where appropriate, the 210 acres of mudflats that abut the western edge of the Refuge (*SDUPD 2001*).

South San Diego Bay Unit

Existing Uses Surrounding the South San Diego Bay Unit

A wide variety of uses occur on the lands and waters beyond the acquisition boundary of the South San Diego Bay Unit, including developed and undeveloped Port lands, wildlife habitat areas, and an array of industrial, commercial, military, residential, and recreational uses. From north to south, uses include commercial and recreational boating and some fishing immediately to the east and west from the northern edge of the acquisition boundary to the north end of the Coronado Cays. To the west along the Coronado Cays,

the Refuge is bounded by a dredged channel that provides boating access to the Cays, a hotel development further to the west, residential development, limited water related commercial, parkland, and additional residential development, all regulated by either the Port or the City of Coronado. To the east within the City of Chula Vista, the Refuge is bounded by a dredged channel that provides boating access to the Chula Vista Marina; further east it is bounded by the Chula Vista Bayfront Master Plan Area, which includes the South Bay boatyard, Bayside Park, the Chula Vista Marina, Bayfront Park, and the South Bay Power Plant.

The South Bay Power Plant, located to the northeast of the salt ponds, is a gas- and oil-fueled generating plant with four major steam cycle units. Bay water is the primary component of the plant's circulating cooling water system. The plant takes in water from the bay through a channel constructed to the north of the Chula Vista Wildlife Reserve and discharges the heated water just to the north of the salt works. There have been various discussions regarding the future of this plant, from decommissioning the plant and constructing a new plant somewhere else in the region, to more recent discussions of decommissioning the existing plant and constructing a more efficient plant slightly to the south of the current site.

The area to the east of Pond 29 supports various light industrial facilities within the City of Chula Vista. Further to the south, across the street from the salt plant, the land uses include a combination of industrial and residential uses. Some of this property is included within the City of Chula Vista, while other areas are located within the City of San Diego.

The Navy owns the land to the north and west of Ponds 10 and 11, as well as a small portion of the northwest corner of Pond 11 and the westernmost end of the northern levee of Pond 11 (Figure 3-21). This area, which is located to the south of the Coronado Cays in the vicinity of Emory Cove, includes uplands and some wetlands and is used primarily for military training operations. The Naval Radio Receiving Facility, Naval Base Coronado (NRRF), located further to the south is also used for military training operations and other Navy related activities. Other military lands in the vicinity of the Refuge include Naval Base Point Loma, Naval Station San Diego, Naval Base San Diego, Naval Air Station North Island, Naval Amphibious Base Coronado, and Naval Base Coronado.

Community commercial development and a mobile home park are located within the City of San Diego, to the south of the Otay River floodplain and outside of the acquisition boundary. A sewer pump station operated by the City of San Diego's Metropolitan Wastewater Department is located further to the west. Beyond the pump station to the west is Pond 20A, which although located within the jurisdictional boundaries of the City of San Diego and is owned and managed by the Port (refer to Figure 3-21). Pond 20A was once a part of the salt making operation to the north, but is no longer connected to the system. The northern portion of this pond is included within the Refuge management and acquisition boundary, while the southern end of the pond is located outside the acquisition boundary. Redevelopment of the southern end of this pond has been considered in the past, but at present no specific proposals are being considered.

To the southwest of the Refuge, within the City of Imperial Beach, surrounding uses include residential development, a few light industrial uses, an elementary school, a public works yard, and a mobile home park. The Imperial Beach General Plan (*1994*) describes this area as the Bayview Neighborhood, and identifies the Imperial Beach bayfront as unique and environmentally sensitive. The General Plan encourages the evaluation of

opportunities for increased public access to the bay, including a marina or other commercial recreational marina alternatives. The Plan also supports the creation of a recreational corridor along the Imperial Beach bayfront incorporating bicycles and pedestrian paths and suggests that additional public access be provided to the bayfront.

Potential Future Development around the South San Diego Bay Unit
As described previously, the City of Chula Vista and the Port are currently developing plans for the Bayfront Redevelopment area that could change the types of uses currently occurring to the east of the South San Diego Bay Unit. The redevelopment area extends from about the F&G Street Marsh in the Sweetwater Marsh Unit to the south end of the South Bay Power Plant site. Preliminary proposals envision a significant increase in the intensity of uses occurring in the vicinity of the Chula Vista Marina, to the east of the J Street Marsh, and within the existing power plant property. The plans also propose to improve public access to the bay and could result in the development of residential uses adjacent to some portions of the Refuge.

The property currently occupied by Ponds 50 through 54 is currently being considered for development as part of another redevelopment planning effort to the south of the Bayfront. This smaller redevelopment area includes most of the properties to the east of the salt works and west of I-5 between Palomar Street and Main Street. Although no specific development plans have been released, preliminary planning indicates that this area could be proposed for community commercial, multi-family residential, and/or mixed use development. The property is currently located within the jurisdictional boundaries of the City of San Diego; however, the cities of San Diego and Chula Vista have been discussing the possible reorganization of their boundaries, which could lead to the annexation of this area into the City of Chula Vista.

Another potential future redevelopment site is the 17-acres of the salt works owned by the Airport Authority. The Airport Authority currently leases this property to the South Bay Salt Works. That lease expires in 2007. The Airport Authority would then have the option to renew the lease, lease the property to another party, or sell the property. No information is currently available regarding the types of uses, if any, that could potentially be proposed for this site in the future.

3.6.1.3 Regional Habitat Conservation Planning

The MSCP is a comprehensive habitat conservation planning program that addresses multiple species habitat needs and the preservation of native vegetation communities in southwestern San Diego County (*City of San Diego 1998*). Both the Sweetwater Marsh and the South San Diego Bay Units are included within the MSCP study area. Sixteen core biological resource areas and associated habitat linkages were identified in the MSCP study area; these include the South San Diego Bay/Silver Strand core resource area and the Otay River and Sweetwater River habitat linkages, portions of which occur within the boundaries of the Sweetwater Marsh and/or the South San Diego Bay Units.

The MSCP was developed cooperatively by affected local jurisdictions and special districts with the goal of conserving native vegetation communities and associated species, rather than focusing preservation efforts on one species at a time. Local jurisdictions and special districts are to implement their respective portions of the MSCP Plan through subarea plans, which describe specific implementing mechanisms for the MSCP. The subarea plans will contribute collectively to the conservation of vegetation communities and species in the MSCP study area. The

southeastern portion of the South San Diego Bay Unit is included within the City of San Diego's MSCP Subarea Plan (*City of San Diego 1997*), while the Sweetwater Marsh Unit is included within the City of Chula Vista MSCP Subarea Plan (*City of Chula Vista 2003*).

The Chula Vista MSCP Subarea Plan (*City of Chula Vista 2003*) includes the Sweetwater Marsh Unit within the area identified as Habitat Preserve and addresses the Refuge in several places, particularly in the discussion of covered species. Despite the inclusion of the Refuge within the Subarea Plan, the management and maintenance of Refuge property remains the responsibility of the Service. The Subarea Plan goes on to state that buffers outside the Refuge boundary, as well as lighting and water quality controls, will be required as part of the land use controls within the Chula Vista LCP to reduce the effects of adjacent development on sensitive Refuge habitats. The Framework Management Plan of Chula Vista's MSCP Subarea Plan includes a number of management directives that represent the management requirements of the Habitat Preserve. Particularly relevant are the adjacency management issues, which address illegal intrusions into the Preserve, the need to install barriers and/or signage in new communities to properly direct public access, and adjacency guidelines for all new development. These guidelines address drainage, lighting, noise, invasive plants, and the need for public outreach.

The City of San Diego MSCP Subarea Plan (*City of San Diego 1997*) includes the southeastern portion of the South San Diego Bay Unit within its MHPA. The MHPA delineates core biological resource areas and corridors targeted for conservation. The portion of the Refuge included within the MHPA is that portion of the salt works situated within the jurisdictional boundaries of the City of San Diego, as well as western end of the Otay River floodplain. The City of San Diego's Subarea Plan was prepared prior to establishment of the South San Diego Bay Unit; therefore, it is not entirely accurate with respect to the current status of these lands. It does, however, state that the sensitive species supported by the salt works should be protected. It further states that should the site no longer be used for solar salt production, then the new use should be compatible with the resource goals and objectives of the MHPA and other regulations/policies applicable to the site or that the site should be enhanced or restored.

The City of San Diego's MSCP Subarea Plan also includes management policies and directives for the Otay River Valley. The Plan's primary goal for this area is to maintain a fairly unrestricted floodplain containing natural riparian and wetland habitats. Specific directives for the Otay River mouth include restoring the salt ponds to baylands by breaching levees in several locations, if solar salt operations cease, and converting the disturbed agricultural lands west of I-5 either to sustainable agriculture or restoring them to native habitat to provide foraging areas for wildlife.

3.6.1.4 Aircraft Operations in the South Bay

The military maintains several helicopter and fixed wing air routes over San Diego Bay, which are used primarily, but not exclusively by military flights in and out of Naval Air Station, North Island (NASNI) and Navel Outlying Landing Field (NOLF), Imperial Beach. The current instrument approach (TACAN) used by fixed wing and rotary wing aircraft to Runway 29, NASNI, is from south to north, up the middle of the bay at an altitude of between 1,600 and 2,300 feet. Military aircraft also operate over the bay using visual flight rules (VFR) approach and departure corridors, which extend the entire length of the bay. Within this "bay approach" corridor, military aircraft operate at altitudes of between 500 and 800 feet. Departures from Runway 36, NASNI, travel from north to south, down the middle of the bay at an altitude of about 500 feet. These flights leave the airspace above the bay either to the southeast at about the location of the South Bay Power Plant or to southwest over the Naval Radio Receiving Facility (NRRF). A VFR helicopter route also extends northwest to southeast over Sweetwater Marsh Unit, entering the airspace above the bay just south of the National City Marine Terminal (*Rollins 1998*).

3.6.1.5 Military Operations in and Around San Diego Bay

Considered the center of the largest Naval Complex in the nation, San Diego, and in particular, San Diego Bay, supports important naval operations (*U.S. Navy 2002*). The three major naval bases in the vicinity of San Diego Bay include Naval Base San Diego, Naval Base Point Loma, and Naval Base Coronado (NBC) (Figure 3-23). There are four U.S. Navy land units within the NBC that are located on or near San Diego Bay; these include Naval Air Station North Island, Naval Amphibious Base Coronado (NAB Coronado) with its Silver Strand training beaches, Naval Radio Receiving Facility (NRRF), and Naval Outlying Landing Field Imperial Beach. The mission of the Navy at NBC is to equip, maintain, train, and support Naval surface and aviation units of the Pacific Fleet and other operating forces in order to conduct military operations in support of the Fleet's operational commanders (*U. S. Navy 2002*). The operations closest to the Refuge occur at NAB Coronado's bayside beach training areas and at NRRF. Basic, special, and expeditionary warfare training and operations are supported at NAB Coronado and NRRF is used primarily by the Naval Special Warfare community for clandestine training (*U. S. Navy 2002*). In August 2001, the Navy published a Notice of Intent to prepare an EIS for optimizing current and future operations, training, and maintenance at the beaches of NAB Coronado and the NRRF. The EIS is not yet available for public review; however, according to the NOI, the EIS will address the potential effects of integrating use of NAB and NRRF for current operations and for adding new types of operations at NAB and NRRF.

To ensure compliance with natural resource protection laws, the Navy has prepared Integrated Natural Resources Management Plans (INRMPs) for their operations in San Diego Bay and at NBC. The San Diego Bay Integrated Natural Resources Management Plan (*U.S. Navy 2000*) is a long-term strategy sponsored by the Navy and the Port to provide direction for the good stewardship of natural resources, while also supporting the ability of the Navy and Port to meet their missions and continue to function within the Bay. The plan serves as a planning tool, management guide, reference document, and policy strategy for the Navy and the Port. The Integrated Natural Resources Management Plan for Naval Base Coronado (*U.S. Navy 2002*) was prepared to provide Naval Base Coronado with a viable framework for managing natural resources on lands it owns or controls. These INRMPs are prepared to address operations for a period of five years.

3.6.2 Traffic Circulation/Parking

The Refuge can be accessed via local streets and regional transportation corridors. In addition, activities associated with the Refuge, such as wildlife observation and general refuge operations, would involve the need for some off- and/or on-street parking. Information regarding current and future traffic volumes and parking availability is provided to facilitate the evaluation of how changes in current uses and activities on the Refuge could affect traffic circulation and parking in the vicinity of the Refuge.

3.6.2.1 Traffic Circulation

Sweetwater Marsh Unit

The current vehicle trips generated as a result of refuge-related management and public use activities, as well as the Chula Vista Nature Center, are estimated at approximately 100 trips per day. This is based on an estimated 35,000 visitors per year to the Nature Center, of which approximately 5,000 are students who arrive via a school bus, and an estimate of the number of employee, volunteer, and service related trips that are generated by both the Nature Center and the Refuge. All of these trips are accommodated by a series of local streets within the cities of National City and Chula Vista, as well as I-5, which provides regional access. Table 3-19 provides the current street classifications,

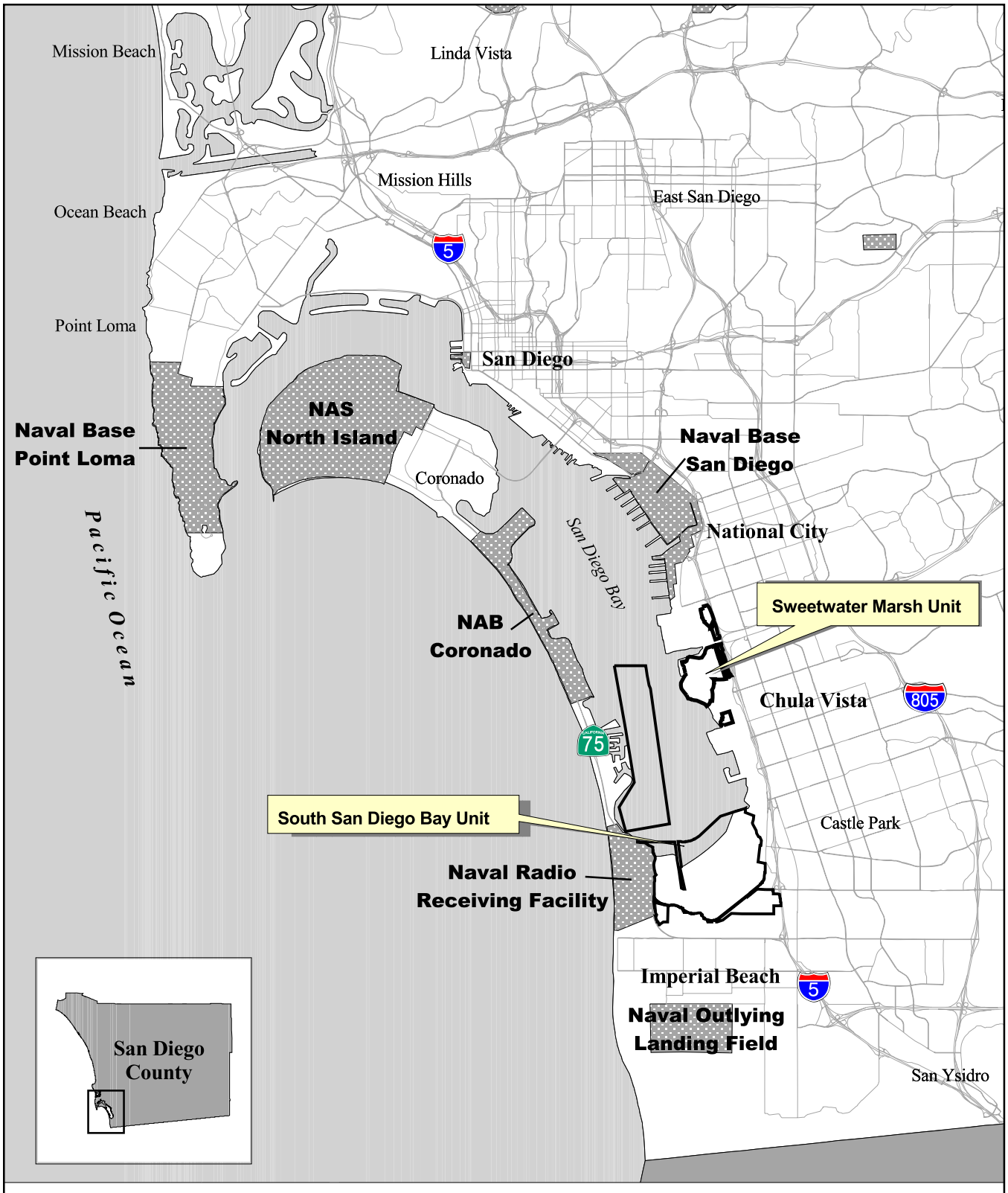

Figure 3-23
Navy Lands in Proximity to the San Diego Bay NWR

Source: California Spatial Information Library, SANDAG, Tele Atlas, USFWS

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design capacity at Level of Service (LOS) C, and current average daily traffic volumes (ADT) for those roadway segments that provide access to the Sweetwater Marsh Unit.

The term Level of Service is used to describe the operational conditions of a particular roadway segment or intersection. LOS is a qualitative measure that generally describes these conditions in terms of speed, travel time, freedom to maneuver, comfort and convenience, and safety (*Whitson 2000*). LOS A is typically described as free flowing; LOS B, free to stable flow with light to moderate volumes; LOS C, moderate volumes, freedom to maneuver noticeably restricted; LOS D, approaches unstable flow with heavy volumes and limited freedom to maneuver; LOS E, extremely unstable flow with maneuverability and psychological comfort extremely poor; and LOS F, heavy congestion with stop and go traffic and delays of greater than one minute per vehicle at signalized intersections.

Table 3-19
Existing Traffic Volumes and Street Capacities
in the Vicinity of the Sweetwater Marsh Unit

Street Segment	Classification	Capacity (thousands)	ADT[1] (thousands)
City of National City[2]			
24th Street (I-5 to Harrison Ave.)	2 Lane Collector w/ Dedicated Turn Lanes	20.0	10.0
Harrison Ave. (24th St. to 32nd St.)	2 Lane Collector	7.5	4.8
City of Chula Vista[3]			
E Street (Bay Blvd. to I-5)	4 Lane Major	30.0	14.5
E Street (I-5 to Woodlawn Ave.)	4 Lane Major	30.0	32.2
E Street (Woodlawn Ave. to Broadway)	4 Lane Major	30.0	23.6
Bay Blvd. (E St. to F St.)	2 Lane Class II Collector	12.0	6.5
Bay Blvd. (F St. to G St.)	2 Lane Class II Collector	12.0	2.8

[1]SANDAG (1996 – 2000) Average Daily Trip Volumes
[2]Source for Classifications and Capacity, City of National City (1998a)
[3] Chula Vista data provided by Michael Maston (pers. comm.) and David Kaplan (pers. comm.)

In San Diego, the region-wide goal for an acceptable LOS on all freeways, roadway segments, and intersections is "D;" however, local jurisdictions, as well as Caltrans, have slightly different LOS objectives. For example, the City of Chula Vista currently has an established threshold standard of LOS C at all intersections, except for two hours per day when LOS D is permitted (*City of Chula Vista 1993*).

Based on the design capacities and current traffic volumes for the various roadway segments in the vicinity of the Refuge, the portion of E Street just to the east of I-5 is currently operating at LOS D, while the remaining segments are operating at LOS C or better. According to the San Diego Association of Governments (SANDAG) 20/30 Regional Transportation Plan (*2002*), I-5 is currently operating at LOS F north of Highway 54 and LOS D south of Highway 54 during peak traffic hours. Available traffic volumes on various segments of this freeway include 196.9 ADT between 24th Street and Highway 54, 146.3 ADT between Highway 54 and E Street, and 171.6 ADT between E Street and H Street (*SANDAG 1996 – 2000*).

South San Diego Bay Unit

It is estimated that less than 100 vehicle trips per day are currently generated from activities related to this Refuge. These activities include Service employee visits for monitoring and maintenance, occasional tours of the salt works, occasional trucks delivering maintenance materials, and the activities associated with the current solar salt operation. The limited traffic generated by current Refuge management activities on the South San Diego Bay Unit is accommodated by a number of local streets within the cities of Chula Vista, San Diego, and Imperial Beach, as well as by I-5 and SR-75. Table 3-20 provides the street classification, design capacity, and current ADT for those roadway segments that provide access to the Refuge. The design capacity for the streets in the City of San Diego represent the capacity at LOS D, while the design capacity for the streets in the Cities of Chula Vista and Imperial Beach, as well as SR-75, represent the capacity at LOS C.

Table 3-20
Existing Traffic Volumes and Street Capacities
in the Vicinity of the South San Diego Bay Unit

Street Segment	Classification	Capacity (thousands)	ADT[1] (thousands)
City of Chula Vista[2]			
Bay Blvd./Frontage Rd. (Palomar to Anita)	2 Lane Class II Collector	12.0	2.2
Bay Blvd. (L St. to Palomar)	2 Lane Class II Collector	12.0	6.8
City of San Diego[3]			
Main St. (west of I-5)	2 Lane Collector	5	Not Available
Palm Ave. (I-5 to Saturn Blvd.)	6 Lane Prime Arterial	55	70.1
Palm Ave. (Saturn Blvd. to 13th St.)	6 Lane Major	45	51.3
Saturn Blvd. (Boundary to Palm Ave.)	4 Lane Major	35	22.1
Saturn Blvd. (Palm Ave. to Elm St.)	4 Lane Major	35	13.9
Imperial Beach			
Palm Ave. (13th to 9th)	6-Lane Prime Arterial	Not Available	37.2
Palm Ave. (9th to Delaware)	6-Lane Prime Arterial	Not Available	24.6
SR 75 (Delaware to 7th)	6-Lane Prime Arterial	Not Available	22.2
SR 75 (7th to Rainbow)	4-Lane Major	Not Available	18.5
13th Street (North of Palm Ave.)	3-Lane Collector	Not Available	5.2[4]
9th Street (Cypress to Palm Ave.)	2 and 3-Lane Collector	Not Available	5.0
7th Street (North of Palm Ave.)	2-Lane Collector	Not Available	Not Available
Cypress Avenue	2-Lane Residential	Not Available	Not Available
Coronado[4]			
SR 75 (Rainbow to Coronado Cays)	6-Lane Prime Arterial	28	20.7

[1]SANDAG (1996 – 2000) Average Daily Trip Volumes

[2] Source for Classification and Design Capacity, Michael Maston (pers. comm.)

[3] Source for Classification (City of San Diego 1997), for Design Capacity, Labib Qasem (pers. comm.)

[4]Source City of Imperial Beach, Public Works, Street Division, Traffic Count (11/02)

[5]SR 75 is maintained and managed by Caltrans, District 11

As stated previously, a San Diego region-wide goal of LOS D has been established for all freeways, roadway segments, and intersections. While the City of San Diego finds LOS D

to be acceptable, the currently adopted Circulation Elements for the cities of Chula Vista and Imperial Beach establish a higher standard. Imperial Beach's Circulation Element establishes a threshold standard of LOS C or better for arterial and local streets under average daily traffic volume conditions, while it is acceptable for signalized intersections under peak hour conditions to operate at LOS D or better. A lower standard is also acceptable for special events and seasonal beach related traffic (*Imperial Beach 1994*).

Access in and around the Refuge via local streets includes Palomar and Bay Boulevard in Chula Vista; Main Street, Palm Avenue, and Saturn Boulevard in San Diego; Palm Avenue, from 13th Street to Rainbow Drive, 13th Street, Florida Street, 9th Street, Delaware Street, 7th Street, and Cypress Avenue in Imperial Beach; and SR-75 in Coronado. Of these streets, Palm Avenue between I-5 and 13th Street in the City of San Diego, experiences average daily traffic volumes in excess of the street's carrying capacity at LOS D. All of the other streets, including the portion of Palm Avenue located within the City of Imperial Beach, are currently operating at LOS C or above.

It should be noted that the streets in Imperial Beach were constructed prior to the City of Imperial Beach's incorporation and as a result, the City of Imperial Beach has never developed its own design capacity figures for these streets. In order to evaluate the current level of service on the road segments surrounding the Refuge, the street classifications assigned to the streets in Imperial Beach by the Circulation Element of the General Plan (*Imperial Beach 1994*) were compared to similar street classifications in the adjoining jurisdictions. The design capacities at LOS C, as determined by Chula Vista and San Diego for similar street classifications, were then compared to the current traffic volumes on the road segments in Imperial Beach. Based on these comparisons, it appears that these roadway segments are currently operating at LOS C or above.

According to SANDAG's 20/30 Regional Transportation Plan (*2002*), I-5 operates at LOS D south of Highway 54 during peak traffic hours. Available traffic volumes on various segments of this freeway include 156.9 ADT between L Street and Palomar, 158 ADT between Palomar and Main Street and 154.5 ADT between Main Street and Palm Avenue (*SANDAG 1996 – 2000*).

3.6.2.2 Parking

Sweetwater Marsh Unit

Refuge visitors who wish to park in order to participate in wildlife dependent recreational uses in the vicinity of Sweetwater Marsh and Gunpowder Point currently use a parking lot located at the terminus of E Street, near the E Street/I-5 interchange. This parking lot, which is maintained by the City of Chula Vista for the Chula Vista Nature Center, consists of 50 marked parking spaces; however, if needed, the parking lot can be configured to accommodate 75 to 80 vehicles. The public is transported from the parking lot to the Nature Center via a transit bus. The property on which this parking lot is located is part of the Midbayfront development site. If this area is ultimately developed for urban uses, the parking lot would most likely be relocated to an area closer to the Refuge boundary. It is anticipated that a similar number of parking spaces would be provided within the new lot.

Parking is provided for Refuge employees and Service vehicles in a small, unpaved lot located across the primary access road to the east of the Refuge Office. Approximately 10 vehicles can be accommodated in this lot. Parking for an additional two to three vehicles is available immediately to the east of the Refuge office and another two or three vehicles can

be accommodated about 50 yards to the south of the Refuge office. Nine parking spaces located adjacent to the Nature Center are designated for Nature Center employees. Access for bus loading and unloading is also provided in front of the Nature Center to accommodate Nature Center visitors, as well as students participating in the various educational programs conducted by the Nature Center. No Refuge parking is provided in the vicinity of Paradise Marsh or the F&G Street Marsh; however, public parking is available nearby either on the street or in public parking lots.

South San Diego Bay Unit

Public parking in the vicinity of the South San Diego Bay Unit is currently available along limited portions of Bay Boulevard in Chula Vista, in a small parking lot at the northern terminus of 13th Street in Imperial Beach, and along several public streets in Imperial Beach. The parking lot on 13th Street includes 13 parking spaces and was created to accommodate users on the Bayshore Bikeway. On-street parking is permitted near the southern end of the bay in the City of Imperial Beach along 13th Street, on Cypress Avenue, on the south side of Boulevard between 12th Street and Florida Street, and on Cherry Avenue between 10th Street and 11th Street. Much of this on-street parking serves the surrounding single and multi-family residents in the area. The parking spaces along Cherry Avenue provide overflow parking for the adjacent Bayside Elementary School and the City of Imperial Beach Public Works Yard, although there are no signs posted in this area to control who uses the spaces. Public parking is also available at the South Bay Biological Area, which was recently renovated as part of the Silver Strand Improvement Project. This parking lot, which accommodates 22 vehicles, is available for public parking throughout the day except between the hours of 2 AM and 6 AM, when all parking is prohibited.

3.6.3 Public Utilities/Easements

3.6.3.1 Sweetwater Marsh Unit

The only public utilities present within the Sweetwater Marsh Unit are a 12 kilovolt (kV) electrical distribution line that extends onto the Refuge within an underground conduit and a potable water distribution line. Both of these utility lines provide services to the Nature Center and Refuge office. No gas or sewer lines are present on the Refuge. Sewage generated at the Nature Center and Refuge office is stored in holding tanks until the sewage is pumped into a transport truck and taken to an appropriate off-site treatment facility. Immediately to the east of the Refuge within a 150-foot-wide right-of-way is a major north/south electrical transmission corridor and an abandoned ten-inch fuel pipeline that once served the South Bay Power Plant.

3.6.3.2 South San Diego Bay Unit

The open waters of the South San Diego Bay Unit are not encumbered by public utilities. Of the upland areas included within the Refuge, the most significant number of public utilities occur within the Otay River floodplain. Some of these utilities occur within existing easements on Refuge property, while others are located within a dedicated, unimproved street, owned by the City of San Diego and located outside the current Refuge boundary (refer to Figure 3-19). There are six such dedicated, unimproved streets ("paper streets") within the Refuge's approved acquisition boundary. These include: 1) 60-foot-wide Saturn Boulevard (also referred to as 19th Street on some documents), which extends north/south through the Refuge; 2) a 40-foot-wide unnamed street, located to the west of Saturn Boulevard that extends north into the Refuge for a distance of approximately 670 feet from the southern Refuge boundary; 3) a 600-foot section of 25-foot-wide Louret Avenue, which extends east from Saturn Boulevard through the southern portion of the Refuge; 4) 60-foot-wide Charles Avenue, located north of Louret Avenue, extends east/west

for approximately 1,160 feet from the eastern boundary of the Refuge to Saturn Boulevard; 5) 30-foot-wide Marian Avenue is north of Charles Avenue and extends approximately 1,110 feet from the eastern Refuge boundary to Saturn Boulevard; and 6) 50-foot-wide Anita Avenue, which extends north/south through the Refuge between Louret Avenue and Marian Avenue for a distance of 560 feet. If these roads were to be vacated, ownership would revert to the adjacent property owner, which in this case is the Federal government.

Various public utilities are located within these unimproved, dedicated streets, including sewer and water lines, electric lines, and several high pressure gas lines. Included within 60-foot-wide Saturn Boulevard right-of-way are a 54-inch sewer interceptor line (the South Metro Interceptor), a 36-inch gravity sewer line, a 24-inch storm drain, an 8-inch and a 3-inch gas line, and an 8-inch water line. In addition, a combined 69 kv/128 kV electrical transmission line is included within this 60-foot-wide corridor. A 27-inch sewer line, owned and maintained by the Montgomery Sanitation District, extends from I-5 west in Louret Avenue then turns north on Anita Avenue, continuing north within an easement through Refuge property and on toward Main Street. The 36-inch gravity sewer line that extends north/south in Saturn Boulevard turns east at Louret Avenue then north in Anita Avenue. At Marian Avenue, the line enters a diversion structure then travels north as a 30-inch sewer line, paralleling the 27-inch line described above. A 4-inch gas line is also present in Louret Avenue from Saturn Boulevard to I-5. An 18-inch abandoned sewer line extends north through Refuge property from the Otay River pump station to the site of the old Palm City sewer pump station. Another 21-inch abandoned sewer line extends east from the old Palm City pump station through Refuge property to Saturn Boulevard.

Some of the utilities within the Saturn Boulevard right-of-way extend onto Refuge property via a recorded easement at a point just north of the Marian Street right-of-way. These include the 8-inch gas line, 69/138 kV electrical transmission lines, the 54-inch South Metro Interceptor sewer line and a 57-inch force sewer main, all of which extend northeast from Marian Street to Main Street. A trail easement that generally follows the alignment of the South Metro Interceptor also extends from the Saturn Boulevard right-of-way, through Refuge property toward Main Street.

Within the salt works, there are several overhead electrical distribution lines that provide power to the water pumps used in the solar salt operation. In addition, there is a 12 kV overhead electrical distribution line that extends along the western edge of Pond 10A, paralleling SR-75. This line continues north to Coronado. The City of Coronado proposes to underground the portion of this line that extends from Coronado's southern city limits to the Coronado Cays (*City of Coronado 2001*). This project would occur outside of the Refuge boundary along SR-75.

The City of Imperial Beach maintains five storm drain outlets that affect the waters within the Refuge. These include a 36-inch reinforced concrete pipe that empties into the Otay River channel between 12th Street and Florence Street, a 10-inch pipe that empties into the Otay River between 11th Street and Florida Street, a 48-inch reinforced concrete pipe that empties into the Otay River just north of the Bay Shore Elementary School, and a 24-inch reinforced concrete pipe that empties into Pond 10A after crossing under SR-75 from 5th Street. There is also a small discharge pipe that empties into Pond 10A from 7th Street, between Boulevard Avenue and Basswood Avenue.

3.6.4 Recreation

According to the San Diego Convention and Visitors Bureau, it is estimated the San Diego region registered 26.4 million visitors in 2002. Unfortunately, no specific data is available regarding the number of tourists and residents who visit the attractions and open space areas around San Diego

Bay each year. San Diego Bay represents one of many established tourist destinations in the San Diego region. In addition to over 250 acres of open space, the bay also provides 27 miles of waterfront, 10 miles of pathways that front the bay, 22 marinas, three museums and a nature center, numerous restaurants and hotels, and a variety of unique shopping experiences. In the southern end of the bay there are opportunities to participate in a variety of recreational activities, including boating, fishing, wildlife observation, biking, hiking, and some forms of organized sports. Prior to the urbanization of this area, duck and waterbird hunting also occurred here. Each of these activities is described in greater detail in the text that follows.

3.6.4.1 Boating

Sweetwater Marsh Unit

Within the Sweetwater Marsh Unit, open water is limited to the channels that meander through the marsh habitat. These waters are currently closed to boating.

South San Diego Bay Unit

San Diego Bay, which accommodates a wide range of year-round boating activities, supports U.S. Navy ships and small boat activity, commercial ship traffic, and various forms of recreational boating. Studies conducted to characterize the boat traffic patterns in the bay demonstrate that most of the Bay's boating activity takes place to the north of the Sweetwater Flood Control Channel (*U.S. Navy 2000*). This is due in large part to the shallow water depths in the South Bay. Artificial deep water channels have been constructed along the east and west sides of the bay to facilitate the passage of larger boats into and out of the Chula Vista Marina and the Coronado Cays. These channels are located outside of the approved acquisition boundary for the South San Diego Bay Unit.

Most boat activity that occurs within Refuge waters is associated with sightseeing, wildlife viewing, exercising, fishing, and general recreating. The shallow water depths, which range from 1 foot to 6 feet at low tide, limit the type of boats used in this area to motorized and non-motorized shallow draft vessels, such as rowboats, powerboats, canoes, kayaks, sail boards and personal water craft. Windsurfing and parasailing also occur within this area. No boat inventories for this area are available to depict actual usage by season or day of the week. FWS biologists did however noted boat usage in the South Bay during the 1993 to 1994 weekly bird inventory (*USFWS 1995*) and during the human disturbance study conducted by Huffman (*1999*). The data provided during these studies indicated that the majority of the boats observed within the South Bay were motorized boats, followed by sailboats, personal watercraft, and sailboards.

Although no boat ramps are provided within the Refuge, there are several public and private boat ramps and marinas just beyond the Refuge boundaries (Figure 3-24). Public boat ramps are available in Chula Vista at Bayfront Park, near the Chula Vista Marina, and in National City at Pepper Park. Marinas located in proximity to the Refuge include the Chula Vista Marina with 552 slips, the Loew's Crown Isle Marina with 80 slips, and two marinas in the Coronado Cays that together provide 756 slips. Another marina is under construction in National City to the east of Pepper Park. Boat rentals including paddle boats, sailboats, and personal water craft are available at the Loew's Crown Isle Marina and water skiing occurs in the bay just off the marina.

Boating speeds in the South Bay are regulated by the Port. Section 4.30(c)3 of the Port Code states "It shall be unlawful for any vessel to be operated at a speed in excess of Five (5) Miles Per Hour in South San Diego Bay as defined in Sec. 4.30(b)1 of this Code, except

Figure 3-24
Fishing and Boating Facilities in the South Bay

Boat launch Fishing pier Marina

N

0 0.5 1 Miles

Source: USFWS, USGS (1 m imagery, year 2002)

Carlsbad Field Office - 2003
/stem/stacey/ssdbay/fig_4-03/figures.apr

while transiting the Chula Vista Harbor Channel seaward of daymarks 11 and 12. Vessels must maintain a reasonable and prudent speed pursuant to Section 4.04 of this Code."

The waters in San Diego Bay are considered United States Navigable Waters; therefore, any future proposals that would limit the public's right to free access of these waters would require Federal and/or State rulemaking prior to implementation.

3.6.4.2 Fishing

Sweetwater Marsh Unit

Fishing is not permitted within the Sweetwater Marsh Unit, although significant fishing opportunities are available immediately adjacent to the Refuge in San Diego, as described in detail below.

South San Diego Bay Unit

According to the Port, San Diego Bay supports approximately 35,000 to 40,000 recreational angler days per year. Much of this fishing is from boats and using the catch-and-release method (*U.S. Navy 2000*), although fishing is also popular from the various fishing piers around the bay. The closest fishing piers to the Refuge are located at Pepper Park in National City and Bayside Park in Chula Vista (refer to Figure 3-24). Refuge staff has also documented unauthorized fishing in Pond 11. According to a survey conducted by the County in 1990 (*San Diego County Department of Health Services 1990*), 74 percent of the fish caught in the bay was represented by four species: Pacific mackerel, California lizardfish, barred sand bass, and spotted sand bass. In addition, some anglers fish for finfish and shellfish species not eaten by other anglers (*U.S. Navy 2000*). A study conducted by the Environmental Health Coalition (*2005*) to look at fish consumption patterns in San Diego Bay found that 58 percent of the fishers contacted during the survey fished in the bay at least once a week and 25% fished in the bay daily. A high percentage of those participating in subsistence fishing in the bay are believed to consume the entire fish, rather than eating only the muscle.

One commercial fishing boat that targeted striped mullet operated in the bay from 1979 to 1995; however, no commercial fishing operations are active in the bay today (*M. Fluharty pers. comm.*), with the possible exception of the collection of bait fish. Possible reasons for the lack of commercial fishing include health concerns related to water pollution in the bay, reduced fish populations, and economic pressures.

The evaluation of the potential health risk to humans from fish caught and consumed in San Diego Bay that was conducted by the County in 1990 (*San Diego County Department of Health Services 1990*) identified potential health risks to unborn or young children through the consumption of mercury-contaminated fish by pregnant and/or breast-feeding women and also from direct consumption of contaminated fish by young children (up to ten years of age). Adult consumers who eat more than 165 grams per day of such fish, especially barred and spotted sand bass, could also be at risk. The levels of PCBs found in fish analyzed in San Diego Bay were also considered a potential risk to human health at consumption levels at or above 165 grams per day. Based on these results, the San Diego County Health Officer posted health advisories at seven locations around the bay including the major public fishing piers to inform the public about the potential health risks associated with the consumption of fish from San Diego Bay. Although many of these signs are no longer in place, the risks remain the same. The County is currently working with the Port and others to install new signs at appropriate locations. The Environmental

Health Coalition and others are also continuing to evaluate the potential risks of current fish contamination levels in the bay to those individuals who consume fish at above average consumption levels, eat the whole fish rather than just the muscle, and/or eat the fish raw rather than cooked.

The State of California has not published any specific fish consumption advisories for San Diego Bay, primarily because the specific studies necessary to establish these advisories have not be conducted for the Bay and because the State's Office of Environmental Health Hazard Assessment (OEHHA) already provides general advice on how to reduce your exposure to chemicals in sport fish. This advice addresses fishing practices, such as consuming fish caught at a variety of locations, as well as consumption guidelines that suggest consuming smaller amounts of a variety of fish species, eating smaller fish of a particular species, eating only fillet portions, and avoiding the consumption of raw sport fish (*State of California 2002*).

Some shellfish, particularly mussels, may contain natural toxins that cause paralytic shellfish poisoning (PSP) or other serious illness, and even death. Because these toxins are not destroyed during cooking, shellfish quarantines may be issued by OEHHA. Throughout California, mussels are quarantined from May 1 through October 30, and local quarantines may be posted for other bivalves if monitoring indicates a potential health risk. The State maintains a 24-hour PSP information line in an attempt to keep the public informed of such quarantines (*State of California 2002*).

3.6.4.3 Wildlife Observation and Photography

Sweetwater Marsh Unit

Opportunities for wildlife observation and photography on the Sweetwater Marsh Unit are currently provided from Gunpowder Point. Existing observation points include an elevated observation platform at the Chula Vista Nature Center, which provides impressive views of the surrounding salt marsh habitat that extends to the east and north of Gunpowder Point, and a bird blind located at the edge of the bay that provides observation opportunities of the various shorebirds and waterbirds supported by the mudflats bordering the southern edge of Gunpowder Point. Additional opportunities for observing and photographing wildlife are also provided along portions of the existing trail system on Gunpowder Point. Although opportunities for wildlife observation on the Refuge are limited Gunpowder Point, wildlife activity within Paradise Marsh and the F&G Street Marsh can be observed from the public right-of-way that abuts these areas.

South San Diego Bay Unit

Within the South San Diego Bay Unit, opportunities for observing and photographing wildlife are available via boats traveling on the bay, from areas adjacent to the Refuge, such as the Bayshore Bikeway and the County's Biological Study Area, and during occasional guided nature tours of the salt works. Bird and sea turtle watching from kayaks and canoes is particularly popular in the South Bay. The Bayshore Bikeway extends for about ten miles from 13th Street in Imperial Beach to Coronado and provides a variety of observation points where Refuge wildlife can be observed. With financial assistance from a Transportation Enhancement Act for the 21st Century (TEA-21) grant, the City of Coronado and the County of San Diego recently installed an observation deck within the South Bay Biological Study Area (*City of Coronado, 2001*). The deck is located just to the north of Pond 11 and provides the public with the opportunity to observe the wildlife within the Refuge's salt pond system and adjacent mudflats.

3.6.4.4 Environmental Education and Interpretation

Sweetwater Marsh Unit

A number of environmental education programs are currently conducted on the Sweetwater Marsh Unit. These programs are conducted in partnerships with the Chula Vista Nature Center, National City, several school districts, and various nonprofit organizations. One program, implemented by the Chula Vista Elementary School District, focuses on a science and social studies curriculum. The program serves some 12,000 kindergarten through 12th grade students annually. The Refuge, specifically Gunpowder Point, provides the outdoor classroom for this program where students study topics such as the tides, water quality, native vegetation, and birds.

Another program, created by the San Diego Zoological Society, Chula Vista Nature Center, and the San Diego NWR Complex through a grant to the Zoo's Habitat Conservation Education Department, is Sweetwater Safari. This program, which meets the State of California's science standards for fourth grade, was created for students to learn about science and the local environment through a hands-on experience. The program includes on-site or on-refuge curriculum and a post-visit curriculum that is conducted in the classroom. The on-site curriculum is taught by the teachers. To lead the self-guided on-site program, which takes place on Gunpowder Point, the teacher must first participate in a training session conducted by Refuge staff, Chula Vista Nature Center staff, and other volunteer teachers. These training sessions, which are provided free of charge, are conducted quarterly at the Chula Vista Nature Center. Once a teacher has completed this training, he or she can arrange a time with the Nature Center to guide his/her class through the program. Equipped with backpacks containing relevant educational materials, the class travels along the 0.5 mile trail system on Gunpowder Point gathering information regarding the many resources supported by the Refuge. The Refuge trails are flat, wide and wheelchair accessible. Transportation grants to bring student onto the refuge are available for this program.

Another program supported by the Refuge is conducted by Kimball Elementary School in National City. This program, which generally occurs just upstream of the Refuge, presents a science and mathematics-based curriculum focused on the protection of watersheds, the function of wetland systems, and water quality testing.

The Refuge also partners with the Chula Vista Nature Center, San Diego Zoo, Kimball Elementary, Paradise Creek Educational Park, Aquatic Adventures, and others to facilitate occasional field trips to the Refuge to support the organizations' desire to introduce students to the biological and cultural resources of the region. The majority of these programs incorporate language arts, math, and social sciences into their curriculum in accordance with California State Education Standards.

Environmental education programs are conducted on the Refuge once or twice a week throughout the year, with field trip opportunities open to only one classroom of approximately 32 students per day. Participants are generally transported to the site by bus or van. In some cases, the students use the existing shuttle bus system operated by the City of Chula Vista.

Opportunities for environmental interpretation on the Sweetwater Marsh Unit are currently available through a series of interpretive panels installed along an existing half-

mile trail system located on Gunpowder Point. The Refuge also benefits from the interpretation provided at the Chula Vista Nature Center. The Center includes a variety of indoor and outdoor interpretive elements that present information about the wildlife and habitats that occur in the vicinity of the Refuge. Of particularly interest are the exhibits related to the bay's marine life and a walk-in aviary that includes various shorebirds commonly found in the area. Light-footed clapper rails are also available for viewing. The Nature Center also conducts weekly docent-lead nature hikes along the trail system on Gunpowder Point. Approximately 35,000 people visited the Nature Center during 2003.

Other interpretation in the South Bay is provided by the Port, the County of San Diego, and the City of Coronado. Much of this interpretation occurs adjacent to the bay along the Bayshore Bikeway.

South San Diego Bay Unit

The South San Diego Bay Unit provides the site for the Habitat Heroes environmental education program. This program provides second graders through community college students with the opportunity to participate in an education program that focuses on two significant threats to coastal wetland habitat quality: invasive plant species and storm water pollution. The program incorporates the use of GIS technology, cross-age student mentoring, and habitat-based investigations with traditional and internet-based instruction. The outdoor components of this program are conducted on the upland areas along the southern boundary of the Refuge Unit. The work completed under the Habitat Heroes program is included on a national web site, "Hands on the Land," which is sponsored by several federal agencies including the Service.

No formal environmental interpretation program is currently implemented on this Refuge Unit.

3.6.4.5 Bicycle Facilities

The primary bicycle facility in the South Bay is the Bayshore Bikeway, a 26-mile bicycle facility being constructed around San Diego Bay. When completed, this bikeway will consist of combination of bicycle paths, lanes and routes providing convenient and scenic bicycle transportation around the bay. In the vicinity of the Sweetwater Marsh Unit, a segment of the Bayshore Bikeway was recently completed that provides off-road bicycle access from National City, near Pepper Park, to E Street in Chula Vista, skirting around the eastern edge of the Refuge. To the south, in the vicinity of the South San Diego Bay Unit, the off-road portion of the Bayshore Bikeway currently extends west from 13th Street in Imperial Beach, around the south end of the Bay and up the Silver Strand to Coronado. This segment of the bikeway provides spectacular views of the salt ponds and the southern end of the bay. Construction plans are currently being processed that, if approved, would enable the bike path to be extended eastward from 13th Street to Main Street. This segment of the bike path would be constructed between the salt ponds and the Otay River channel within the old Coronado Branch of the San Diego & Arizona Eastern railroad right of way. The proposed route is not included within the approved acquisition boundary for the South San Diego Bay Unit.

Another bike path, maintained by the City of San Diego, traverses north/south through the Otay River floodplain, primarily within the right-of-way of Saturn Boulevard (an unimproved street right-of-way owned in fee title by the City of San Diego). This bike path provides access from Main Street to Palm Avenue.

3.6.4.6 Hiking/Interpretive Trails

The only official walking trails currently in place on the San Diego Bay NWR are located on the Sweetwater Marsh Unit. The half mile of trails on Gunpowder Point provide access from the Nature Center to the edge of the bay for interpretation, environmental education, and wildlife observation. Trails are only open during Nature Center hours, which are generally 10 AM to 5PM Tuesday through Sunday.

Trail planning is currently underway for the Otay Valley Regional Park (OVRP). The goal is to provide trail access along the entire length of the OVRP, which extends from the bay to the Otay Lakes Reservoirs. The boundaries of the western most segment of the OVRP overlap with the current boundary of the South San Diego Bay Unit. The trail proposal for this area, as described in the Otay Valley Regional Park Trail Guidelines (*County of San Diego 2003*), is to extend a regional trail linkage under I-5 to connect with the existing bike path in Saturn Boulevard, ultimately providing a connection to the Bayshore Bikeway. Additional trails are being considered for inclusion in the Chula Vista Bayfront Redevelopment Plan. The current vision is to provide a connecting system of trails that will provide the public with access to and along the eastern edge of San Diego Bay.

3.6.4.7 Developed Park Land

A number of active parks have been developed in the vicinity of the Refuge, including Chula Vista Bayfront Park at the foot of Marina Way, Chula Vista Bayside Park at the end of Bayside Parkway, Chula Vista Marina View Park on Marina Park Way at Marina Way, Coronado Grand Caribe Shoreline Park, and Pepper Park in National City. Silver Strand State Beach is located to the northwest of the South San Diego Bay Unit.

3.6.4.8 Hunting

Hunting is not currently permitted on the San Diego Bay NWR, and there are no other opportunities for hunting in the immediate vicinity. Within the San Diego County region, waterfowl hunting is currently offered seasonally at Barrett Lake and Lake Sutherland, both operated by the City of San Diego. Waterfowl hunting has also historically been available at Lake Cuyamaca. Opportunities for upland game hunting are available within the California Department of Fish and Game's San Felipe Valley Wildlife Area and Boden Canyon Ecological Reserve, as well as within portions of the Cleveland National Forest.

3.6.5 Vectors and Odors

3.6.5.1 Vectors

Sweetwater Marsh Unit

A vector is any insect or other arthropod, rodent, or other animal of public health significance capable of causing human discomfort, injury, or capable of harboring or transmitting the causative agents of human disease. The vector of most interest within the Refuge is the mosquito. Twelve mosquito borne viruses are currently known to occur in California; including western equine encephalomyelitis virus, St. Louis encephalitis virus, and West Nile virus

The County of San Diego, Department of Environmental Health, Vector Surveillance and Control Program is responsible for the monitoring and control of vectors, and in particular mosquitoes, in all of San Diego County. The mosquito surveillance traps located closest to the San Diego Bay NWR are maintained near Hollister Street where it crosses the Otay River. Based on trapping results provided by the County of San Diego for these traps during 2003 (*Chris Conlon, pers. comm. December 16, 2003*), the following species of

mosquitoes could occur on the Sweetwater Marsh and/or South San Diego Bay Unit when conditions are appropriate to support them:

- *Culex tarsalis* – This species is the most competent vector mosquito in San Diego County and is quite common in the Otay traps. It is most active in the spring, winter, and fall.

- *Culex erythrothorax* – This species, which is the most common mosquito species in San Diego County, is very common in the Otay traps. It is typically considered a nuisance, but has also been observed to vector disease.

- *Culex pipiens/quinquefasciatus* – A fairly competent disease vector, this species is only detected in measurable numbers when stagnant water is present in the area.

- *Anopheles hermsi* – This species of mosquito is very common in the Otay traps. Where malaria exists, this species is known as a very competent vector of the disease.

- *Ochlerotatus increpitus* – This species, which breeds in many fresh water situations, can also be commonly found in the Otay traps. An annoying day biter, this species represents more of a nuisance than a disease vector.

- *Ochlerotatus taeniorhynchus* – This species, which is common in salt marsh habitat, is typically present between May and October. It is not considered a significant vector, but can be a day biting nuisance.

- *Ochlerotatus sierrensis* – This species, which breeds in tree holes and bites during the day, is often found in the traps in very small numbers. This mosquito is known to transmit heartworm to dogs.

- *Culiseta inornata* – This species, which breeds in fresh or brackish water, is not common in the Otay traps, but when it is present, it usually occurs in small numbers during the cooler months. This mosquito is also considered a nuisance and is not an important disease vector.

- *Culiseta incidens* – Regularly found in the Otay traps in small to moderate numbers, this species is not considered to be a disease vector, but can be a biting nuisance. It can breed in fresh or brackish water.

- *Culiseta particeps* – Also regularly found in the Otay traps in small to moderate numbers, this species breeds primarily in freshwater and is generally considered a biting nuisance, rather than a disease vector.

- *Ochlerotatus squamiger* – This species generally occurs in intertidal marshes of the California coast, where the female lays eggs in puddles in the extreme high tide zone. When present, it is most common in February and March. This species was not observed in the traps in 2003; however, it has occurred in the South Bay region in the past.

It is not known at this time which, if any, of these species are vectors of the West Nile virus; however, the California Department of Health Service considers *Culex tarsalis* a potential vector of this disease in California.

Within the Refuge, the existing salt marshes and freshwater wetland areas on the Sweetwater Marsh Unit represent potential breeding habitat for one or more of the mosquito species described above. On the South San Diego Bay Unit, potential breeding habitat include the Otay River and Nestor Creek areas and the shallow salt water areas that occasionally form along the edges of the lower reaches of the Otay River.

Although not considered a vector, the hypersaline ponds within the salt works generate substantial populations of brine flies. These flies appear to confine their activities to the boundaries of the Refuge.

South San Diego Bay Unit

The mosquito species described above could also be present on the South San Diego Bay Unit, which is located downstream of the County's traps near Hollister Street. Potential breeding grounds for mosquitoes on this Refuge include stagnant water areas along the Otay River channel and Nestor Creek and puddles of water resulting from high tides and rainfall in the vicinity of Ponds 10 and 10A.

Although not considered a vector, the salt works does generate substantial populations of brine flies. These flies occur in many of the salt ponds within the Refuge and appear to confine their activities to the boundaries of the salt works.

3.6.5.2 Odors

Sweetwater Marsh Unit

The generation of unpleasant odors can occur in coastal wetlands as a result of dissolved oxygen depletion and/or algal die-offs. Although odors have been a historic problem in some San Diego County coastal wetland areas, no strong odors have been reported from the Sweetwater Marsh complex.

South San Diego Bay Unit

The areas within the South San Diego Bay Unit that are most prone to generating strong odors include Ponds 10A, 20, and 22. These odors are produced when a combination of shallow water depths, good light attenuation, warm water temperature, and increased nutrient concentrations result in abundant algal growth and low dissolved oxygen levels.

3.6.6 Economics/Employment

San Diego has a diverse economic base that includes a strong government sector (due in part to the presence of U.S. Navy and Marines installations throughout the area) and active tourism-related industries. The service industry, which includes both personal and business services, employs the largest percentage of people in the region. The population, area, and leading industry of each community are presented in Table 3-21.

A socioeconomic study was conducted in 1994 for the Service to assess the potential impacts, both adverse and beneficial, of implementing habitat protection for the southern portion of San Diego Bay (*Niehaus, Inc. 1994*). This study and its findings are incorporated by reference into this document. An important component of this study was the determination of baseline levels of socioeconomic activity in the study area, including both the current and potential future activity levels. The socioeconomic variables that were analyzed included land uses in the area; economic activity; recreation and tourism activities; local public finance issues; and nonmarket socioeconomic issues. The study characterized existing and projected socioeconomic conditions in the greater San Diego area, as well as in San Diego Bay and South San Diego Bay. It considered the most recent

Table 3-21
Population, Areas, and Leading Industries by South Bay Community[1]

Jurisdiction	Population 2000	Change in Population 1990 to 2000	Area (in acres)	Leading Industries[2]
County of San Diego	2,813,833	+315,817	2.7 million	Education, Health, and Social Services, Professional Services
City of Imperial Beach	26,992	+480	2,838	Education, Health, and Social Services, Visitor Services
City of Coronado	24,100	-2,440	9,112	Armed Forces, Education, Health, and Social Services
National City	54,260	+11	5,916	Education, Health, and Social Services, Visitor Services, Manufacturing
City of Chula Vista	173,556	+38,393	33,024	Education, Health, and Social Services, Retail
City of San Diego	1,223,400	+112,851	219,250	Education, Health, and Social Services, Professional Services

[1]Source: U.S. Census, SANDAG, October 2002
[2]Source: U.S. Bureau of the Census, Census 2000

period data available in 1994 and then projected the socioeconomic conditions for these areas through the year 2015.

The commercial solar salt operation that occurs within the South San Diego Bay Unit currently employs between 20 and 25 individuals and generates approximately $300,000 in local and state sales tax. No revenues from this operation are provided to the Service, but the Airport Authority, which owns the processing plant, does collect a lease payment plus a royalty for every ton of salt purchased from this operation. The current operation produces between 60,000 and 80,000 tons of salt per year; however, the operation will be reduced by 10 to 20 percent following the elimination of the Fenton ponds from the system.

3.6.7 Environmental Justice

The goal of environmental justice in the United States is to afford the same degree of protection from environmental and health hazards to all individuals and communities throughout the nation. Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies. To achieve meaningful involvement requires that all potentially affected individuals have an appropriate opportunity to participate in decisions about proposed activities that could affect their environment and/or health and that the concerns of all participants are considered in the decision making process.

Historically, low-income and minority communities have suffered disproportionately from exposure to unhealthy environmental conditions, due in large part to the tendency to place facilities and infrastructure that pose a risk to human health in proximity to these communities. In 1994, in response to increased public concern and awareness about such inequities, Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) was issued. This Executive Order requires each Federal agency to make achieving environmental justice part of its mission by identifying and addressing disproportionately high and adverse human health or environmental effects of its program, policies, and activities on minority and low-income populations. To ensure compliance with this Executive Order, the Service established Environmental Justice Teams responsible for functions, such as ensuring day-to-day implementation of the environmental justice provision of NEPA. The role of these teams is to establish active liaisons with local community groups and Tribal leaders to create an ongoing dialogue about environmental justice and ensure that impacted communities and Tribal leaders are consulted on all new and proposed actions of the Service.

To understand the current proposal's potential effect as is relates to environmental justice, the following information is presented regarding the economic and ethnic composite of the communities that surround the San Diego Bay NWR.

The U.S. Department of Housing and Urban Development (HUD) defines low income as 80 percent of the median family income for the area, subject to adjustment for areas with unusually high or low incomes or housing costs. According to the 2000 Census, the median household income in 1999 dollars was $44,861 in the City of Chula Vista, $66,544 in the City of Coronado, $35,882 in the City of Imperial Beach, $29,826 in National City, and $44,124 in the Otay Mesa Nestor Community of the City of San Diego (*SANDAG 2002*). This compares with an estimated countywide median household income of $47,067. An income of $37,650 would represent 80 percent of the median family income for the region; therefore, based on the figures available, several of the communities that surround the Refuges would meet the definition of low income.

The ethnic composite of the areas that surround the San Diego Bay NWR are presented in Table 3-22. For purposes of comparison, the percentage of minorities in the communities surrounding the Refuge is higher than the San Diego Region as a whole.

Table 3-22
Ethnic Composite of the Cities in the Vicinity of the Refuge[1]

Ethnic Group	Coronado	Chula Vista	Imperial Beach	National City	Otay Mesa Nestor (San Diego)[2]	San Diego Region
American Indian	5%	< 1%	< 1%	< 1%	1%	< 1%
Asian	< 1%	11%	6%	18%	15%	9%
Black	4%	4%	5%	5%	7%	5%
Hawaiian & Pacific Islander	< 1%	< 1%	< 1%	< 1%	1%	< 1%
Hispanic	10%	50%	40%	59%	51%	27%
White	79%	32%	43%	14%	20%	55%
Other	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
2 or More Races	2%	3%	4%	2%	5%	3%

[1]Source: SANDAG 2002 (except as noted for Otay Mesa Nestor)
[2]Source: U.S. Census Bureau 2002