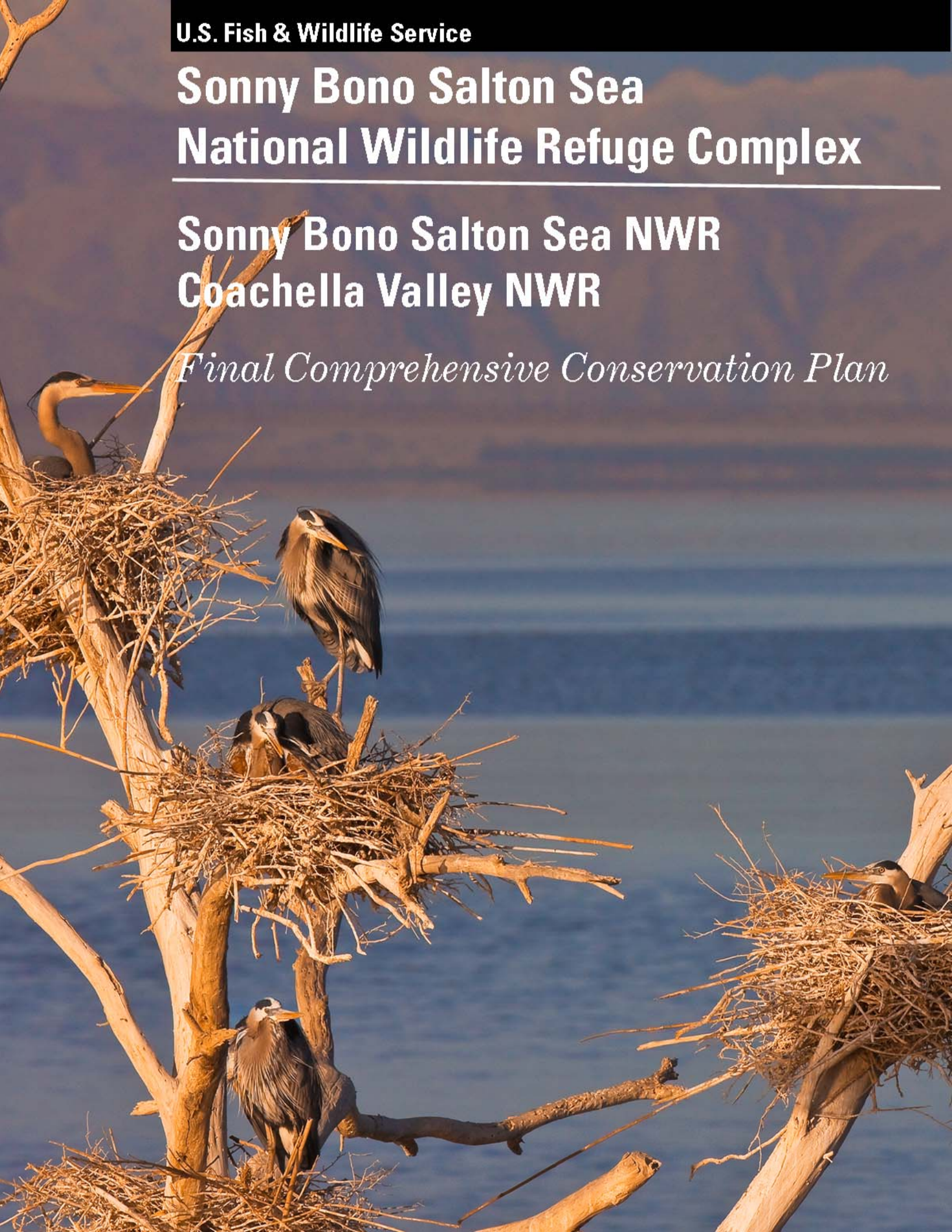
U.S. Fish & Wildlife Service

Sonny Bono Salton Sea National Wildlife Refuge Complex

Sonny Bono Salton Sea NWR
Coachella Valley NWR

Final Comprehensive Conservation Plan



Comprehensive Conservation Plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Sonny Bono Salton Sea National Wildlife Refuge Complex

(Sonny Bono Salton Sea National Wildlife Refuge & Coachella Valley National Wildlife Refuge)

Final Comprehensive Conservation Plan

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Approved: _____ Date: March 6, 2014
Regional Director, Pacific Southwest Region

Implementation of this Comprehensive Conservation Plan and alternative management actions/programs have been assessed consistent with the requirements of the National Environmental Policy Act (42 USC 4321 et. seq.).

U.S. Fish & Wildlife Service

Sonny Bono Salton Sea National Wildlife Refuge Complex

Sonny Bono Salton Sea National Wildlife Refuge and Coachella Valley National Wildlife Refuge

Final Comprehensive Conservation Plan
March 2014

Sonny Bono Salton Sea National Wildlife Refuge Vision Statement

Often described as one of the most important bird areas in the North America, the Salton Sea has been a vital stopover and wintering spot for migratory birds for about a century. Located within the southern end of the Sea, the Sonny Bono Salton Sea NWR continues to play an important role in the monitoring and management of the abundance of birds that annually visit the Sea and adjacent habitats. The predicted changes to the Salton Sea including decreasing water elevations and increasing salinity levels will necessarily influence how management on the Refuge proceeds into the future. In partnership with other agencies and organizations, the Refuge will manage existing and new habitat areas to compensate for the losses in foraging opportunities within the Sea.

Managed fields of lush, green forage will continue to entice wintering snow and Ross's geese to congregate on Refuge lands rather than adjacent commercial agricultural fields, with the Refuge's wintering population of sandhill cranes also taking advantage of these resources. Managed open water and shallow seasonal wetlands within and adjacent to the historical footprint of the Sea will provide a range of foraging and loafing habitats for a diverse array of migratory seabirds, shorebirds, waterfowl, and other waterbirds. The continued management of cattail marshes will aid in the recovery of the endangered Yuma Ridgway's rail, while also providing essential habitat for other secretive marshbirds of concern. Tree rows, restored riparian corridors, and native upland areas will provide breeding and foraging habitat for resident birds and wildlife, as well as migratory songbirds.

Public involvement in and appreciation for ongoing efforts to provide essential habitats for migratory birds, as well as the Refuge's resident birds and wildlife, will be fostered through continued opportunities for wildlife-oriented recreation, environmental education, and interpretation.

Coachella Valley National Wildlife Refuge Vision Statement

Management and enhancement of the Refuge's native habitat areas will aid in the recovery of the federally endangered Coachella Valley milk-vetch and threatened Coachella Valley fringe-toed lizard and benefit core habitat areas for the Coachella Valley giant sand-treader cricket, flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse. The Coachella Valley NWR, as a partner in a larger effort to conserve the native habitats and listed and sensitive species within the Coachella Valley, will continue to actively participate in the management and monitoring efforts outlined in the Coachella Valley Multiple Species Habitat Conservation Plan and will encourage research on the Refuge that supports Refuge purposes and the goals of the larger conservation planning effort. Support for the protection of the Refuge's unique resources will be achieved through environmental education and a public outreach program that includes permanent off-site and traveling interpretive displays.

U. S. Fish and Wildlife Service
Pacific Southwest Region
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March 2014

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1. Introduction

1.1 Introduction and Background

The Sonny Bono Salton Sea National Wildlife Refuge Complex (Complex or NWRC) consists of the Sonny Bono Salton Sea National Wildlife Refuge (NWR) and Coachella Valley NWR. Although both Refuges are located within the 8,000-square-mile Salton Basin of the Colorado Desert (Figure 1-1), the purposes of these two Refuges are as different as the habitats and species they protect.

Thousands of shorebirds, seabirds, and waterfowl stop-over or winter at the Salton Sea (Mark Stewart/USFWS)

The Sonny Bono Salton Sea NWR, which consists of 37,660 acres, is situated at the south end of the Salton Sea, about 20 miles north of El Centro in Imperial County, California (Figure 1-2). The purpose of this Refuge is to protect and manage habitat to support migratory birds, particularly waterfowl, and other wildlife.

About 75 miles to the northwest is the 3,577-acre Coachella Valley NWR, located 10 miles east of Palm Springs in Riverside County, California (Figure 1-3). The purpose of this Refuge is to protect and contribute to the long-term survival of the federally threatened Coachella Valley fringe-toed lizard (*Uma inornata*) and federally endangered Coachella Valley milk-vetch (*Astragalus lentiginosus* var. *coachellae*), both endemic to the active sand habitats in the Coachella Valley.

Active sand dune habitat in the Coachella Valley supports a variety of listed and sensitive species (USFWS)

The U.S. Fish and Wildlife Service (Service) prepared this Comprehensive Conservation Plan (CCP) for the Sonny Bono Salton Sea NWR and Coachella Valley NWR to guide the management of these Refuges over the next 15 years. The CCP describes future Refuge conditions and provides long-range management direction for achieving the purposes for which each Refuge was established.

The CCP also addresses a range of Service legal mandates, policies, and goals, as described below. The National Environmental Policy Act (NEPA) of 1969 (P.L. 91-190, 42 U.S.C. 4321-43470), as amended, requires Federal agencies to consider the effects to the environment of all actions they take. In accordance with NEPA, a joint draft CCP/environmental assessment (EA) was prepared to analyze the potential effects to the environment of managing the Sonny Bono Salton Sea NWRC under several different management alternatives. The Environmental Assessment and FONSI are provided as Appendix F.

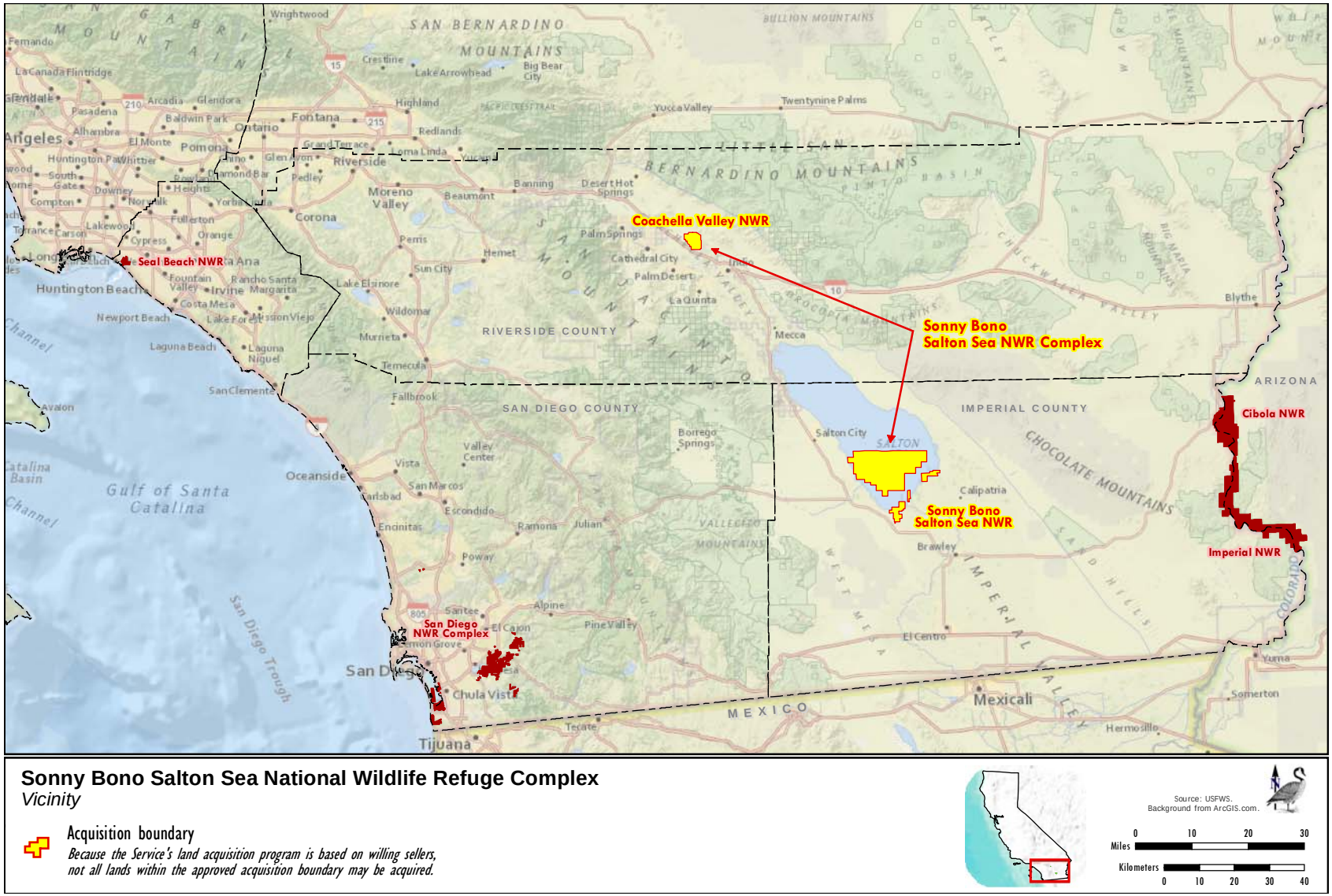

Figure 1-1. Vicinity Map - Sonny Bono Salton Sea National Wildlife Refuge Complex

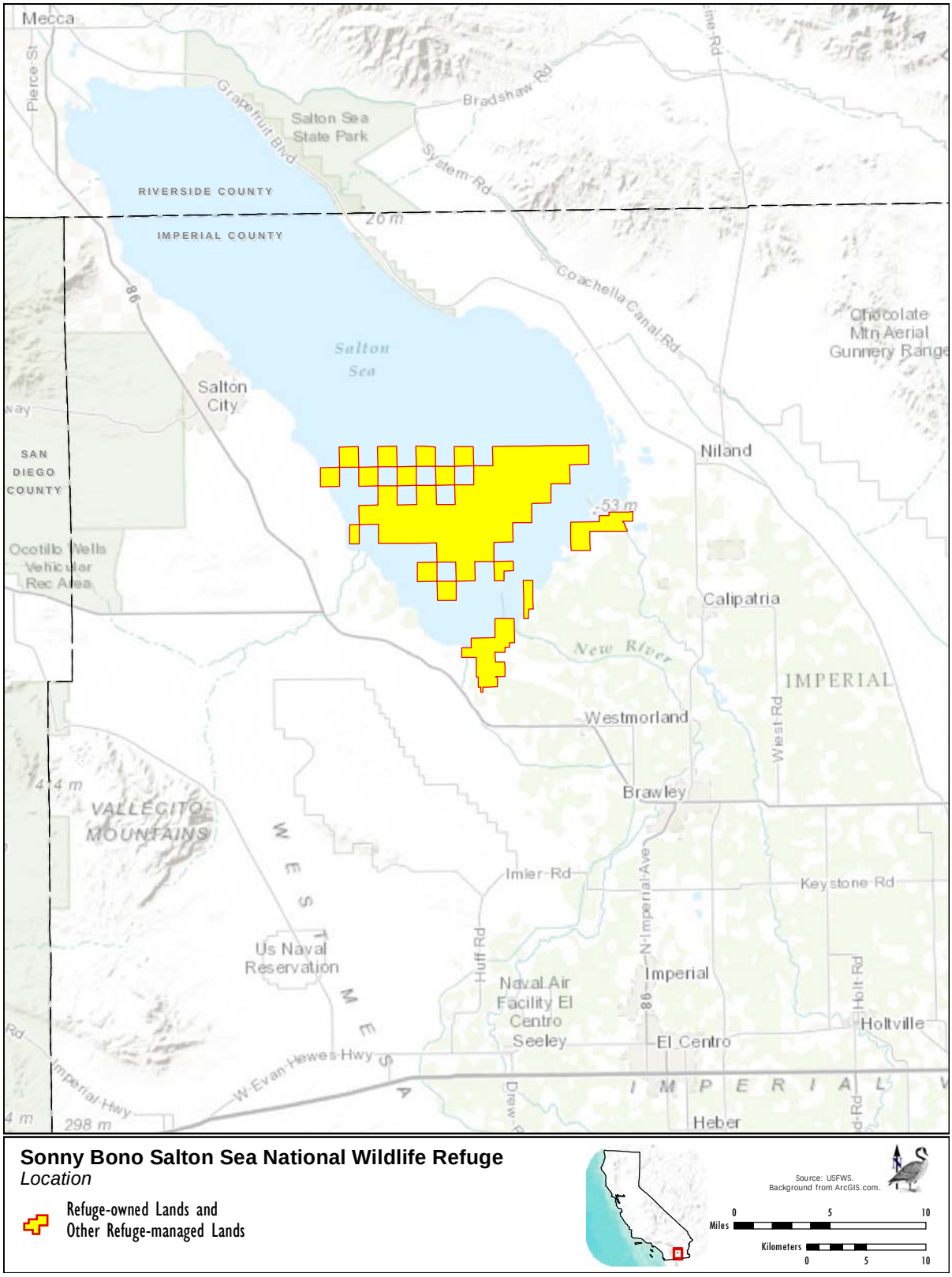

Figure 1-2. Location Map - Sonny Bono Salton Sea National Wildlife Refuge

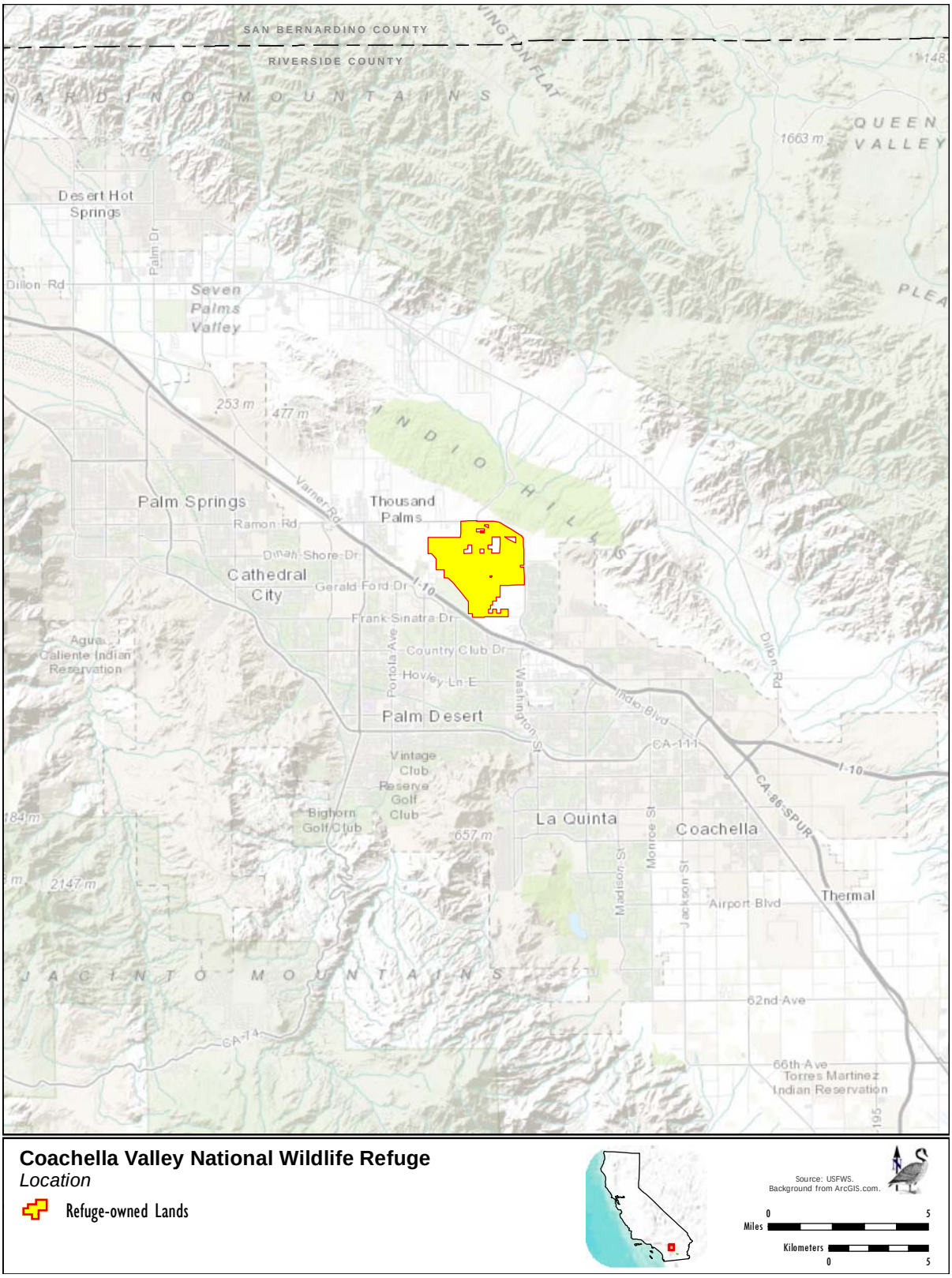

Figure 1-3. Location Map - Coachella Valley National Wildlife Refuge

1.2 Purpose and Need

The purpose and need for the Sonny Bono Salton Sea NWRC CCP is to provide guidance to the Refuge Manager and others for how the Refuges within the Complex should be managed to best achieve the purposes for which they were established and to contribute to the mission of the National Wildlife Refuge System (Refuge System or NWRS). This CCP addresses the management of wildlife, fish, and plant resources and their related habitats, while also considering opportunities for compatible wildlife-dependent recreational use. It is through the CCP process that the overarching wildlife, public use, and/or management needs for these Refuges, as well as any issues affecting the management of Refuge resources and public use programs, are identified; and various strategies for meeting Refuge needs and/or resolving issues that may be impeding the achievement of Refuge purposes are evaluated and ultimately presented for implementation.

A CCP is intended to:

- Ensure that Refuge management is consistent with the NWRS mission and Refuge purposes and that the needs of wildlife come first, before other uses;
- Provide a scientific foundation for Refuge management;
- Establish a clear vision statement of the desired future conditions for Refuge habitat, wildlife, visitor services, staffing, and facilities;
- Communicate the Service's management priorities for the Refuge to its neighbors, visitors, partners, State, local, and other Federal agencies, and to the general public;
- Ensure that current and future uses of the Refuge are compatible with Refuge purposes;
- Provide long-term continuity in Refuge management; and
- Provide a basis for budget requests to support the Refuge's needs for staffing, operations, maintenance, and capital improvements.

This CCP also fulfills the legislative obligations of the Service. Its preparation is mandated by the National Wildlife Refuge System Administration Act of 1966, as amended by the National Wildlife Refuge System Improvement Act of 1997 (16 United States Code [USC] 668dd-668ee) (Improvement Act). The Improvement Act requires that a CCP be prepared for each refuge or related complex of refuges within 15 years of the law's enactment. In accordance with the Act, the Service is developing a CCP for each refuge included within the NWRS.

A plan to guide management of the Sonny Bono Salton Sea NWR has not been updated since 1972; as a result, limited guidance is currently available for how best to achieve Refuge purposes and other mandates. General management direction for the Coachella Valley NWR is currently provided within the Coachella Valley Multiple Species Habitat Conservation Plan (CVAG 2007a). This CCP sets forth specific Refuge goals and objectives and describes the strategies to be implemented to achieve these goals and objectives. The guidance provided is based on specific Refuge purposes, Federal laws, NWRS goals, and Service policies.

Although the CCP addresses all management actions and activities occurring or proposed to occur on the Refuge, some of these actions or activities are broadly stated, while others, such as implementation of an Integrated Pest Management Plan, Predator Management Plan, and restoration of Red Hill Bay, are described in sufficient detail to ensure adequate consideration of potential effects on the environment as required by NEPA.

1.3 U.S. Fish and Wildlife Service and National Wildlife Refuge System

1.3.1 U.S. Fish and Wildlife Service

The Service is the primary Federal agency responsible for conserving and enhancing the Nation's fish and wildlife populations and their habitats. Although this responsibility is shared with other Federal, State, tribal, local, and private entities, the Service has specific responsibilities for migratory birds, threatened and endangered species, interjurisdictional fish, and certain marine mammals. The Service also has similar trust responsibilities for the lands and waters it administers to support the conservation and enhancement of fish and wildlife. The mission of the Service is "Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."

1.3.2 National Wildlife Refuge System

The NWRS is the largest system of lands and waters in the world specifically dedicated to the conservation of fish and wildlife. Unlike other public lands, which are managed under a multiple-uses mandate (e.g., National forests managed by the U.S. Forest Service [USFS] and lands administered by the Bureau of Land Management [BLM]), the lands within the NWRS are managed primarily for the benefit of fish, wildlife, and plant resources and their habitats. The Refuge System consists of over 550 units that provide more than 150 million acres of habitat for native plants, fish, and wildlife, including threatened and endangered species.

In 1903, President Theodore Roosevelt established Pelican Island as the Nation's first bird sanctuary. With this action, pelicans, herons, ibis, and roseate spoonbills nesting on a small island in Florida's Indian River were given protection from feather collectors who were decimating their colonies. President Roosevelt went on to establish many other wildlife sanctuaries during his tenure. This small network of sanctuaries continued to expand, later becoming the NWRS, whose mission is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (Improvement Act).

The administration, management, and growth of the NWRS are guided by the following goals (Service Manual, Part 601 FW1, NWRS Mission and Goal, and Refuge Purposes):

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered;
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges;
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts;
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); and
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

1.4 Legal and Policy Guidance

Refuges are guided by the purposes of the individual refuge, the mission and goals of the Refuge System, Service policy, various Federal laws, and international treaties. Relevant guidance includes the Refuge Recreation Act of 1962 (16 U.S.C. 460k-460k-4), the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), which was significantly amended by the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act, 16 U.S.C. 668dd-668ee), and selected portions of the Code of Federal Regulations and the U.S. Fish and Wildlife Service Manual (Service Manual).

Refuges are also governed by a variety of other Federal laws, Executive orders (EOs), treaties, interstate compacts, regulations, and policies pertaining to the conservation and protection of natural and cultural resources (see Service Manual 602 FW 1 (1.3)). Federal laws and Executive orders relevant to the management of the Refuges within the Sonny Bono Salton Sea NWRC are summarized in Table 1-1 and addressed in greater detail in Appendix J.

Table 1-1 Federal Laws and Executive Orders Applicable to the Management of the Sonny Bono Salton Sea NWRC
Agency Coordination
• Executive Order No. 12372, Intergovernmental Review of Federal Programs
Refuge Uses
• The National Wildlife Refuge System Administration Act of 1966 (16 USC 668dd-668ee), National Wildlife Refuge System Improvement Act of 1997 (P.L.105-57) • The Refuge Recreation Act of 1962, as amended • Fish and Wildlife Improvement Act of 1978 • Executive Order No. 12996, Management and General Public Use of the NWRS
Biological Resources
• Endangered Species Act of 1973 (16 USC 1531 et seq.), as amended (ESA) • Fish and Wildlife Act of 1956 (16 USC 742a-743j, not including 742d-742l) • Fish and Wildlife Conservation Act of 1980 (16 U.S.C. §661-667e), as amended • Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds (10, Jan. 2001) Migratory Bird Treaty Act of 1918, as amended (MBTA) • The Bald and Golden Eagle Protection Act of 1940 (16 USC 668 et seq.) • Fish and Wildlife Coordination Act of 1958
Water Quality
• Clean Water Act of 1972, Section 404 (33 USC 1344 et seq.), as amended • Clean Water Act, Section 401
Air Quality
• Clean Air Act of 1970, as amended (P.L. 91-604; 42 USC 1857 et seq.)

Table 1-1 Federal Laws and Executive Orders Applicable to the Management of the Sonny Bono Salton Sea NWRC
Resource Protection
• National Environmental Policy Act of 1969 (42 USC 4321 et seq.) (NEPA) • Executive Order 13112, Invasive Species • Federal Noxious Weed Act of 1990 • Executive Order No. 11990, Protection of Wetlands • Emergency Wetlands Resources Act of 1986 • Executive Order No. 11988, Floodplain Management • Farmland Protection Policy Act (7 USC 4201 et seq.)
Cultural Resources
• Antiquities Act of 1906 • Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001 et seq.)(NAGPRA) • Executive Order 13007, Indian Sacred Sites (24 May, 1996) • American Indian Religious Freedom Act 1978 (42 USC 1996) • Executive Order No. 11593, Protection and Enhancement of the Cultural Environment • Archaeological Resources Protection Act of 1979 (16 USC 470aa-47011), as amended (ARPA) • National Historic Preservation Act of 1966 (16 USC 470 et seq.; 36 CFR 800), as amended (NHPA) • Archaeological and Historic Preservation Act of 1974 (16 USC 469) • Curation of Federally-Owned and Administered Archaeological Collections (36 CFR 79)
Tribal Coordination
• Executive Order 13175, Consultation and Coordination with Indian Tribal Governments
Paleontological Resources
• Paleontological Resources Preservation Act of 2009 (P.L. 111-11, Title VI, Subtitle D)
Human Rights
• Executive Order 12898, Environmental Justice • Architectural Barriers Act of 1968, as amended (42 USC 4151 et seq.)
Contaminants and Hazardous Materials
• Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (P.L. 96-510; 42 USC 9601, et seq.) (CERCLA) • Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (P.L. 80-104; 7 USC 136 et seq.)

1.4.1 National Wildlife Refuge System Improvement Act of 1997

Statutory authority for Service management and associated habitat management planning on units of the NWRS is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), which was significantly amended by the National Wildlife Refuge System Improvement Act of 1997 (P.L.105-57). The Improvement Act intends that each refuge be managed to fulfill the mission of the Refuge System, as well as the specific purposes for which that refuge was established. As stated in the Refuge Administration Act, as amended by Improvement

Act, "purposes of the refuge and purposes for each refuge mean the purposes specified in or derived from law, proclamation, Executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit."

The Refuge Administration Act, as amended, clearly establishes wildlife conservation as the core NWRS mission. House Report 105-106, accompanying the Improvement Act, states that "the fundamental mission of our Refuge System is wildlife conservation: wildlife and wildlife conservation must come first." In contrast to other systems of public lands, the NWRS is a primary-use network of lands and waters. First and foremost, refuges are managed for fish and wildlife, plants, and their habitats.

The Improvement Act provides clear standards for management, use, planning, and growth of the NWRS. Its passage followed the promulgation of Executive Order 12996 (April 1996), "Management of Public Uses on National Wildlife Refuges," reflecting the importance of conserving natural resource for the benefit of present and future generations of people. The Improvement Act recognizes that wildlife-dependent recreational uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation, when determined to be compatible with the mission of the NWRS and purposes of the Refuge, are legitimate and appropriate public uses of the Refuge System.

Section 5 of the Improvement Act directs the Secretary of the Interior to ensure or conduct 14 actions in administering the NWRS. In addressing these actions, a number of policies have been developed to help guide the administration of Refuge lands. Refuge System policies, which can be found in the land use management series (600) of the U.S. Fish and Wildlife Service Manual (available online at http://www.fws.gov/policy/manuals), are summarized in Table 1-2.

Table 1-2
Key Service Policies Related to the Management of National Wildlife Refuges

Policy	Purpose
Refuge System Mission and Goals and Refuge Purposes (601 FW 1)	Reiterates and clarifies the Refuge System mission and how it relates to the Service mission; explains the relationship between the Refuge System mission, goals, and purpose(s).
Comprehensive Conservation Planning (602 FW 3)	Describes the requirements and processes for developing refuge comprehensive conservation plans.
Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3)	Provides guidance for maintaining and restoring, where appropriate, the biological integrity, diversity, and environmental health of the NWRS.
Appropriate Use Policy (603 FW 1)	Describes the initial decision process the Refuge Manager follows when considering whether to allow a proposed use on a refuge. For uses other than the six wildlife-dependent recreational uses of the Refuge System, the Refuge Manager must first find the use appropriate before undertaking a compatibility review. Appropriateness reviews are included with the compatibility determinations in Appendix E of this CCP.

Table 1-2 Key Service Policies Related to the Management of National Wildlife Refuges	
Policy	**Purpose**
Compatibility Policy (603 FW 2)	Details the formal process for determining if a use proposed on a refuge is compatible with the Refuge System mission and the purposes for which the refuge was established. Units of the Refuge System are legally closed to all public access and use, including economic uses, unless and until they are officially opened through a compatibility determination (CD). Appendix E contains the CDs for the uses on Sonny Bono Salton Sea NWR and the Coachella Valley NWR. The draft CDs were made available for public comment along with the draft CCP.
Wildlife-Dependent Recreation (605 FW 1-7)	Provides specific information and guidance for each of the six priority wildlife-dependent uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation): the policy for the use; guiding principles for the use; guidelines for program management; and guidelines for opening the specific program.
Wilderness Stewardship Policy (610 FW 1-5)	Provides guidance on conducting wilderness inventories for Refuge System lands to determine if these lands should be recommended for wilderness designation; establishes policy for managing wilderness study areas and recommended and proposed wilderness; and prescribes how refuge managers will preserve the character and qualities of designated wilderness while managing for refuge purpose(s). The wilderness inventory for the Sonny Bono Salton Sea NWRC is provided in Appendix M.

1.4.2 National Environmental Policy Act (NEPA) of 1969

As the basic national charter for the protection of the environment, NEPA requires Federal agencies to consider the environmental effects of all actions (i.e., policies, plans, programs, or projects that are implemented, funded, permitted, or controlled by a Federal agency or agencies) they undertake. Agencies must also consider the environmental effects of all reasonable and feasible alternatives to a proposed action and must make public the environmental effects of the proposed action and possible alternatives. If adverse environmental effects cannot be entirely avoided, NEPA requires an agency to show evidence of its efforts to reduce these adverse effects and to restore and enhance environmental quality as much as possible. The contents of an EA or Environmental Impact Statement (EIS) document that an agency has addressed these issues.

The CCP process must comply with the provisions of NEPA through the concurrent preparation of an EA or EIS. The NEPA document can accompany the draft CCP or be integrated into the draft CCP. The Sonny Bono Salton Sea NWRC CCP was prepared consistent with the requirements of NEPA, the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR §1500 et seq.), and the Department of Interior's NEPA procedures (43 CFR Part 46). To comply with CEQ NEPA regulations and ensure the NEPA process was integrated into the CCP process at the earliest possible time, an EA was integrated directly into the draft CCP. The EA and FONSI prepared for this CCP are provided as Appendix F.

1.5 Sonny Bono Salton Sea National Wildlife Refuge Complex

1.5.1 Location

The Sonny Bono Salton Sea NWRC, which includes the Sonny Bono Salton Sea NWR and the Coachella Valley NWR, is located in the southern end of the State of California within the low-lying Colorado Desert subregion of the Sonoran Desert bioregion. Separated by a distance of about 75 miles, these Refuges are situated within the Salton Basin (refer to Figure 1-1), also known as the Salton Trough, which extends for approximately 200 miles from San Gorgonio Pass in the north through the Coachella, Imperial, and Mexicali valleys to the Gulf of California.

1.5.1.1 Sonny Bono Salton Sea NWR

The Sonny Bono Salton Sea NWR is located within and adjacent to the southern and southeastern portions of the Salton Sea in the northern portion of the Imperial Valley, Imperial County, California. The Refuge consists of approximately 37,900 acres; however, most of this area is currently located below the surface of the Salton Sea. The lands managed within the Refuge occur in three general locations as described below and illustrated in Figure 1-4.

1) Approximately 32,405 acres are located in the southern portion of the Salton Sea, including 23,425 acres of Federal land controlled by the Bureau of Reclamation and administered by the Service and 8,980 acres owned in fee title by the United States and under the jurisdiction of and managed by the Service. When the Refuge was established in 1930, this area consisted of both wetland and upland habitat; however, these lands were subsequently flooded by the Salton Sea.

Unit 1 provides foraging and loafing areas for thousands of wintering geese (Mark Stewart/USFWS)

2) Approximately 3,782 acres are included in Unit 1, located along the southern edge of the Salton Sea. Within this area, about 3,226 acres are located just to the south of Bruchard Bay and include a combination of open water, managed wetlands, and upland areas, some of which are actively farmed to create foraging areas for snow geese [*Chen caerulescens caerulescens*], Ross' geese [*Chen rossii*], and other waterfowl. To the northeast are an additional 556 acres, most of which were until recently submerged beneath the Salton Sea. Of the lands included within Unit 1, about 560 acres are owned in fee title by the United States and under the jurisdiction and management of the Service, about 2,980 acres are leased from the Imperial Irrigation District (IID), and approximately 240 acres are owned by the State of California (Caltrans) and managed by the Service through an agreement with the State.

3) Approximately 2,026 acres, which include the Refuge headquarters and a variety of managed uplands and wetlands, are located along the southeastern edge of the Salton Sea near the terminus of the Alamo River (Unit 2). Of the 2,026 acres of Refuge lands within Unit 2, approximately 164 acres (including the 3.44-acre refuge headquarters site) are federally owned and under the jurisdiction and management of the Service, about 1,247 acres are leased from IID, and 615 acres are leased from the California Department of Fish and Wildlife (CDFW).

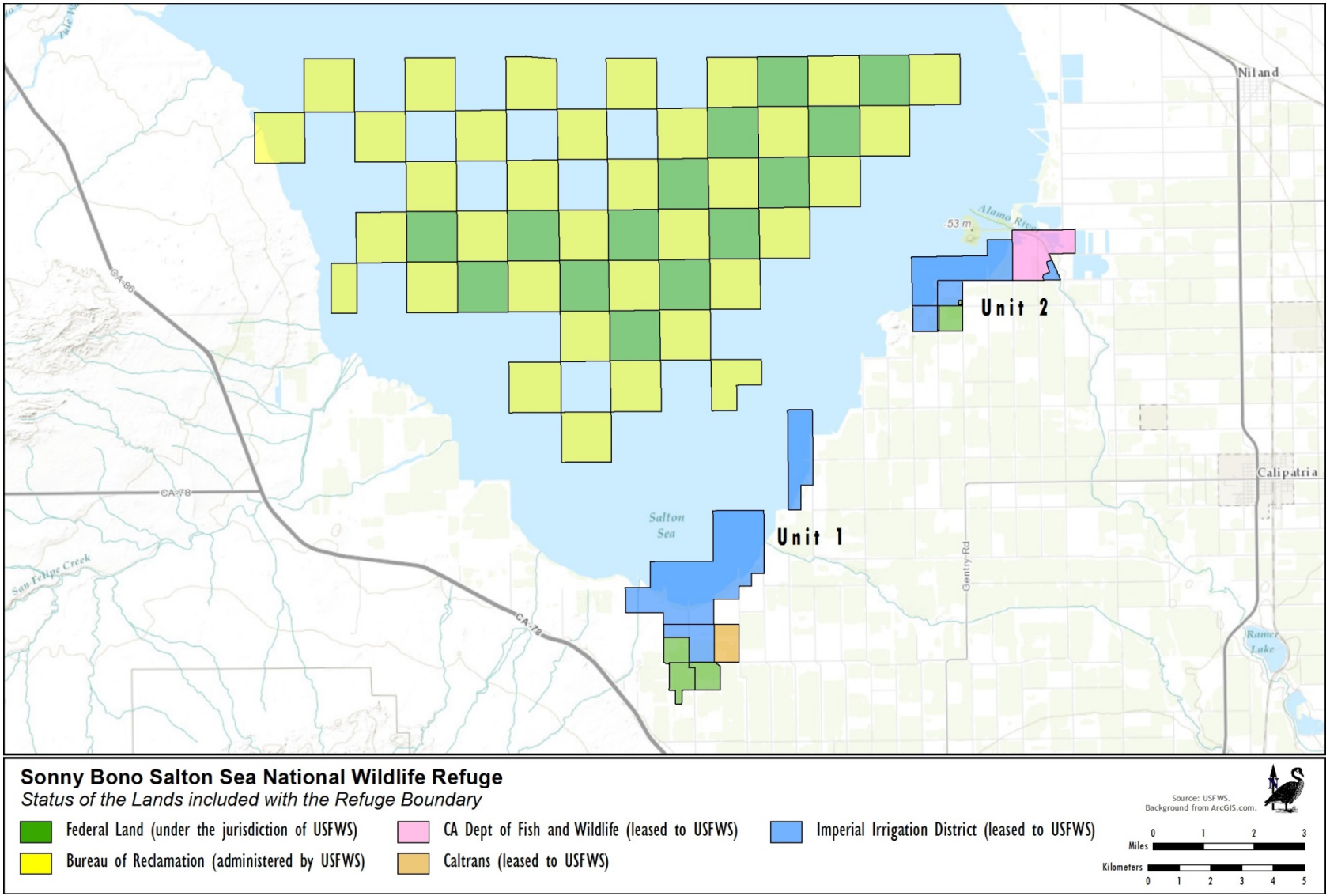

Figure 1-4. Land Status Map – Sonny Bono Salton Sea NWR

1.5.1.2 Coachella Valley NWR

The 3,577-acre Coachella Valley NWR is located in the Coachella Valley in eastern Riverside County to the north of Interstate 10 (I-10) near the communities of Bermuda Dunes and Thousand Palms. The Refuge is bounded on the south by Avenue 38, on north by Ramon Road, and on the east by Washington Street (refer to Figure 1-3). All of the lands included within the Refuge are federally owned and under the jurisdiction of and managed by the Service.

1.5.2 Refuge Setting

1.5.2.1 Sonny Bono Salton Sea NWR

The Sonny Bono Salton Sea NWR is located in the rain shadow of the Peninsular Ranges; consequently, the climate is generally very hot and dry. Much of the Salton Trough, where the Refuge is situated, is below sea level. These low-lying lands historically provided an area for Colorado River floodwaters to flow, resulting in the periodic formation of an extensive freshwater lake known as Lake Cahuilla. Today, the Salton Sea, a saline lake that receives most of its water from agricultural drainage occupies only a portion of the Salton Trough.

The Imperial Valley is geographically located at the confluence of numerous bird migration pathways as birds fly north and south along the California coast, the Peninsular Mountain Range, California's Central Valley, or the Colorado River corridor through the Imperial Valley and into mainland Mexico. It is in this setting that birds migrate through or winter at the Sonny Bono Salton Sea NWR foraging or loafing in the highly productive wetland and cropland areas of the Refuge. The Refuge also serves as a summer nesting area for several species of seabirds and shorebirds, and provides habitat to support the Federal endangered Yuma Ridgway's rail (*Rallus obsoletus yumanensis*), formally referred to as the Yuma clapper rail.

1.5.2.2 Coachella Valley NWR

The Coachella Valley NWR is located in the eastern portion of Riverside County (refer to Figure 1-1) within the Coachella Valley, a broad, low elevation, northwest-southeast trending valley comprising the westernmost limits of the Sonoran Desert (CVAG 2007b). At the western edge of the valley, the San Jacinto and San Gorgonio Mountains nearly meet forming the San Gorgonio Pass, which funnels nearly continuous winds from the cooler coastal basins inland. Desert washes draining out of the Little San Bernardino Mountains to the north of the Valley provide alluvial sand that is picked up by wind blowing through the pass and deposited within the Coachella Valley. Over the years, large areas of the Valley's natural desert habitats have been converted to agriculture fields or community developments, leaving limited areas undeveloped to support desert blowsand habitats such as those protected within the Coachella Valley NWR.

1.5.3 Ecosystem Context

To the extent possible, the management actions proposed in CCPs should assist in achieving the conservation goals established in existing national and regional plans, California's Wildlife Action Plan, and landscape-scale plans covering the same watershed or ecosystem in which the Refuge resides (602 FW 3.3). CCPs should also consider the larger landscape-level planning that is occurring in various regions of the country through Landscape Conservation Cooperatives (LCCs). The Refuges of the Sonny Bono Salton Sea NWRC are included within the Desert LCC, which encompasses portions of five states: California, Nevada, Arizona, New Mexico, and Texas, as well as a substantial portion of Northern Mexico. The area is topographically complex, including three different deserts (i.e., Mojave, Sonoran, Chihuahuan), grasslands and valley bottoms, and isolated mountain ranges. The richness of the topography supports a diverse species composition; including many endemic species.

The LCCs provide a forum for information sharing that will help scientists and resource managers deal with uncertainties on the landscape and provide tools to compare and contrast the implications of management alternatives. LCC partners jointly decide on the highest priority needs and interests of the LCC and will have a role in helping partners identify common goals and priorities.

Other regional planning efforts that have the potential to influence the management practices within the Refuge Complex are summarized below.

Sonoran Joint Venture Bi-national Bird Conservation

The Sonoran Joint Venture is a partnership of diverse organizations and individuals from the southwestern United States and northwestern Mexico that share a common commitment to bird conservation within the region. The Strategic Plan for the Sonoran Joint Venture presents a regional strategy to protect, conserve, restore, and enhance bird populations and their habitats. The strategic plan and the Joint Venture's actions in general are intended to address and integrate the conservation recommendations of the North American Waterfowl Management Plan, Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004), North American Waterbird Conservation Plan (Kushlan et al. 2002), and other bird conservation plans for the areas included within this joint venture. Bird conservation plans are discussed further in Chapter 4.

Sonny Bono Salton Sea NWR and Coachella Valley NWR are located within the Arid Borderlands Region of the Sonoran Joint Venture Bird Conservation Plan. This plan identifies 81 areas within this Region as focus areas (Sonoran Joint Venture Technical Committee 2006). Focus areas are locations that have been identified as having significant bird populations and habitat values, and/or the potential to be restored to a condition that supports bird populations. The Salton Sea is identified as one of these focus areas.

California Wildlife Action Plan

The Refuge Complex is included within California's Colorado Desert Region as designated by the California Wildlife Action Plan (California Department of Fish and Game [CDFG] 2007). The Plan's conservation actions that apply to the management of the Sonny Bono Salton Sea NWR include maintaining and restoring the Salton Sea ecosystem in a form that provides vitally important aquatic habitats. Conservation actions relevant to the Coachella Valley NWR include eradicating or controlling invasive species and implementing actions such as monitoring recreational uses, trespass, and other activities that could impact the habitats and species protected on the Refuge.

Habitat Conservation Plans/Natural Community Conservation Plans

Habitat Conservation Plans (HCPs) are Federal planning documents required as part of an application for an incidental take permit under the Endangered Species Act of 1973 (ESA). They describe the anticipated effects of the proposed taking; how those impacts will be minimized, or mitigated; and how the HCP is to be funded. The preparation of HCPs, which are authorized under section 10(a)(1)(B) of the ESA, provide for partnerships with non-Federal parties to conserve the ecosystems upon which listed species depend, ultimately contributing to their recovery.

Natural Community Conservation Plans (NCCP) are planning documents prepared to provide for effective protection and conservation of the State of California's wildlife resource while continuing to allow appropriate development, growth, and other activities. The purposes of NCCPs, as described in the Fish and Game Code section 2801, are to provide for the conservation of biological diversity by protecting biological communities.

To address a range of species for which future development proposals could result in incidental take, the Service and the State often work together to develop multiple species habitat conservation plans that can adequately address the requirements of both the ESA and the State's requirements for protecting the natural biological communities of California.

The Coachella Valley NWR, which was included within the Coachella Valley Fringe-toed Lizard Preserve in 1986, was incorporated into the Thousand Palms Conservation Area of the Coachella Valley Multiple Species Habitat Conservation Plan (MSHCP) in 2007 (CVAG 2007a). In addition to providing core habitat for the Coachella Valley fringe-toed lizard, the Refuge also provides core habitat for Coachella Valley milk-vetch, Coachella Valley giant sand-treader cricket (*Macrobaenetes valgum*), flat-tailed horned lizard (*Phrynosoma mcallii*), Coachella Valley round-tailed ground squirrel (*Xerospermophilus tereticaudus chlorus*), and Palm Springs pocket mouse (*Perognathus longimembris bangsi*). The Coachella Valley MSHCP, which emerged out of the habitat conservation planning process implemented in the 1980s to ensure the long-term protection of the Coachella Valley fringe-toed lizard, provides a regional vision for balanced growth to meet the requirements of Federal and State listed endangered species laws, while promoting enhanced opportunities for recreation, tourism, and job growth.

With the approval of the Coachella Valley MSHCP in 2007, the MSHCP Reserve System was established. This Reserve System includes 21 Conservation Areas, including the Thousand Palms Conservation Area, that collectively are intended to conserve 27 species and 27 natural communities (CVAG 2007c). Management and monitoring activities implemented by the Service on the Coachella Valley NWR that relate to the conservation of listed and covered species and their habitats are expected to be consistent with the management and monitoring objectives and protocols developed as part of the Coachella Valley MSHCP.

In the Imperial Valley, the IID is currently in the process of preparing a HCP and NCCP in consultation with the Service and CDFW (formerly CDFG). The IID's HCP/NCCP permit is anticipated to cover a number of listed and non-listed fish, wildlife, and plant species. Because the Refuge leases land from the IID for management as part of the NWR, it is possible that the objectives of the HCP/NCCP developed for IID Covered Activities could apply to some IID lands currently managed by the Service.

1.5.4 Refuge Purposes

1.5.4.1 Sonny Bono Salton Sea NWR

Snow geese in managed agricultural fields (USFWS)

The Refuge was established in 1930 under the Executive Order 5498 as "a refuge and breeding ground for birds and wild animals." Additional lands were acquired for management as part of the Refuge either through fee title, lease, or other agreement for various purposes, including: "for use as an inviolate sanctuary, or for any other management purpose for migratory birds" (Migratory Bird Conservation Act of 1929 [16 U.S.C. 715 to 715s]); "for the management and control of migratory waterfowl and other wildlife" (Lea Act of 1948 [16 U.S.C. 695-695c; 62 Stat. 238]); and "primarily for the production of crops to provide wintering feed for waterfowl and to aid and assist in the control of depredation by waterfowl to commercial crops in the area" (Fish and Wildlife Act of 1956, as amended [16 U.S.C. 742a-742j, not including 742 d-l; 70 Stat. 1119]).

1.5.4.2 Coachella Valley NWR

The Coachella Valley NWR was established in 1985 "to conserve (A) fish and wildlife which are listed as endangered species or threatened species . . . or (B) plants…" (Endangered Species Act of 1973 [16 U.S.C. §1531 et seq.]).

1.5.5 Refuge Vision Statement and Goals

1.5.5.1 Sonny Bono Salton Sea NWR

Presented here is our vision for the future of the Sonny Bono Salton Sea NWR:

> *Often described as one of the most important bird areas in the North America, the Salton Sea has been a vital stopover and wintering spot for migratory birds for about a century. Located within the southern end of the Sea, the Sonny Bono Salton Sea NWR continues to play an important role in the monitoring and management of the abundance of birds that annually visit the Sea and adjacent habitats. The predicted changes to the Salton Sea including decreasing water elevations and increasing salinity levels will necessarily influence how management on the Refuge proceeds into the future. In partnership with other agencies and organizations, the Refuge will manage existing and new habitat areas to compensate for the losses in foraging opportunities within the Sea.*
>
> *Managed fields of lush, green forage will continue to entice wintering snow and Ross's geese to congregate on Refuge lands rather than adjacent commercial agricultural fields, with the Refuge's wintering population of sandhill cranes also taking advantage of these resources. Managed open water and shallow seasonal wetlands within and adjacent to the historical footprint of the Sea will provide a range of foraging and loafing habitats for a diverse array of migratory seabirds, shorebirds, waterfowl, and other waterbirds. The continued management of cattail marshes will aid in the recovery of the endangered Yuma Ridgway's rail, while also providing essential habitat for other secretive marshbirds of concern. Tree rows, restored riparian corridors, and native upland areas will provide breeding and foraging habitat for resident birds and wildlife, as well as migratory songbirds.*
>
> *Public involvement in and appreciation for ongoing efforts to provide essential habitats for migratory birds, as well as the Refuge's resident birds and wildlife, will be fostered through continued opportunities for wildlife-oriented recreation, environmental education, and interpretation.*

The goals for the Sonny Bono Salton Sea NWR include:

Goal 1: Protect, manage, enhance, and restore foraging, loafing, and nesting habitats on the Refuge to support migratory birds.

Goal 2: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of federally and State listed threatened and endangered species and other species of concern known to occur on the Refuge.

Goal 3: Manage and protect remnant native desert scrub habitat, tree rows, and riparian areas on the Refuge to support resident bird and other wildlife species, as well as nesting habitat for Neotropical bird species.

Goal 4: Work in partnership with other Federal, State, and local agencies and tribes to restore, enhance, and adaptively manage habitat functions that support fish and bird life, as well as to protect other resources of region-wide significance, in and around the Salton Sea.

Goal 5: Enhance the public's awareness, appreciation, and enjoyment of the Refuge's biological resources by providing opportunities for compatible wildlife-dependent recreational uses.

1.5.5.2 Coachella Valley NWR

Presented here is our vision for the future of the Coachella Valley NWR:

Through the combined forces of rain and wind, sand is created and carried from the little San Bernardino Mountains, through the Indio Hills, and onto the wide alluvial fan that includes the lands within the Coachella Valley NWR. Deposited sand forms active sand dunes and sand fields that are continually being reshaped as natural sand transport processes moves the sand downwind, replacing the lost sand with new sand blowing down from the Indio Hills. As nearly half of the sand dune and sand field habitat (about 200 acres) remaining within the Thousand Palms Conservation Area is conserved within the Coachella Valley NWR, we will strive to protect this habitat, work in partnership with others to protect the natural sand transport processes, and if necessary, actively manage this habitat to mimic the natural processes essential to the long-term persistence of these aeolian sand communities.

Coachella Valley milk-vetch (USFWS)

Management and enhancement of the Refuge's native habitat areas will aid in the recovery of the federally endangered Coachella Valley milk-vetch and threatened Coachella Valley fringe-toed lizard and benefit core habitat areas for the Coachella Valley giant sand-treader cricket, flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse. The Coachella Valley NWR, as a partner in a larger effort to conserve the native habitats and listed and sensitive species within the Coachella Valley, will continue to actively participate in the management and monitoring efforts outlined in the Coachella Valley Multiple Species Habitat Conservation Plan and will encourage research on the Refuge that supports Refuge purposes and the goals of the larger conservation planning effort. Support for the protection of the Refuge's unique resources will be achieved through environmental education and a public outreach program that includes permanent off-site and traveling interpretive displays.

The goals for the Coachella Valley NWR include:

Goal 1: Protect, restore, and enhance Refuge lands to contribute to the recovery of the federally threatened Coachella Valley fringe-toed lizard and endangered Coachella Valley milk-vetch, as well as to conserve other species of concern supported on the Refuge.

Goal 2: Through participation in a coordinated management effort involving all of the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP) partners, sustain the ecological and evolutionary processes necessary to maintain the viability of the natural communities and habitats that support the species identified in the CVMSHCP and manage these communities and habitats adaptively to be responsive to short- and long-term environmental change.

Goal 3: Enhance the public's awareness, appreciation, and support for the Refuge's listed and sensitive species, as well as the ecological functions and geological processes that sustain these species, through compatible opportunities for environmental interpretation.

1.5.6 History of Refuge Establishment

1.5.6.1 Sonny Bono Salton Sea NWR

Events Leading Up to Refuge Establishment. The geographical area occupied by the current Salton Sea has for most of the last several millennia been a naturally occurring wetland receiving floodwaters from the nearby Colorado River. That was the situation that was repeating itself in the spring of 1905 when Colorado River floodwaters burst through a diversion structure built to bring irrigation water to the Imperial Valley for agricultural development. For most of 18 months, the Colorado River flowed into the Salton Sink. Birds were attracted to the re-flooded wetland, taking advantage of this inland water source, just as they had done in the past, as documented by analysis of bird bones from Native American midden sites in the area. The original massive re-flooding of the Salton Sink gradually abated, but with agriculture expanding in the Imperial Valley and a steady flow of Colorado River irrigation water to supply that need, the Salton Sea would remain a flooded inland sea by virtue of the continuous supply of drainage water flowing from the growing agricultural enterprises within the Valley.

The Salton Sea is recognized as a Globally Important Bird Area (USFWS)

The birds observed at the Salton Sea in 1908 seemed to forecast the unusual and unlikely diversity of birdlife for which the Salton Sea would later become well known. Bird species present at that time included pelagic cormorants (*Phalacrocorax pelagicus*), Brandt's cormorants (*P. penicillatus*), double-crested cormorants (*P. auritus*), pigeon guillemots (*Cepphus columba*), tufted puffins (*Fratercula cirrhata*), black oystercatchers (*Haematopus bachmani*), and more commonly phalaropes (*Phalaropus* spp.), long-billed curlews (*Numenius americanus*), great blue herons (*Ardea herodias*) and various species of sandpipers. Many gulls found and used the Sea at this early stage of its new incarnation, but what impressed ornithologist Joseph Grinnell most were the more than 2,000 American white pelicans (*Pelecanus erythrorhynchos*) he discovered nesting on the Salton Sea's Echo Island (Bent 1922).

Secretarial orders dated April 2, 1909, October 19, 1920, and June 4, 1930, issued under the authority of the Reclamation Act of 1902, Section 3, withdrew approximately 80,000 acres of public lands in and around the present day Salton Sea for Reclamation project purposes. The lands withdrawn under the October 19, 1920 Secretarial order included 19,131 acres of land that are now within the boundaries of the Sonny Bono Salton Sea NWR. The purpose of the withdrawn land was to serve as a repository to receive and store agricultural surface and subsurface drainage waters.

The use of the Sea as a repository for agricultural drainage water was also addressed in an Executive order issued by President Coolidge on March 10, 1924, at which time additional lands, those below elevation 244 feet below MSL, were withdrawn and placed in a public water reserve (Public Water Reserve No. 90). In February 1928, President Coolidge issued a subsequent Executive order that withdrew additional lands below elevation 220 feet below MSL as storage for wastes and seepage from irrigated lands in the Imperial Valley (Public Water Reserve No. 114). Both Executive orders for Public Water Reserves Nos. 90 and 114 were revoked in their entirety by Public Land Order 6105, effective March 5, 1982. Of the lands subject to these Executive orders, the public lands (13,740 acres), which were withdrawn under the previously described Secretarial Order, were opened to mineral entry.

Refuge Establishment. As the water level within the Salton Sea increased, so too did the diversity and abundance of bird life in and around the Sea. The importance of this area to birds and wildlife was recognized by the Federal government in 1930, when President Hoover on November 25, 1930 issued Executive order 5498 establishing the "Salton Sea Wild Life Refuge." Per the Executive order, the 32,766-acre Salton Sea Wild Life Refuge was set aside as a sanctuary and breeding ground for birds and other wildlife. At the time of establishment, nearly 60 percent of the Refuge consisted of open saline lake. The remaining areas included shoreline alkali flats, freshwater marshes, native desert scrub, and farm fields. Although the area was set aside for refuge purposes, the underlying withdrawal of October 19, 1920 remained in place and today, many of these original refuge lands are administered by the Service and held by the Bureau of Reclamation for the Yuma Irrigation Project.

In 1940, management of Federal wildlife refuges was shifted from the Department of Agriculture to the Department of the Interior, and on July 30, 1940, President Franklin D. Roosevelt changed the name of the refuge to the Salton Sea National Wildlife Refuge. The refuge name was changed again in 1998 in memory of Congressman Sonny Bono, who was very active in the efforts to restore the health of the Salton Sea.

The lands and waters managed as part of the Sonny Bono Salton Sea NWR have been acquired at various times under one or more of the following authorities: Executive Order, the Migratory Bird Conservation Act (16 U.S.C. 715-715d, 715e, 715f-715r) of 1929, the Lea Act of 1948 (16 U.S.C. 695-695c), and the Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l).

Land Tenure. Between 1930 and 1947, approximately 32,400 acres located in the southern portion of what is now the Salton Sea where managed to protect ducks, geese, and shorebirds. As agricultural development expanded in both the Imperial and Coachella valleys, the inflow of drainage water to the Sea increased, resulting in a significant rise in the water level within the Salton Sea. Today, much of the original land set aside for the Refuge is submerged below the Salton Sea.

In the mid-1940s, the Imperial Irrigation District (IID) made 24,000 acres of land located between what was then the south end of the Salton Sea and private farmlands to the south available for leasing (USFWS 1963). Under the lease agreement, the lands could be reclaimed and improved for Refuge management purposes. The first of the IID lands to be leased were located in the area of the Refuge referred to today as Unit 1 (refer to Figure 1-4). These lands were acquired under the authorities of the Migratory Bird Conservation Act. The lease, which was approved in 1945, involved lands that had either never been farmed or had not been farmed since 1924. As a result, major work (e.g., land leveling, ditch and canal construction) was required to prepare these lands for cultivation.

The Refuge lands located within the area referred to today as Unit 2 (refer to Figure 1-4) were acquired for management in 1949 via a lease with IID. These lands were already in agricultural production when they were leased to the Refuge (USFWS 1963). Once acquired by the Refuge, cereal grains were initially cultivated to support geese foraging during the winter. In 1956, the Service acquired 637 acres of upland, including the site of the current Refuge headquarters, from the IID under the authorities of the Lea Act.

In 1964, the Service reached an agreement with CDFG (now CDFW) that allowed the Refuge to manage the habitat within the Hazard Tract (located in the eastern portion of Unit 2) as a waterfowl foraging area. This agreement enabled the Refuge to better achieve its purpose of reducing depredation on commercial cropland. A Refuge office was maintained on Unit 1 until 1964, when the office was moved to higher ground on Unit 2 to avoid the encroaching Salton Sea.

Throughout the 1960s and 1970s, the Service pursued a variety of options for purchasing lands suitable for farming, including various parcels owned by IID and a portion of the Salton Sea Test Base, which was declared surplus government property in 1962. For various reasons, these acquisition efforts either did not work out or were ultimately deemed inappropriate for Refuge use.

Despite a number of unsuccessful attempts to acquire additional farmland, a few parcels have been acquired by the Service to the south of the Salton Sea. These parcels were acquired in the 1970s and 1980s. Approximately 160 acres (referred to as the Union Tract), located in the southeast corner of Unit 2, were acquired in 1972. In 1973, 178 acres in the southeast corner of Unit 1 were acquired, while 160 acres were acquired in 1982 and 193 acres were acquired in 1985 at the southwestern corner of Unit 1. All of these acquisitions expanded the total acreage available to the Refuge for producing green forage for wintering geese and other waterfowl.

As of 2012, the Sonny Bono Salton Sea NWR included about 1,785 acres of manageable habitat; the balance of the Refuge remains inundated by the waters of the Salton Sea. As the Sea continues to recede, additional areas of Refuge land will become exposed.

1.5.6.2 Coachella Valley NWR

Events Leading Up to Refuge Establishment. Before the Coachella Valley was developed for urban uses, there was an estimated 200 square miles of loose, wind-blown sand that provided abundant habitat for species like the Coachella Valley fringe-toed lizard and Coachella Valley milk-vetch (England 1983). The source of this sand is the San Jacinto, San Bernardino, and Little San Bernardino Mountains, as well as the Indio Hills. During torrential rain events, the sandy soils present within these mountainous areas are carried in floodwaters down the Whitewater River and its tributaries to the San Gorgonio Pass, as well as through Thousand Palms Canyon in the Indio Hills to the base of the valley (England 1983). Once deposited, the sand is available to be carried further into the Coachella Valley by strong winds that blow in a southeasterly direction. As the winds dissipate, the sand is deposited within the valley, only to be moved again when winds from the west blow existing sand further to the southeast as new sand is moved into valley. These sand deposits support species endemic to this unique and ever-changing environment.

In the early 1900s, the valley had less than 1,000 permanent residents. With the availability of abundant groundwater, which was later supplemented by delivered Colorado River water, agriculture quickly became a dominant industry in the valley, spurring growth and community development. With mild winter temperatures and beautiful scenery, the area became a popular winter tourist spot, as well as a popular place to build winter homes. As a result, over the years community development and agricultural uses have replaced significant areas of the wind-blown sand habitat.

By 1979, approximately half of this habitat (100 square miles) had been converted to agriculture uses or community development (England 1983). In 2007, this area supported a population of over 418,000 (CVAG 2007b) with significant potential for additional growth.

Refuge Establishment. The loss of large areas of sand dunes and sand fields in the Coachella Valley changed the physical appearance of the landscape, but more significantly changes to the landscape were eliminating habitat essential to the survival of the area's endemic blowsand dependent species. As a result, one of these endemic species, the Coachella Valley fringe-toed lizard, was listed as endangered by the State of California in June 1980, and federally listed as a threatened species in September 1980. At the time of listing, the vast majority of the Coachella Valley was privately owned, making it difficult to protect and manage the blowsand habitat in which the lizard occurred, as well as the sand source areas needed to ensure the long-term persistence of blowsand habitat in the southeastern portion of the valley.

Coachella Valley fringe-toed lizard (Ginny Short)

To prevent the extinction of the Coachella Valley fringe-toed lizard, several public agencies, nonprofit organizations, and groups of concerned citizens (e.g., BLM, USFWS, CDFW, Coachella Valley Ecological Reserve Foundation, The Nature Conservancy), initiated efforts to acquire lands within the Coachella Valley that would protect habitat occupied by the fringe-toed lizard, as well as protect those lands on which the source of the sand for the downwind occupied sand dunes and sand fields were located. Protection focused on three areas including a portion of the Whitewater River floodplain, Edom Hill/Willow Hole (located at the western toe of the Indio Hills), and the Thousand Palms area of the Coachella Valley. By 1982, CDFW had acquired approximately 230 acres of Coachella Valley fringe-toed lizard habitat from willing sellers within the Thousand Palms area of the Coachella Valley and additional acquisitions were proposed for future years.

Efforts to protect sensitive blowsand habitat to support the Coachella Valley fringe-toed lizard continued and in 1985, the Coachella Valley Fringe-toed Lizard Habitat Conservation Plan was completed and subsequently approved by the Service in 1986 (BLM 1986). This was the first HCP developed under the authority of the 1982 amendment to the ESA.

Of the three areas proposed as preserves for the Coachella Valley fringe-toed lizard and its associated blowsand habitat, the Thousand Palms area of the Coachella Valley was the largest, most complicated to establish, and most critical to the continued survival of the lizard (USFWS 1985). As a result, efforts to protect the lizard and its blowsand habitat included appeals by concerned citizens and non-governmental organizations for the Service's involvement in the development of the Preserve. Through these efforts, an appropriation was provided to the Service in the FY 1985 budget to establish a Refuge within the Coachella Valley for the protection of the Coachella Valley fringe-toed lizard. The Service completed a Land Protection Plan (LPP) that addressed the establishment of the Coachella Valley NWR in 1986.

The LPP proposed to acquire approximately 2,000 acres of privately owned lands from willing sellers in the Coachella Valley. The lands to be acquired were to be located within designated Critical Habitat for the Coachella Valley fringe-toed lizard; consist of blowsand habitat known to support the lizard, as well as other plant and animal species characteristic of the Coachella Valley ecosystem; and located within and contribute toward the establishment of the Coachella Valley Preserve. In March 1986, the LPP was amended to permit the acquisition of an additional 1,000 acres of land from The Nature Conservancy for inclusion in the Refuge.

The Coachella Valley NWR was officially established under the authorities of the Endangered Species Act on August 28, 1985 when approximately 1,384 acres were acquired from The Nature Conservancy using Land and Water Conservation Funds. Additional acquisitions involving The Nature Conservancy, State of California, and several private willing sellers occurred between 1986 and 1997. As of September 2012, the total acreage of the Refuge was 3,577.61 acres.

2. The Comprehensive Conservation Planning Process

2.1 Introduction

The CCP for the Sonny Bono Salton Sea NWRC (Sonny Bono Salton Sea NWR and Coachella Valley NWR) is intended to guide the management of the Refuge over the next 15 years. The CCP was developed in association with the preparation of an accompanying environmental assessment (EA) to meet the dual compliance requirements of the Improvement Act and NEPA. Preparation of the CCP is guided by the Improvement Act, as well as the Refuge Planning Policy, as outlined in Part 602, FW 1, 3, and 4 of the Service Manual. Service policy, the Improvement Act, and NEPA each provide specific guidance for how the CCP process and/or the associated environmental analysis of alternatives should be conducted. For example, the Service is required to actively seek public involvement in the preparation of CCPs and associated environmental documents, such as EAs. In addition, the associated environmental document must provide equal and full analysis of a range of alternatives, or different approaches to refuge management, that can reasonably be implemented to achieve refuge goals and purposes and help fulfill the Refuge System mission.

The EA for the Sonny Bono Salton Sea NWRC CCP evaluated the environmental effects to the human environment of implementing a range of management alternatives for the Sonny Bono Salton Sea NWR and Coachella Valley NWR. NEPA requires that we consider all reasonable alternatives, including the "no action" alternative, which represents the continuation of current conditions and management practices. Alternative approaches for managing these Refuges were developed during the planning process and considered in the EA, which is provided in Appendix F.

Key steps in the CCP and parallel NEPA processes include:

- Preplanning;
- Public scoping and involvement;
- Identifying issues, opportunities, and concerns;
- Defining and revising vision statement and Refuge goals;
- Developing and evaluating alternatives;
- Identifying the preferred alternative for each Refuge;
- Drafting the CCP and EA;
- Revising draft documents and releasing the Final CCP;
- Implementing the CCP; and
- Monitoring and adapting management practices as necessary.

Figure 2-1 presents the overall steps in the CCP process, many of which include opportunities for public input, in a linear cycle, but the planning process is actually a non-sequential movement among the steps, with many revisions occurring during plan development.

2.2 Preplanning

Preplanning for this CCP began in 2010 with the establishment of a core planning team. The core planning team included the Project Leader, Deputy Project Leader, Refuge Planner, Refuge Wildlife Biologist, and other members of the Sonny Bono Salton Sea NWRC, as well as a representative from CDFW. In addition, an expanded team was formed to integrate stakeholders into the planning process. Appendix A lists the members of the core planning team, as well as other participants who provided important insight regarding planning issues and ongoing refuge management.

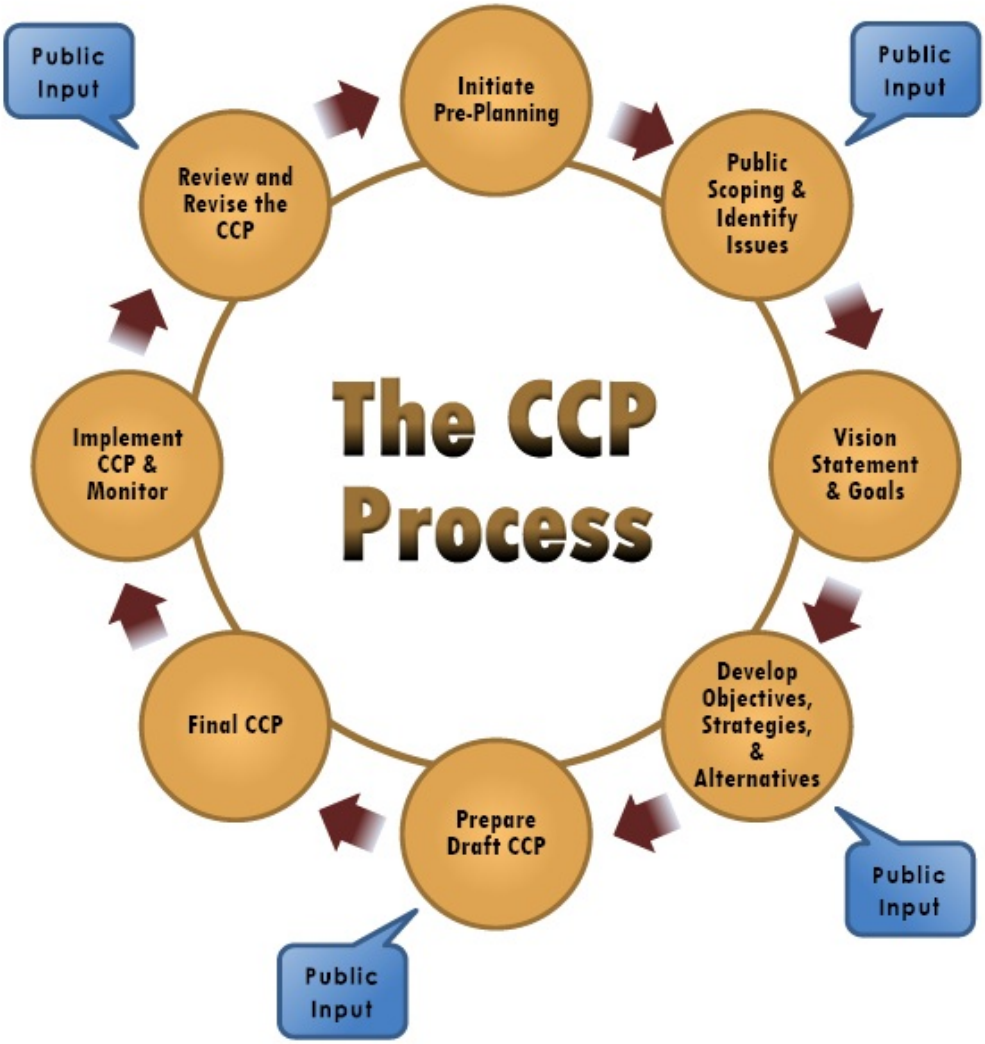

Figure 2-1. Comprehensive Conservation Planning Process

The initial tasks of the core planning team involved the collection of pertinent data for each Refuge and the identification of preliminary issues, concerns, and opportunities. Through this process, the planning team identified primary areas of focus, including wildlife and habitat management, public use, and Refuge operations. These focus areas, which were presented to the public during the scoping process, helped to shape the public input received during the scoping period into potential objectives for each Refuge.

2.3 Public Involvement in Planning

Public involvement is an essential component of the CCP and NEPA process. The public is encouraged to participate in this planning effort from its initiation during the scoping process through the public comment period on the draft CCP/EA. The Service also encourages the public to stay involved in the planning process during plan implementation. The public planning effort for the Sonny Bono Salton Sea NWRC CCP began in August 2010 when a newsletter (referred to as a "Planning Update") was distributed to approximately 380 entities, including local, State, and

Federal agencies; special districts; tribes; interested organizations; adjacent property owners; potential user groups; and other interested members of the public. This initial Planning Update described the planning process and requested input regarding the future management of the Refuge Complex. The CCP was officially initiated on October 15, 2010, when the Notice of Intent to prepare a CCP for the Sonny Bono Salton Sea NWRC was published in the *Federal Register* (75 FR 63379 [15 October 2010]).

Two public scoping meetings were held in September 2010, one in Palm Desert and one in Calipatria, to further develop and ascertain Refuge planning issues. Representatives from affected public agencies and non-profit organizations, elected officials, private property owners, and interested members of the public attended these meetings and provided written and verbal comments that were recorded and compiled for consideration during the development of objectives, strategies, and alternatives. Others contributed written comments either electronically or by mail in response to the *Federal Register* notice, the appeal for input provided in the Planning Update, and the press release that was issued regarding the planning effort and the scoping meetings. The issues raised during the scoping process addressed a range of topics from requests for expanded public uses to concerns regarding the fate of the Salton Sea.

A summary of the comments received during the scoping process was provided in a second Planning Update, distributed in January 2012. This Planning Update also presented preliminary management alternatives for the Sonny Bono Salton Sea NWR and Coachella Valley NWR, with an invitation for the public to provide comments regarding the proposed alternatives. A number of comments were provided that related to the hunting proposals included in two of the alternatives, and several other comments addressed habitat management proposals.

On July 23, 2013, the Notice of Availability of the draft CCP/EA for the Sonny Bono Salton Sea NWR Complex was published in the *Federal Register* (78 FR 44144). Public comments were accepted through August 22, 2013. Notice of the document's availability was distributed to Federal, State, and local agencies, Tribal governments, State Clearinghouse, several public libraries, and interested organizations and individuals. Two public meetings were held to take comments: one in Palm Desert on July 30, 2013 and one in Brawley on July 31, 2013.

Thirteen letters, containing 87 comments, were received during the public review process. These comments, which are provided in Appendix F as Appendix F-3, addressed a range of issues (e.g., Salton Sea restoration, water rights, land tenure, surrounding land use, visitor services), and changes were made to the Final CCP and EA, as appropriate, in response to these comments.

2.4 Public Scoping Comments, Issues, Concerns, and Opportunities

Issues, concerns, and opportunities associated with the future management of the Refuges within the Sonny Bono Salton Sea NWRC were obtained from a variety of sources. As previously discussed, a range of issues was identified during the public scoping process. Additional issues were identified by the planning team and during meetings with Refuge staff. A focused discussion of wildlife and habitat management issues was conducted that involved other Federal and State agencies, The Center for Natural Lands Management, and several wildlife professionals. The Service also conducted a visitor services review to examine existing and potential future wildlife-dependent recreational uses on these Refuges.

All of this input was compiled by the Service and taken into consideration during the development of management alternatives. This input was also used to further refine Refuge goals. The key issues and comments for each Refuge are summarized here.

2.4.1 Sonny Bono Salton Sea NWR

Wildlife/Habitat Management

- Optimize forage productivity in managed agricultural fields to support wintering geese.
- Control mammalian predators in seabird nesting areas to protect western gull-billed tern (*Gelochelidon nilotica* ssp. *vanrossemi*) and black skimmer (*Rynchops niger*) chicks and eggs from predation.
- Improve existing nesting areas and provide new nesting opportunities in proposed wetland restoration areas to support nesting gull-billed terns and other seabirds.
- Identify and implement strategies, including habitat restoration, to address the physical and biological effects of a shrinking Salton Sea.
- Ensure that Refuge planning is consistent with the larger restoration planning being conducted for the Salton Sea, including the Salton Sea Species Conservation Habitat Project.
- Encourage research related to Yuma Ridgway's rail movement between established marsh areas on the Refuge, as well as the effects that burning overgrown marshes has on existing movement patterns.
- Maintain adequate habitat to support the Yuma Ridgway's rail, identify, in the CCP or step-down habitat management plan, new locations on the Refuge for cattail marsh creation to replace existing marsh areas as they become decadent.
- Continue the current level of participation in the active surveillance of and responses to avian disease on the Salton Sea.

Public Use

- Continue to provide opportunities of waterfowl hunting and consider expansion of these opportunities on the Refuge, including allowing hunting in Unit 1.
- Expand waterfowl hunting to include wing shooting.
- Discontinue waterfowl hunting on the Refuge.
- Reduce goose hunting on the Union Tract by one day per week to improve the quality of the hunt at this location.
- Expand opportunities for bird watching and other wildlife observation, as well as interpretation and environmental education.
- Include the topic of climate change in environmental education programs.
- Improve trail accessibility.

Cultural Resources

- Evaluate potential impacts to cultural resources and consult with affected tribal governments.

Refuge Operations

- Hire a Federal wildlife officer to address enforcement issues on both Sonny Bono Salton Sea NWR and Coachella Valley NWR.
- Coordinate with surrounding landowners and other partners, and establish a volunteer group to assist Refuge staff with public use activities.
- Implement repairs and improvements to public facilities, including restrooms and parking areas.
- Consider cooperative farming as an option for managing managed agricultural fields on the Refuge.
- Evaluate current and future land tenure issues.

Environmental Effects

- Evaluate, and where appropriate implement, measures to address air quality impacts associated with newly exposed Salton Sea sediments in areas managed by the Refuge.
- Evaluate long-term water availability for current and future management practices.
- Evaluate existing and future water quality issues including increases in temperature and concentrations of constituent of concern.
- Address the effects of climate change on Refuge resources and management.
- Evaluate the potential cumulative impacts of implementing the management proposals.
- Address effects of alternative energy development on Refuge resources.

2.4.2 Coachella Valley NWR

Wildlife/Habitat Management

- Control invasive weeds, particularly Sahara mustard (*Brassica tournefortii*), in sand dune and sand field areas of the Refuge.
- Identify measures to ensure continued sand transport onto the Refuge.
- Patrol for and enforce regulations prohibiting vehicle use within the Refuge.
- Encourage aggressive control of small outbreaks of new invasive plants on the Refuge to prevent large infestations in the future.

List and Sensitive Species Management

- Increase staff involvement in monitoring listed and Coachella Valley MSHCP-covered species on the Refuge.
- Develop and implement management actions to benefit flat-tailed horned lizard.

Public Use

- Provide opportunities for hunting upland bird and large and small game on the Refuge.
- Expand opportunities for wildlife observation and interpretation.
- Provide off-refuge interpretation of the resources protected on the Refuge.

Refuge Operations

- Hire a Federal wildlife officer to address enforcement issues on both Sonny Bono Salton Sea NWR and Coachella Valley NWR.
- Coordinate with the U.S. Army Corps of Engineers (USACOE) on flood control proposals for the Thousand Palms area.

Environmental Effects

- Address the effects of climate change on Refuge resources and management.
- Evaluate the potential cumulative impacts of implementing the management proposals.

2.5 Management Challenges and Opportunities

In addition to the issues raised during the public scoping process, the planning team, with input from other partners, also identified several challenges, threats, and/or opportunities that will likely affect management within the Sonny Bono Salton Sea NWRC over the next 15 years and beyond.

2.5.1 Management Challenges

The majority of the issues expected to present challenges for the future management of the Sonny Bono Salton Sea NWR and Coachella Valley NWR involve issues of regional and in some cases global significance, including a receding Salton Sea, climate change, the increasing prevalence of

invasive plant species in the Salton Basin, protection of existing sand transport processes in the Coachella Valley, and the long-term impacts of depleted groundwater levels in the Coachella Valley. These issues and their effects on Refuge resources will likely have to be addressed through a coordinated effort involving many partners. As a result, management actions taken on the individual Refuges in response to these factors will have to be evaluated from time to time to determine if adjustments in current management practices are required to adapt to changing conditions. These issues, which are summarized here, were considered during the development of the management alternatives presented in the EA (Appendix F).

A Receding Salton Sea

From the time the Sonny Bono Salton Sea NWR was established in 1930 until about 1980, management of the Refuge included the need to address the effects of inundation as the water level in the Salton Sea continued to increase in response to increasing inflows of drain water from upstream agricultural activities. By the early 1980s, water levels in the Sea had stabilized due to water conservation measures implemented by IID (http://www.iid.com/index.aspx?page=172). Between the mid-1990s and 2000s, IID entered into three related agreements to transfer water from the Imperial Valley to urban areas in southern California, including the Coachella Valley and San Diego County. The effect of these transfer agreements, along with increased water conservation measures that allowed more efficient transport and utilization of water, was initially a stabilization of water levels in the Salton Sea, followed by a gradual lowering of the water surface elevations. In 2000, the water surface elevation in the Salton Sea was 228 feet below mean sea level; by October 2010, the Sea had dropped to 231.87 feet below mean sea level (USACOE and California Natural Resources Agency 2011).

Water levels in the Salton Sea are expected to decrease gradually through 2017, but beginning in 2018, when mitigation water associated with a water transfer agreement between IID and the San Diego County Water Authority is no longer delivered to the Sea, the water level is expected to recede at a much faster rate (Cohen and Hyun 2006). According to the Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report (California Department of Water Resources and CDFG 2006), the predicted surface water conditions in 2030 could range from 246 feet below mean sea level to 254 feet below mean sea level. The actual surface water elevation will depend upon the rate of inflow from various sources, as well as the water surface net evaporation rate, over this period. The greater decrease in water elevations is consistent with a predicted drop of 20 feet in water elevation in the 10 to 12 years after 2017 modeled by Cohen and Hyun (2006) under a no restoration condition.

Regardless of whether the elevation rate in 2030 is 246 or 254 feet below mean sea level, the salinity levels in the Sea at these elevations are expected to be well above levels that can support most fish, as well as the invertebrates that have historically supported the fish and migratory birds in the Sea. For example, the pileworm (*Neanthes succinea*), which has been a primary component of the Salton Sea food chain, is unlikely to be present in areas exceeding 50 mg/L (California Department of Water Resources and CDFG 2006). The consequences of this scenario are loss of foraging opportunities for fish-eating birds such as pelican, gulls, and terns, as well as substantial losses of foraging, rafting, and loafing areas for waterfowl, shorebirds, and other waterbirds. In preparation for the need to continue to provide foraging habitat to support the range of migratory bird species that have depended on the Salton Sea as a resting and fueling station for almost a century, several agencies are currently developing restoration proposals along the edge of the Salton Sea. Some proposals focus on the needs of fish-eating birds, while others will provide shallow water habitat to support shorebirds, waterfowl, and

other waterbirds. In addition, the existing managed wetland areas on the Sonny Bono Salton Sea NWR will continue to provide foraging opportunities for migratory birds.

The effects of the receding Salton Sea are already apparent on lands managed by the Refuge around the southern perimeter of the Sea. Between 2010 and 2012, a significant portion of the waters within the Red Hill Bay area, in the southeast end of the Salton Sea, receded, leaving behind exposed playa that provides no benefits for migratory birds. Similar losses of habitat have occurred at the edges of Bruchard Bay in Unit 1. By about 2030, some of the original refuge lands currently submerged below the Salton Sea will likely be exposed, as will the currently submerged lands the Service leases from IID for Refuge management.

The changes to the Salton Sea that are predicted to occur over the next 15 years will likely affect how and where habitats are managed on the Refuge. The need for the existing managed wetlands located just beyond the south end of the Sea will likely continue and could expand as water levels in the Sea decrease and the salinity level rises. How the current diversity and abundance of birds using the habitats in and around the Salton Sea will change is unknown, therefore, management on the Sonny Bono Salton Sea NWR will likely have to be adapted over the coming years to achieve the Refuge's migratory bird purposes.

Climate Change

Increasing carbon dioxide and other greenhouse gas emissions from anthropogenic sources have undeniably altered the temperature over the last century. The Intergovernmental Panel on Climate Change (IPCC 2007a), in its Summary for Policymakers, states that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Such temperature changes can have different consequences worldwide from sea-level rise to greater meteorological fluctuations.

The Service recognizes that a changing climate will affect natural resources on refuges and has been charged by the Secretary of the Interior (Secretarial Order 3289) to consider climate change during CCP and other planning processes. Anticipated impacts may include species range shifts, species extinctions, phenological changes, and increases in primary productivity. The effects of climate change on Refuge resources, facilities, and management activities are critical components of all Refuge management decisions. As part of Service's strategy for addressing climate change, the NWRS has initiated work on a national inventory and monitoring program that will provide data for a long-term understanding of the effects of changing climate on fish and wildlife and for assessing the success of conservation actions taken on the ground to help fish and wildlife adapt to climate change.

Higher temperatures and reduced annual precipitation in southern California are likely to increase the demand for water in urban areas and increase the need for water conservation in the Imperial Valley. These effects, along with increased evaporation, could result in an observable increase in the rate at which the Salton Sea recedes, exacerbating the effects of the loss of available foraging habitat for migratory birds.

Within the Coachella Valley, climate change is likely to extend drought conditions, which would affect blowsand habitats and the species these habitats support. During periods of drought, fluvial sediment delivery to the Coachella Valley floor declines, limiting the potential for rejuvenation of diminishing dune systems (USFWS 2010a). Drought conditions also reduce the foraging opportunities and water availability (e.g., decreased precipitation, groundwater levels) for native wildlife and plants, including a reduction in the arthropod populations present

in the spring, which represent an important source of food for the Coachella Valley fringe-toed lizard. On the other hand, if predictions that rainfall will increase in the southwest are realized, the abundance of invasive plants in sensitive habitat areas could increase resulting in conflicts with native plant and animal species. The presence of invasive plants could over time stabilize active dune areas and/or increase the potential for wildfires.

Monitoring must be an integral part of the management efforts implemented on these Refuges, so changes over time can be noted and measures to address adverse effects can be developed and implemented to achieve Refuge purposes and goals.

Invasive Species

Non-native plant and animal species introduced into areas where conditions are favorable for their establishment have the potential to affect native species in many ways, including predation, competition (in which exotic species outcompete native species when natural predators and/or competitors are not present), changing the physiognomy of the habitat in such a way as to interfere with essential behavior such as foraging, or altering ecological processes (e.g., exotic annual grasses and unnaturally frequent fire exacerbating one another in a positive feedback loop). Under these circumstances, non-native species can cause harm to the environment, the economy, or human health.

Non-native species that cause harm are collectively referred to as invasive species (National Invasive Species Council 2008). Invasive species are considered one of the most pervasive threats to habitat management in the NWRS. The Service recently established a pilot program to map selected invasive plant species on several refuges. Conducting inventories of priority invasive species is an integral component of invasive species management and is critical to improving our understanding of, confronting, and deterring the invasive species threat. Without inventory data, we will not be able to address the full extent of the problem, nor can we fully understand how and at what locations management will be most effective.

The Refuges of the Sonny Bono Salton Sea NWRC are primarily affected by invasive plant species, with annual invasive herbs, particularly Sahara mustard, and grasses the biggest problems on the Coachella Valley NWR. Perennial vegetation, such as salt cedar and common reed (*Phragmites australis*), can reduce habitat quality in riparian wetland areas on the Sonny Bono Salton Sea NWR.

Sand Transport Processes

The Coachella Valley MSHCP describes the aeolian sand communities of the Coachella Valley, including the sand dunes and sand fields protected within the Coachella Valley NWR, as "extremely dynamic in terms of spatial mobility and tendency to change from active to stabilized and back" (CVAG 2007a). These dynamic habitats can be affected by natural and human events. Unfortunately, human activities in the Coachella Valley can substantially change the natural processes that create and sustain these habitats. It is estimated that active sand dune habitat in the Coachella Valley suitable to support the Coachella Valley fringe-toed lizard has decreased by more than 50 percent since 1980 due to modification to and disruption of the historical sand transport processes (USFWS 2010a).

The Refuge is part of the Thousand Palms sand transport system, one of four main sand transport systems in the Coachella Valley. These systems are composed of sand source areas, fluvial transport zones, fluvial deposition/aeolian erosion areas, wind transport corridors, and aeolian sand deposition areas. Fine sand within the dune systems on the Refuge is transported by the winds from windblown sand sources in the Indio Hills. Shrubs, topographic features,

and structures slow the wind near the ground surface, causing sand to drop out and accumulate and dunes and hummocks to form near these features (USFWS 2010a). Sand accumulations increase and decrease over time depending on the extent of the upwind sand supply and the speed of the winds. When upwind sand supply is substantial, temporary accumulations of blowsand build up, creating dunes often lasting for years or decades. A reduction in the supply of additional blowsand transported from areas upwind will result in the erosion of active sand dunes because the wind erodes the blowsand from these areas faster than it is replaced. The result is depleted or eliminated dunes or hummocks. This is the case within the Thousand Palms Conservation Area; at the current rate of dune migration, the existing dunes are expected to migrate downwind at an average of 20 to 30 feet (6 to 9 meters) per year. At this rate, these dunes are expected to be extirpated by 2060 (USFWS 2010a).

Addressing the effects of natural and human actions on sand transport systems requires the continuation of current regional partnerships. In addition, active management of the sand dune habitat on the Refuge to mimic natural processes will likely be necessary in the near future, but as suggested by Barrows (1997), understanding the habitat features important to the species supported by the aeolian sand communities "is a necessary prerequisite to habitat manipulation."

Groundwater Availability

The Coachella Valley NWR is located within a portion of and hydraulically connected to the Whitewater River subbasin, the largest of the four subbasins within the upper Coachella Valley groundwater basin (Tyley 1974). This subbasin is recharged primarily by flows from the Whitewater River watershed with groundwater generally flowing from the recharge areas of the surrounding mountain fronts southeast through the center of the valley to the Salton Sea (Tyley 1974). Groundwater well data for the upper Coachella Valley groundwater basin indicate that over the last two decades water levels in the aquifer below the lands being conserved as part of the Coachella Valley MSHCP, including the Coachella Valley NWR, have dropped considerably as a result of groundwater pumping to meet the needs of the surrounding areas (CVWD 2005). Records of the water levels in several wells located along the perimeter of the Coachella Valley NWR indicate a drop in water levels between the 1990s and 2012 of about 20 feet (My Desert.com 9/9/13).

Loss of Mesquite Hummocks

In the 1990s, geologists studied a time series (1939-1995) of aerial photographs of the dunes and sand transport corridor in the Thousand Palms Conservation Area. These aerial photographs indicate the loss of large areas of mesquite hummocks within the Thousand Palms Conservation Area, including areas within the Coachella Valley NWR (USFWS 2010a). Based on the available literature, the loss of mesquite vegetation on the Refuge appears to be related to a combination of a substantial lowering of the water table (CVAG 2007b, USFWS 2010a), extended drought conditions, human disturbance, and the increased presence of invasive plant species.

Groundwater elevations on the southeast end of the Refuge in 1936 ranged from about 50 to 70 feet below the surface (Tyley 1974). Between 1936 and 1967, groundwater levels decreased by approximately 30 feet at the southeast corner of the Refuge (Tyley 1974). Some of this decline in water level has been attributed to a dry period that extended from 1946 to 1964 (Tyley 1974). This substantial lowering of the water table has likely contributed to the loss of mesquite vegetation in the southeast portion of the Refuge (USFWS 2010a).

Mesquite hummocks are believed to have historically played an important role in dune formation on the Thousand Palms Conservation Area (Barrows 1996), as they locally slowed the wind causing blowsands to drop out and accumulate. The loss of mesquite vegetation will likely have a direct long-term effect on the status of the aeolian sand communities present on the Refuge, because of the role that mesquite vegetation plays in the development and protection of dune habitat. When they were alive and foliaged, these mesquite stands served to capture blowsands, which then accumulated to form hummocks and dunes, supporting a range of species specially adapted to these blowsand habitats (USFWS 2010a). The lack of mesquite will likely expedite the loss of blowsand from the Refuge and other parts of the Thousand Palms area (USFWS 2010a).

2.5.2 Opportunities

Despite the issues and threats described here, opportunities exist for protecting the resources within the Refuge Complex, including conserving habitat quality, protecting listed species, and providing habitat to support migratory bird populations and other trust species. These opportunities include: 1) the potential to cooperatively manage conserved lands in the vicinity of each Refuge involving, as appropriate, other Federal, State, and local agencies; tribes; and land conservancies to reduce overall costs, improve the ability to control illegal access, and share knowledge that will result in more effective management of habitat and species; and 2) the potential to partner with other agencies and educational and research institutions to conduct research related to specific species habitat and foraging requirements, ecological processes, methods for optimizing restoration results, effective control of invasive plants, and other topics that would provide information essential to the long-term management of the species and habitats supported on the Sonny Bono Salton Sea and Coachella Valley NWR.

There is also the opportunity to address the changing conditions at the Salton Sea through an evaluation of the status of the lands currently managed as part of the Sonny Bono Salton Sea NWR. There may be opportunities to exchange area owned in fee-title for areas currently managed to meet Refuge purposes. Some lands currently leased from IID may no longer be needed to meet Refuge purposes and/or longer-term lease agreements for some areas could be pursued to ensure the ability to meet Refuge goals and objectives.

2.6 Development of a Refuge Vision

A vision statement, defined as “A concise statement of what the planning unit should be, or what we hope to do, based primarily upon the Refuge System mission and specific refuge purposes, and other mandates” (Service Manual, 602 FW 1.5 (Z)), has been developed for each Refuge as part of this CCP process. The Refuge vision provides a descriptive picture of how a Refuge will look in the future and describes the desired future conditions in the long term (more than 15 years). The visions for the Refuges within the Sonny Bono Salton Sea NWRC are presented in Chapter 1.

2.7 Development of Refuge Goals, Objectives, and Strategies

Goals and objectives are the unifying elements of successful Refuge management. They identify and focus management priorities, provide a context for resolving issues and concerns raised during the scoping process, guide specific projects, provide rationale for decisions, and offer a defensible link among management actions, Refuge purpose(s), Service policy, and the NWRS mission. In developing goals and objectives, there is a natural progression from the general to the specific. Goals define general targets in support of the Refuge vision, while objectives address the

incremental and measurable steps to be taken to achieve the goals. Finally, strategies identify specific tools, actions, or techniques that would be implemented to accomplish project objectives.

The goals and objectives provide long-term guidance to Refuge managers and staff and help integrate science, improve management practices, and justify compatible use decisions. The Refuge System defines goals as a "…descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units" (Service Manual, 602 FW 1). The goals for each refuge within the Complex are presented in Chapter 1.

Each goal is subdivided into one or more objectives. Objectives are defined as "concise statements of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work" (Service Manual, 602 FW 1). The number of objectives per goal can vary depending upon the number needed to satisfy a particular goal. In cases where there are many objectives, an implementation schedule may be developed to better define when and how the strategies presented under each objective would be implemented to ensure that each objective and the overarching goals can be effectively and efficiently achieved. The objectives and strategies for the alternative selected for implementation on each refuge are presented in Chapter 3.

2.8 Development of Alternatives

As indicated earlier, each CCP must comply with the provisions of NEPA. To facilitate compliance, the requirements of NEPA have been integrated directly into the overall CCP process. This includes the requirement to analyze a reasonable range of alternatives or approaches to Refuge management that could be reasonably undertaken to achieve Refuge goals and refuge purposes. The Refuge Planning policy (602 FW 1) defines alternatives as "different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues."

The process of developing alternatives involves analyzing current conditions, identifying various measures that—if implemented—would help achieve Refuge goals, and incorporating, as appropriate, input provided during the public scoping process and from the core and extended planning teams, as well as from other information gathered during subsequent meetings and workshops. As required by NEPA, one of the alternatives that must be analyzed is the "no action" alternative, which constitutes a continuation of current conditions and management practices. The draft CCP/EA analyzed three alternatives, a no action alternative and two action alternatives, for each Refuge (the Sonny Bono Salton Sea NWR and the Coachella Valley NWR). An equal and full assessment of the effects to the human environment of implementing each of the alternatives was conducted. Appendix F provides additional information about the alternatives considered during this process.

2.9 Selection of the Proposed Action

Based on the analysis of the effects on the environment of implementing the various alternatives, and taking into consideration Refuge purposes and goals, we have selected Alternative B (Restore and Enhance Habitat Quality; Expand Opportunities for Wildlife Observation, Environmental Education, and Interpretation) for implementation on the Sonny Bono Salton Sea NWR and Alternative B (Expand Management Actions to Support Listed and Sensitive Species; Expand Public Outreach) for implementation on the Coachella Valley NWR. We have selected these alternatives for implementation because they can best achieve the purposes, vision, and goals of these Refuges; help fulfill the Refuge System mission; are consistent with principles of sound fish

and wildlife management; and minimize adverse effects on the environment. The selected alternative for the Sonny Bono Salton Sea NWR was modified slightly to incorporate one of the visitor services proposals included in Alternative C. This proposal envisions the development of an interpretive auto tour route in the Imperial Valley in partnership with other agencies and organizations to highlight the many natural, cultural, and economic resources of the region.

2.10 Plan Implementation

During the 15 years following CCP approval, the CCP will serve as the primary reference document for all Refuge planning, operations, and management. The CCP presents wildlife and habitat management, visitor services (public use), and other Refuge operations objectives that when implemented are intended to achieve Refuge goals and purposes. It also describes the specific strategies to be implemented to achieve the various objectives. Refuge staff will review the CCP when preparing annual work plans and updating future project and maintenance management databases.

The CCP may be reviewed during routine inspections or programmatic evaluations. The results of these reviews or other monitoring efforts may indicate a need to modify one or more implementation strategies if the desired outcomes anticipated in the CCP are not being achieved. If minor changes are required, the level of public involvement and NEPA documentation will be determined by the Refuge Manager. Major changes to Refuge goals or objectives would require formal revisions to the CCP. In addition, the CCP will be evaluated and formally revised, as necessary, approximately every 15 years.

3. Refuge Management

3.1 Overview of Refuge Goals, Objectives, and Strategies

The development of Refuge goals and objectives is one of the most important components of the CCP process. It is through this process that we establish the desired future conditions of the Refuge. Goals and objectives are the unifying element of Refuge management, intended to identify and focus management priorities and provide a link between management actions, Refuge purposes, and the National Wildlife Refuge System mission and goals. Goals, which define general targets in support of the Refuge vision, are ". . . descriptive, open-ended, and often board statements of desired future conditions that convey a purpose but do not define measurable units" (Service Manual, 602 FW 1). Full achievement of Refuge goals may or may not be feasible within the 15-year time frame of the CCP, but the management actions and programs described in this chapter are intended to move us closer to realizing the Refuge vision.

The path toward achieving Refuge goals is defined by the objectives and strategies developed during the CCP process. The objectives, which are derived from the goals and provide the basis for determining strategies and monitoring, are concise statements of what will be achieved to meet a particular goal. Objectives should be specific, measurable, achievable, results oriented, and time fixed; and they should be feasible within the 15-year lifespan of the CCP. Refuge strategies describe specific actions, tools, and techniques that can be used to meet Refuge objectives. In some cases, strategies describe specific projects in enough detail to assess funding and staffing needs. In other cases, further site-specific detail is required to implement a strategy. This additional detail can take the form of a step-down plan, restoration plan, or site plan.

The goals presented in this CCP will not change until they are reevaluated as part of a formal CCP revision process; however, objectives and strategies may be revised to better address changing environmental conditions and/or resource needs, or to take advantage of increased knowledge of Refuge resources.

3.2 Goals for the Refuges of the Sonny Bono Salton Sea NWRC

The goals that follow provide the context for the management actions that will be implemented on the Sonny Bono Salton Sea NWR and the Coachella Valley NWR.

3.2.1 Sonny Bono Salton Sea NWR

The goals for the Sonny Bono Salton Sea NWR include:

Goal 1: Protect, manage, enhance, and restore foraging, loafing, and nesting habitats on the Refuge to support migratory birds.

Goal 2: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of federally and State listed threatened and endangered species and other species of concern known to occur on the Refuge.

Goal 3: Manage and protect remnant native desert scrub habitat, tree rows, and riparian areas on the Refuge to support resident bird and other wildlife species, as well as nesting habitat for Neotropical bird species.

Goal 4: Work in partnership with other Federal, State, and local agencies and tribes to restore, enhance, and adaptively manage habitat functions that support fish and bird life, as well as to protect other resources of region-wide significance, in and around the Salton Sea.

Goal 5: Enhance the public's awareness, appreciation, and enjoyment of the Refuge's biological resources by providing opportunities for compatible wildlife-dependent recreational uses.

3.2.2 Coachella Valley NWR

The goals for the Coachella Valley NWR include:

Goal 1: Protect, restore, and enhance Refuge lands to contribute to the recovery of the federally threatened Coachella Valley fringe-toed lizard and endangered Coachella Valley milk-vetch, as well as to conserve other species of concern supported on the Refuge.

Goal 2: Through participation in a coordinated management effort involving all of the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP) partners, sustain the ecological and evolutionary processes necessary to maintain the viability of the natural communities and habitats that support the species identified in the CVMSCP and manage these communities and habitats adaptively to be responsive to short- and long-term environmental change.

Goal 3: Enhance the public's awareness, appreciation, and support for the Refuge's listed and sensitive species, as well as the ecological functions and geological processes that sustain these species, through compatible opportunities of environmental interpretation.

3.3 Refuge Objectives and Strategies

3.3.1 Sonny Bono Salton Sea NWR

The objectives established for meeting the goals of the Sonny Bono Salton Sea NWR and the strategies to be implemented to achieve these objectives are presented here.

Goal 1: Protect, manage, enhance, and restore foraging, loafing, and nesting habitats on the Refuge to support migratory birds.

***Objective 1.1*: Managed Agricultural Lands**
Throughout the 15-year life of the CCP, continue to provide approximately 2,650 tons of green forage on approximately 870 acres of agricultural lands within the Refuge to support approximately 30,000 geese annually.

Rationale:
Managing a portion of the Refuge to provide forage for wintering waterfowl, primarily geese, addresses two of the Refuge purposes (i.e., protecting wildlife, reducing crop depredations by wintering waterfowl by providing adequate foraging opportunities within the boundaries of the Refuge). To accomplish the latter purpose, the Service has grown crops on the Refuge to

provide food for wintering waterfowl since the 1940s (USDOI 1972). In addition, other lands on the Refuge are managed to provide freshwater areas where waterfowl can rest, loaf, and forage. A number of different crops have been cultivated for this purpose over the years, but today, the primary forage crop provided in the managed agricultural fields is rye grass.

Although the diversity and abundance of migratory waterfowl present on the Refuge has changed over the years, the need to reduce crop depredation has not. In the 1960s, supplemental food was provided for both ducks and geese. Today, the managed agricultural fields on the Refuge are intended to support primarily geese, including lesser snow geese, Ross' geese, white-fronted geese, and some Great Basin Canada geese. Individuals that make up the Lower Colorado population of greater sandhill cranes also frequent these managed fields in the winter.

During the winter of 2011/2012, an estimated 25,000 geese (primarily lesser snow geese and Ross' geese) overwintered on the Refuge (Ducks Unlimited at http://in.ducks.org/conservation/where-we-work/sonoran-and-mohave-deserts/more-information, accessed on 5/10/12) and foraged on approximately 870 acres of managed agricultural lands. Little information is available regarding the consumption of agriculturally grown grass (e.g., rye, wheat, barley) by lesser snow goose. However, a study by Hupp et al. (1996) provides some basis for determining how much green forage is required to support the current numbers of geese that winter in the vicinity of the Refuge. The Hupp et al. study determined that lesser snow geese consumed between about 662 grams per day of wet mass cotton-grass while staging at the Arctic NWR during autumn staging.

In another study conducted in Texas by Alisauskas et al. (1988), lesser snow geese wintering in a harvested rice field consumed approximately 919 grams per day of forage, which consisted mainly of germinated green vegetation (i.e., 28 percent graminoids, 70 percent forbs). Extrapolated out, a snow goose at the Sonny Bono Salton Sea NWR likely consumes between about 80 to 111 kilograms (662 grams per day x 121 foraging days foraging and 919 grams per day x 121 foraging days, respectively) of grass forage during the winter season, which extends from about November 1 to February 28. As a result, if the Refuge hosts 25,000 geese during the winter season, between 2,002,500 and 2,780,000 kilograms (2,207 to 3,064 tons) of green forage would be needed to adequately support the current numbers of snow geese that winter at the Refuge.

In a study at the University of California Imperial Valley Field Station, rye grass growth was monitored to determine total production of fields supplemented with fertilizer (Worker 1978). In this case, standard rates of ammonium nitrate fertilizer (120 pounds of nitrogen per acre pre plant with 40 pounds per acre applied after each cutting) were applied to the site. Between early October, when the crop was planted, and March 1, the total production was nearly 3 tons per acre dry weight. If the Refuge produced an average crop of rye grass with fertilization similar to the above referenced study on 870 acres, the anticipated production for the season would be approximately 2,610 tons of dry matter goose forage. Dry matter in rye grass normally is only about 16 percent of the total wet weight, therefore, the total yield of rye grass expected within the Refuge's managed fields would exceed the tonnage required to support snow geese on the site throughout the winter. Additionally, the Refuge's managed wetland areas produce watergrass (*Echinochloa crus-galli*), swamp-timothy (*Crypsis schoenoides*), alkali bulrush (*Scirpus robustus*), cattail (*Typha* sp.), and other seed, vegetative and tuberous plants to help waterfowl meet their nutritional and caloric requirements throughout the winter.

Managed Agricultural Lands Strategies

- Continue to implement no till methods on approximately half of the managed agricultural fields.
- Continue to inspect and maintain the tile drain system within the managed agricultural fields to provide optimum soil conditions for forage crops.
- Laser level the managed agricultural fields to improve water distribution throughout the fields, with the intent of increasing total crop yields.
- Explore methods and potential new crops to optimize forage opportunities for geese.
- Explore the use of soil microbes and/or soil amendments to enhance crop productivity.
- Control invasive weeds to improve forage crop productivity for geese in managed fields by implementing an integrated approach to pest management that includes a combination of mechanical and chemical control, and occasional use of prescribed fire.
- Investigate using cooperative farming agreements on the Refuge that are compatible with Refuge purposes to reduce costs and labor.

***Objective 1.2*: Managed Seasonal Shallow Wetlands**

Throughout the 15-year life of the CCP, annually produce wetland plants (e.g., watergrass [Echinochloa crus-galli], swamp timothy [Crypsis schoenoides], alkali bulrush [Scirpus robustus]) to provide green forage and seeds for migrating waterfowl on approximately 700 acres of seasonally flooded managed ponds using moist soil management techniques to achieve at least 80 percent coverage of the desired green forage plants.

Rationale:

Migratory birds are Federal trust species under the jurisdiction of the Service, and their conservation and management are among the purposes for which the Sonny Bono Salton Sea NWR was established. Waterbird surveys conducted at the Salton Sea and adjacent areas in 1999 identified 107 species of native birds, including 19 species of waterfowl and more than 25 species of shorebirds (Shuford et al. 2002). As the Salton Sea continues to recede, the shallow seasonal wetlands managed on the Refuge will serve a continuously greater role in supporting migrating and wintering waterfowl and shorebirds that travel along the Pacific Flyway.

The seasonal shallow wetlands managed on the Refuge are provided to supplement the foraging opportunities for migratory waterfowl that are provided within the Refuge's managed agricultural fields. The foliage and seeds of wetland plants such as watergrass, swamp timothy, and alkali bulrush, as well as aquatic invertebrates, that thrive in the moist soil areas of these seasonal wetlands provide waterfowl with the additional nutrients needed for a balanced diet (Smith et al. no date). Providing wetland forage for wintering waterfowl requires that seasonal wetland areas be flooded annually in October to a depth of between four and 10 inches and maintained until about March, when the fields are drained. Shorebirds also benefit from these wet areas, particularly in the spring when the water in the ponds is drawn down.

Providing seasonal wetlands to meet the needs of the species that travel along the Pacific Flyway supports the general principle of the North American Waterfowl Management Plan (North American Waterfowl Management Plan Plan Committee 2004), which is "to maintain or restore traditional distributions of waterfowl in North America, consistent with long-standing patterns of waterfowl utilization." Providing these wetlands is also consistent with the Intermountain West Regional Shorebird Plan (Oring et al. 2000) goal of maintaining and enhancing diverse landscapes that sustain thriving shorebird populations.

Although the system-wide mission of the NWRS highlights the importance of maintaining the biological integrity, diversity, and environmental health of a refuge for future generations, it also recognizes that individual refuges may at times find it necessary to compromise elements of biological integrity, diversity, and environmental health at the refuge scale in support of those components at larger landscape scales (FWS Manual 601 FW3). In the case of the Sonny Bono Salton Sea NWR, restoring the biological integrity (which at the highest measure is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions) of the lands within the Refuge would not achieve Refuge purposes, nor would it address the loss of migratory bird habitat that is presently occurring within the Salton Sea. In evaluating an adaptive framework for the NWRS that addresses refuge vulnerability to climate change, in conjunction with other anthropogenic drivers, Magness et al. (2011) recognized the need for an adaptive management approach that allows for flexibility at various landscape scales throughout the reserve network in an effort to moderate harm to trust resources, as well as exploit beneficial opportunities. The strategies for this Refuge that involve highly managed habitat areas are intended to support a diversity of species that have been compromised by the extensive loss of wetland habitat at an international (Pacific Flyway) landscape scale.

Managed Seasonal Shallow Wetlands Strategies

- Continue to maintain shallow wetland areas between October and March when the highest numbers of migratory waterfowl are present on the Refuge.
- Work with the IID to identify and develop water management practices that will improve water use efficiency in shallow seasonal wetland areas and throughout the Refuge.
- Direct spill water from seasonal wetland areas to managed agricultural lands and/or areas that support tree rows in an effort to optimize water use on the Refuge.
- Hire a full-time position (WG 6) responsible for irrigation and water movement throughout the Refuge that is necessary to achieve the objectives for seasonal shallow wetlands, as well as managed agricultural lands, managed cattail marsh, and permanent open water wetlands.
- Continue to develop the soils within the ponds to achieve optimum vegetative productivity.
- Using an integrated approach to pest management, continue to control salt cedar in and around the perimeter of these wetlands.
- Continue the practice of delaying drawdown in some ponds to provide shallow wetland habitat for migratory shorebirds that spend part or all of the spring and summer months on the Refuge.

***Objective 1.3*: Permanent Open Water Wetlands**

Throughout the life of the CCP, continue to manage approximately 110 acres of existing permanent, unvegetated, brackish open water areas with water depths ranging from one to three feet within Units 1 and 2 and maintain at least 10 unvegetated islands of various sizes within these permanent open water areas to provide nesting and roosting habitat for gull-billed terns, black skimmers, and other nesting seabirds.

Rationale:

The results of the comprehensive waterbird surveys conducted in 1999 (Shuford et al. 2002) in and around the Salton Sea demonstrate the importance of open water wetlands in this area to more than 100 species of birds, including pelecaniformes (i.e., pelicans, cormorants), wading birds (e.g., herons egrets, ibis, storks), shorebirds, and larids (e.g., gulls, terns). Providing open water habitat to support these birds is consistent with North American Waterbird

Conservation Plan (Kushlan et al. 2002) goal of protecting, restoring, and managing sufficient high quality habitat and key sites for waterbirds throughout the year to meet species and population goals.

These permanent open water areas, which receive a continuous flow of freshwater from IID supplied water, as well as water that is drained into these areas from other wetlands on the Refuge, are maintained at depths of from one to three feet to support rafting and foraging waterbirds and deter access by mammals to nesting islands. The salinity levels within these areas are not managed, but due to evaporation and existing salts in the soil, salinity levels are generally high enough (brackish) to minimize the potential for invasion by freshwater wetland vegetation.

Minimal disturbance and lack of predators are important determinants of successful seabird breeding (USFWS 2005); therefore, the small islands provided within the Refuge's permanent open water wetlands provide greater protection for these ground nesting birds than would unvegetated areas around the perimeter of open water areas. Protected roosting sites are also important for seabirds and other waterbirds. The maintenance of unvegetated nesting islands within these open water wetlands supports the habitat management goal of the Pacific Region Regional Seabird Conservation Plan to "maintain, protect, and enhance seabird habitats (breeding, roosting, foraging, migrating and wintering) in sufficient quantity and quality to meet seabird needs" (USFWS 2005).

Permanent Open Water Wetlands Strategies

- Continue to manage and maintain the existing permanent open water wetland areas within Units 1 and 2 by providing a continuous flow of freshwater water into these wetland areas.
- Continue to implement maintenance actions (e.g., erosion control around island perimeters, vegetation control, nesting substrate enhancement), as necessary, on the existing islands within the permanent open water areas to provide quality nesting habitat for seabirds.
- To minimize the growth of freshwater emergent vegetation, particularly cattails, and maintain open water areas, sustain slightly elevated salinity levels within these wetlands.
- Using an integrated approach to pest management, continue to control salt cedar and other invasive plants in and around the perimeter of these wetlands.
- Work with the IID to identify and develop water and habitat management actions that will improve water use efficiency in permanent open water wetlands and throughout the Refuge.

***Objective 1.4*: Restored Salton Sea Wetlands**

By 2015, actively begin the phased restoration of Red Hill Bay to provide a total of 420 acres of shallow (six inches to one foot in depth), unvegetated wetlands with salinity levels ranging from 20 to 30 ppt to support foraging and loafing habitat for shorebirds, long-legged wading birds, waterfowl, and seabirds; and continue to work cooperatively with the USACOE and California Resources Agency on efforts to restore up to 1,600 acres of unvegetated, saline (typically 20 to 40 ppt, occasionally up to 50 ppt) wetlands on the Refuge (part of a larger restoration effort in Bruchard Bay involving the construction of independent pond and cascading pond units totaling approximately 3,770 acres) with water depths generally ranging from 0 and 6 feet, but also including excavated holes of greater depths (up to 12 feet) to accommodate a range of foraging needs for fish-eating birds and other migratory birds.

Rationale:
The Sonny Bono Salton Sea NWR was established in 1930 "as a refuge and breeding ground for birds and wild animals," and additional lands were acquired or leased for the management of migratory birds under the Migratory Bird Treaty Act and the Lea Act. As the Salton Sea recedes, the Refuge's open water areas of the Salton Sea, areas that support or have supported a range of migratory birds from fishing-eating birds to shorebirds and waterfowl - are being eliminated both by the direct loss of water due to evaporation and through the degradation of water quality (e.g., increased salinity levels, temperature extremes, eutrophication, anoxia, and increase algal productivity) (USACOE and California Natural Resources Agency 2011).

Despite its origins, the Salton Sea has for many years been considered one of the most important wetlands to wintering, migratory, and breeding waterbirds in North America (Jehl 1994, Shuford et al. 2002), in part because the Sea provides habitat for species displaced by the loss of wetlands elsewhere within the Pacific Flyway, including within California where approximately 91 percent of the historic wetland habitat has been lost to agriculture and other forms of development (Yuhas 1996).

As the salinities within the Salton Sea continue to rise, the availability of adequate forage species to sustain fish-eating birds has declined sharply. The variety of marine sport fish once available for pelicans, double-crested cormorants, and black skimmers are no longer present in the Salton Sea and the remaining populations of tilapia and several smaller nonsport fish species are dwindling (USACOE and California Natural Resources Agency 2011). In addition, pileworms and barnacles, primary components of the Salton Sea food web, also appear to be impacted by deteriorating water quality (USACOE and California Natural Resources Agency 2011).

The State of the Birds report for 2011 (North American Bird Conservation Initiative 2011) identifies continued investment in wetland conservation and management as an important component of addressing the conservation challenges of maintaining healthy populations of birds. To address the changing conditions at the Salton Sea, which pose a threat to tens of thousands of migratory and wintering shorebirds and waterfowl, as well as breeding seabirds and other waterbirds, a range of Federal, State, local, and tribal governments are designing projects in and around the Salton Sea to reestablish habitat needed to support the diversity of waterbirds (e.g., pelicans, shorebirds, seabirds, waterfowl) that rely on the Salton Sea as a migratory stop-over, wintering ground, breeding area, or year-round foraging site.

Consistent with the purposes for which the Sonny Bono Salton Sea NWR was established, the Refuge proposes to participate in a variety of Salton Sea restoration efforts, including the restoration of permanent open saline water areas.

Restored Salton Sea Wetlands Strategies

- Restore approximately 420 acres of shallow, saline water habitat in Red Hill Bay in an effort to maintain recent historical Salton Sea wetland values on this part of the Refuge.
- Coordinate with IID to divert water from the Alamo River to blend with Salton Sea water for the restoration of Red Hill Bay.
- To protect the health of the avian species supported by restored open saline water habitat, partner with USGS to monitor selenium levels within the restored habitat areas, and develop measures that can be implemented to reduce selenium levels should monitoring indicate the need for such measures.

- Incorporate measures into the design of the water delivery and pumping systems needed to maintain managed saline water habitat that will avoid loss and injury to desert pupfish.
- Include habitat features within proposed saline water habitats to support desert pupfish should they enter these managed habitat areas.
- Create and maintain islands within these managed habitats to support gull-billed tern and black skimmer nesting.
- As part of the Red Hill Bay restoration project, implement a multiple year monitoring program to monitor selenium and pesticide levels and the effect, if any, of these constituents on the biotic and abiotic functions of the created habitat.
- Encourage research projects that can help guide the future management of currently proposed and future managed habitat systems in the Salton Sea basin.
- Continue to partner with others in the planning and implementation of the Salton Sea SCH Project, which proposes to restore habitat values within some 3,770 acres of permanent ponded wetlands (potentially including 1,600 acres within the Refuge boundary) at the southern edge of the Salton Sea.

Goal 2: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of federally and State listed threatened and endangered species and other species of concern known to occur on the Refuge.

Objective 2.1: Managed Cattail Marsh
By 2016, work with partners to secure a source of water of sufficient quantity and quality to provide for the long-term (i.e., minimum 25 years) continued active management of at least 180 acres of cattail marsh habitat - consisting of a mosaic of emergent vegetation averaging greater than six feet (2 meters) high (Anderson and Ohmart 1985, Eddleman 1989) with varying stem densities (Smith 1975, Bennett and Ohmart 1978, Conway et al. 1993), shallow open water areas with minimal daily water fluctuation, and open dry ground (slightly higher than the water level) (Anderson and Ohmart 1985, Eddleman 1989, Conway et al. 1993) to support the endangered Yuma Ridgeway's rail at a density of 0.50 rails or more per acre.

Rationale:
Natural cattail/bulrush marshes in the Colorado River Delta are thought to be the primary habitat that historically supported the federally listed endangered Yuma Ridgway's rail. Unfortunately, diversion of water from the lower Colorado River has all but eliminated freshwater flows down into the Delta, and as a result, this native habitat has been lost (USFWS 2009a). Today, the Yuma Ridgway's rail exists primarily in managed cattail ponds, such as those on the Refuge, or other similar habitat areas created as a result of human activity (e.g., effluent-supported marshes, behind dams and diversion structures).

Generally, low stem densities and low residual vegetation coverage are indicative of suitable Yuma Ridgway's rail habitat (Conway et al. 1993), with lower stem densities (less than 75 to 80 stems per square meter) supporting significantly more rails during the breeding seasons (Smith 1975, Bennett and Ohmart 1978). The rails use areas with slightly higher stem densities during the late summer and fall (Anderson and Ohmart 1985, Eddleman 1989).

Other features with significant changes in seasonal use included distance to the adjacent uplands and vegetative edge and percent residual vegetation (the accumulation of fallen cattails) from previous years. The presence of too much residual vegetation adversely affects

habitat quality and overall rail use (Conway and Nadeau 2005). Active management actions, largely through use of prescribed burning, eliminate the residual vegetation and restore the appropriate stem densities (Conway and Nadeau 2005); however, additional research is needed to define the proper cycle of burns.

In considering water quality issues that could affect the Yuma Ridgway's rail, Eddleman (1989) identified selenium as a potential threat to the survival and recovery of the rail. Although the lower Colorado River (including the Salton Sea and Mexico) does not contain local sources of selenium that contribute to selenium levels in the biological environment, selenium from the seliniferous soils of the Mancos shale formations in the Upper Basin (Utah, Wyoming, and Colorado) are transported via the river water to the lower Colorado River where evaporation concentrates the selenium in the water. At present, the selenium level in the Colorado River water coming into the Imperial Valley is somewhat higher than 2.0 μg/L, which is the maximum desirable level recommended by the Department of the Interior. To ensure the highest possible habitat quality for the Yuma Ridgway's rail, the Refuge should strive to maintain the lowest selenium concentration practicable within areas managed for rail habitat.

The draft revised recovery plan for the Yuma Ridgway's rail states that "to achieve recovery, the Yuma Ridgway's rail must reach and maintain a viable population level and have sufficient protected and managed marsh habitat [including movement corridors that connect these habitats] to provide for long-term persistence of populations in the three major core areas" (i.e., the lower Colorado River, Salton Sea, Cienega de Santa Clara) (USFWS 2009a). The draft recovery plan also stresses the importance of water availability, water quality, and ongoing habitat management in maintaining suitable conditions for rails (USFWS 2009a). The strategies presented below would assist in achieving these stated recovery goals.

Management of the Refuge's freshwater cattail marsh habitat to support the Yuma Ridgway's rail also provides benefits to other secretive marsh birds, including the California black rail, a State-listed species (CDFG 2008) and a Service-recognized Bird of Conservation Concern (USFWS 2008a), and the least bittern, a California Bird Species of Special Concern (CDFG 2008) and a Service-recognized Bird of Conservation Concern (USFWS 2008a).

Managed Cattail Marsh Strategies

- Continue to manage at least 180 acres of cattail marsh in a manner that will provide suitable habitat conditions to support the Yuma Ridgway's rail.
- Continue to conduct annual spring surveys of the Refuge's cattail marsh habitat to monitor the Refuge's Yuma Ridgway's rail population size and review current and past survey data to identify any changes in population status that may warrant reevaluation of current management practices.
- Control the establishment of common reed within managed cattail marsh habitat and salt cedar around the perimeter of the marsh through the implementation of an integrated approach to pest management.
- Work with the IID to ensure that the Refuge will be provided with an adequate supply of water of appropriate quality to continue to provide managed cattail marsh habitat to support the current population of Yuma Ridgway's rails on the Refuge.
- By 2016, prepare a Yuma Ridgway's rail habitat management plan, per the direction provided in the draft Yuma Clapper Rail (now referred to as the Yuma Ridgway's Rail) Recovery Plan (USFWS 2009a), to address the long-term management needs of the Refuge's Yuma Ridgway's rail population.

- Seek funding to support research projects that can provide data necessary to: 1) refine suitable habitat parameters for this species in various seasons; 2) assist in identifying appropriate management techniques for maintaining suitable rail habitat over the long-term; 3) maintain adequate water quality within managed areas; 4) evaluate potential threats related to selenium accumulation; 5) evaluate the role of prescribed fire in offsetting vegetation maturity and other habitat degradation; 6) understand rail response and dispersal into new habitat areas as a result of the use of prescribed fire; and safely and effectively controlling invasive plant species in managed habitat areas.

***Objective 2.2*: Desert Pupfish (Cyprinodon macularius)**
In coordination with CDFW and the Palm Springs Fish and Wildlife Office, develop and by 2015 begin to implement a desert pupfish management strategy for the Refuge that includes annual monitoring for the presence of desert pupfish within Refuge wetlands and identifies conservation measures to be implemented to avoid adverse effects to desert pupfish as a result of Refuge management actions implemented to achieve Refuge purposes.

Rationale:
The desert pupfish, which was first documented in the vicinity of the Salton Sea in 1859, currently occurs in two streams tributary to, and in shoreline pools and irrigation drains of, the Salton Sea (Lau and Boehm 1991). Desert pupfish are not currently managed on the Sonny Bono Salton Sea NWR and until recently, this species was not known to occur in the managed habitats on the Refuge. Inadvertent connections to managed habitat areas from adjacent irrigation drains can result in the establishment of desert pupfish within one or more of the Refuge's managed wetland areas. To avoid the unintentional take of desert pupfish during habitat maintenance, it is important to know if pupfish are present in an area that may be drained or otherwise significantly disturbed prior to taking any action. In addition, conservation measures should be in place that can be implemented to avoid adverse effects if the species is present.

According to the Service's 5-year review of the desert pupfish, "the desert pupfish population as a whole is presently stable, though still small, disjunct, and vulnerable to stochastic events that could result in local extirpations. Local populations may be far more variable due to a variety of factors such as amount of habitat, presence of nonnative species, and other threats" (USFWS 2010b). Critical habitat has been established for this species; however, it does not include any areas within the Sonny Bono Salton Sea NWR.

Lau and Boehm (1991) found desert pupfish to be widely distributed in drains that gravity flow into the Salton Sea. Pupfish also have been documented in at least one of the managed habitat areas on the Refuge, where they could be at risk due to the high level of management activity that occurs within these habitats. Examples of such management activities include removing accumulated silt from irrigation drains to facilitate proper drainage and drawing down permanent open water areas to implement repairs on nesting islands. These activities, which are necessary to achieve Refuge purposes, can result in adverse effects to desert pupfish, if they are present. A potential conservation measure may involve the relocation of pupfish found to be occupying highly managed areas of the Refuge to appropriate habitat in the Salton Sea, adjacent drainage ditches, or other parts of the Refuge. By implementing this measure, the potential harm to pupfish would be minimized and the Refuge could continue to manage habitats in accordance with its migratory bird purposes.

Desert Pupfish Strategies

- Work with CDFW and others to monitor water areas within the Refuge, including proposed Salton Sea and Red Hill Bay restoration areas, for the presence of desert pupfish.
- Develop a desert pupfish strategy in coordination with CDFW and the Palm Springs Fish and Wildlife Office that would set forth conservation measures for protecting desert pupfish from adverse effects as a result of ongoing Refuge management actions, including the potential for relocation of desert pupfish from highly managed areas to appropriate habitat within or in the vicinity of the Refuge.
- Incorporate appropriate habitat features to support desert pupfish within the Red Hill Bay restoration site.
- To support the genetic diversity of the desert pupfish population, partner with CDFW to relocate desert pupfish to appropriate locations on or off the Refuge.

***Objective 2.3*: Western Gull-billed Tern (Gelochelidon nilotica vanrossemi)**
Throughout the life of the CCP, continue to maintain approximately 0.5 acres of unvegetated, fine gravel-surfaced islands of variable sizes surrounded by water depths ranging from one to three feet within the permanent open water areas in Units 1 and 2 to provide nesting habitat for the western gull-billed tern; and by 2018 provide at least eight similarly designed and maintained islands (totally approximately two acres) as part of the Red Hill Bay restoration project.

Rationale:
The western gull-billed tern, designated as a Bird of Conservation Concern by the Service (USFWS 2008a) and identified as a Bird Species of Special Concern by the State of California, has nested in the vicinity of the Salton Sea since at least the 1920s (Molina 2008). Until 1986, this was the only breeding site for western gull-billed terns in the U.S. Today, western gull-billed terns also breed within southern California, primarily within the South San Diego Bay Unit of the San Diego Bay NWR (USFWS 2006a).

For many years, the Sonny Bono Salton Sea NWR supported large numbers of nesting western gull-billed terns; however, recently, the total number of nesting birds and birds fledged on the Refuge has been decreasing. Potential causes include depredation by raccoons (*Procyon lotor*) and coyotes (*Canis latrans*), over-crowding due to the presence of Caspian terns (*Hydroprogne caspia*) and California gulls (*Larus californicus*), and limited nesting areas. Opportunities for providing additional defensible nesting sites on the Refuge are limited by water availability, however, the Red Hill Bay and Salton Sea SCH projects will provide an opportunity to create new nesting islands suitable for use by western gull-billed terns.

Gull-billed Tern Strategies

- Improve nesting conditions in Unit 1 by augmenting silty nesting substrates on the nesting islands with barnacle shells and depositing rock around the island perimeters to minimize erosion.
- Annually remove vegetation on and near all nesting islands.
- To minimize take of gull-billed tern eggs and chicks, implement an integrated predator management program using non-lethal (e.g., electric fencing) and, where necessary, targeted lethal predator control measures in accordance with the Predator Management Plan prepared for the Refuge (Appendix H).

- Construct and maintain new nesting islands in appropriate locations within the Red Hill Bay restoration project.
- Working with Federal and State partners, incorporate the creation of new nesting islands within the Salton Sea SCH project.
- Annually monitor use and productivity within potential western gull-billed tern nesting areas.
- Ensure the adequate availability of water around nesting islands to protect the health and survival of nesting gull-billed terns.

***Objective 2.4*: Monitoring Waterbird Abundance and Diversity**
To facilitate the ongoing assessment of trends in abundance, diversity, and distribution of migratory and resident waterbirds at the Salton Sea and within the managed areas of the Refuge, as well as to provide information necessary to address flyway management needs now and into the future, continue to participate in aerial waterfowl surveys monthly between November and February; sandhill crane surveys monthly between October and March; Yuma Ridgway's rail surveys three times a year (March through May); annual western gull-billed tern nesting surveys between April and August; and partner with CDFW to conduct monthly waterbird surveys on the Salton Sea.

Rationale:
Currently, the wetland habitats present at the Salton Sea and within the Sonny Bono Salton Sea NWR support a number of waterbird species that are of regional or continental importance, including at least 16 species identified by the Service as Birds of Conservation Concern (USFWS 2008a) and 14 species of waterfowl of high or moderately high continental priority per the Sonoran Joint Venture Bird Conservation Plan Waterfowl Management Supplement (Beardmore 2007). These habitats provide wintering, stop-over, and breeding areas for a range of waterbirds, and although the species present in the area varies with the seasons, the number of birds and diversity of species present remain high throughout the year (Shuford et al. 2002).

The combination of a receding Salton Sea with continually rising salinity levels and uncertainty regarding the long-term availability of water to support the Refuge's managed habitat areas has raised concerns regarding future waterbird abundance and diversity at the Salton Sea. To better understand how changes at the Salton Sea are affecting past and present bird abundance and diversity, it is necessary to continue on-going monitoring efforts.

The U.S. Shorebird Conservation Plan (Brown et al. 2001), Sonoran Joint Venture Bird Conservation Plan Waterfowl Management Supplement (Beardmore 2007), and Intermountain West Regional Shorebird Plan (Oring et al. 2000) all address population and habitat objectives for healthy waterbird populations. Sharing the information obtained as a result of these ongoing waterbird surveys and monitoring efforts will allow the Refuge, other agencies, and flyway partners to assess any changes in diversity and/or abundance at the Salton Sea, to evaluate how these changes relate to current population objectives, to make predictions for how trends could progress over time, and to begin to develop proposals for offsetting the effects of any adverse trends associated with the changing environment at the Salton Sea.

Migratory and Resident Waterbird Strategies
- Continue to conduct gull-billed tern breeding surveys that also include incidental counts of associated breeding seabirds, annually between April and August.
- Continue to conduct annual aerial waterfowl surveys monthly between November and February.

- Continue to conduct annual sandhill crane surveys monthly between October and March.
- Continue to conduct annual secretive marsh bird surveys, with particular focus on the Yuma Ridgway's rail, three times a year between March and May.
- Continue to partner with CDFW to conduct monthly Salton Sea waterbird surveys.
- Continue to monitor for evidence of avian disease on the Salton Sea throughout the year.
- Consistently disseminate survey and monitoring data to interested agencies, flyway partners, and other partners in bird conservation, encouraging assessment of the trends occurring at the Salton Sea on regional and/or flyway populations.
- Support management-oriented research related to waterbirds.
- Manage areas of seasonal wetlands and permanent shallow open water wetlands to support a range of waterbirds, including shorebirds, wading birds, gulls/terns, and waterfowl, as described under Objectives 1.2 and 1.3.
- Restore shallow, open water habitat in Red Hill Bay, as described under Objective 1.4.
- Partner with others to restore deep water habitat in the Salton Sea to support fish-eating birds, as described under Objective 1.4.
- Manage areas of cattail marsh habitat to support secretive waterbirds and migratory and resident songbirds, as described under Objective 2.1.

Goal 3: Manage and protect remnant native desert scrub habitat, tree rows, and riparian areas on the Refuge to support resident bird and other wildlife species, as well as nesting habitat for Neotropical bird species.

***Objective 3.1*: Native Trees and Shrubs**
To support a range of native upland birds and other native wildlife: by 2018, restore native riparian habitat on 80 acres of refuge land near Bruchard Bay by removing invasive salt cedar and replacing the salt cedar with plantings of Goodding's black willow (Salix gooddingii), screwbean mesquite (Prosopis pubescens)and blue palo verde (Parkinsonia florida); over the life of the CCP as funding permits, restore native riparian habitat in the Hazard Tract, incrementally replacing areas dominated by non-native vegetation with screwbean mesquite and Goodding's black willow; and over the life of the CCP maintain approximately 60 acres of existing tree rows consisting of native honey mesquite (Prosopis glandulosa), blue palo verde, and desert ironwood (Olneya tesota), and some specimens of non-native Mexican palo verde (Parkinsonia aculeate).

Rationale:
Desert wash habitat has broad positive effects on bird species diversity, abundance, and nesting success (CalPIF 2009), and microhabitat characteristics can influence nest-site selection by breeding birds. Desert wash habitat, which occupies less than five percent of the Colorado Desert, supports 90 percent of the Colorado Desert's bird life (Dimmitt 2000), as well as various wildlife species. This habitat, as well as the tree rows present on the Refuge provide habitat for a range of resident birds, as well as a number of migratory songbirds.

Region-specific conservation actions for the Colorado Desert Region included within the California Wildlife Action Plan (CDFG 2007) include development and investment in restoration and protection efforts for regional wildlife habitats and identification and protection of critical avian habitats. The Desert Bird Conservation Plan (CalPIF 2009) also addresses the need in some areas to design and implement cultivated restoration projects that mimic the diversity and structure of a natural desert plant community. The Partners in Flight

North American Landbird Conservation Plan (Rich et al. 2004) and the Desert Bird Conservation Plan (CalPIF 2009) also include objectives related to the need to remove and replace invasive species with native species to increase habitat value for avian species. The Refuge management strategies for supporting native upland birds and animal species address these objectives and conservation actions.

Native Trees and Shrubs Strategies

- Replace approximately 80 acres of invasive salt cedar near Bruchard Bay with native desert riparian species, including Goodding's black willow, screwbean mesquite, and blue palo verde.
- Continue to maintain the existing tree rows (i.e., honey mesquite, blue palo verde, Mexican palo verde, and desert ironwood) in Unit 1 along existing fields, as well as in the vicinity of the Refuge headquarters and at the south end of the Hazard Tract in Unit 2.
- Implement incremental control and removal of invasive non-native woody species, particularly salt cedar, from the Hazard Tract, per available funding, and revegetate these areas with native trees and shrubs (e.g., Goodding's black willow, screwbean mesquite, blue palo verde).
- Optimize water use on the Refuge by irrigating tree rows and desert wash habitat with spill water from the managed agricultural fields whenever possible.

***Objective 3.2*: Burrowing Owls**
Throughout the life of the CCP, maintain approximately 45 burrowing owl nest boxes in appropriate locations throughout the Refuge and provide information regarding burrowing owl conservation at the Refuge visitor contact station to annually reach 10,000 visitors.

Rationale:
The burrowing owl is protected by the Migratory Bird Treaty Act, is considered by the Service to be a Bird of Conservation Concern (USFWS 2008a), and is listed as a Bird Species of Special Concern by the State of California. Bird count data compiled between the late 1980s and early 2000s suggest that the burrowing owl has been extirpated as a breeding species from approximately eight percent of its former range in California (Klute et al. 2003). Nevertheless, California continues to support one of the largest year-round populations of burrowing owls, including both resident and wintering migrants, in the U.S. In the late 1990s, an estimated 71 percent of the burrowing owls in California occurred in the Imperial Valley (Klute et al. 2003).

Based on data from burrowing owl surveys conducted in 1992 and 1993, an estimated 5,600 pairs of burrowing owls (95 percent confidence interval: 3405-7795) were present in the early 1990s in the Imperial Valley (DeSante et al. 2004). In recent years, population estimates have varied. In 2007, the number of burrowing owl pairs was estimated at 4,879 (95 percent confidence interval: 4,692-5,065), and in 2008, the number was 3,557 territories (95 percent confidence interval: 3,370-3,743) (Manning 2009). In 2011, the number was estimated at between 4,589 (95 percent confidence interval: 4,019-5158) and 5,058 (95 percent confidence interval: 4,450-5,666) (Harbin-Ireland 2011). It is unclear from the available data if the variability in population estimates is the result of changes in the actual number of burrowing owl pairs present in the Valley or on differences in the model detection probabilities used to estimate population size. Even with these annual variations, the Imperial Valley continues to support the largest population of burrowing owls in the State.

The primary threats to burrowing owls across its range relate to habitat loss due to land conversion associated with agriculture and urban development; habitat degradation; and reductions in burrowing mammal populations. Of these threats, the loss of burrowing mammal populations has been identified as the primary factor responsible for the decline in the overall burrowing owl population (Klute et al. 2003). With the extent of agricultural activity occurring in the Imperial Valley, opportunities for mammals to establish burrows are limited and often focus on disturbed areas associated with irrigation drains, canals, and ditches (Manning 2009). It is within these burrows that burrowing owls often establish nests. Unfortunately, these areas can be unstable and are subject to disturbance from ongoing activities associated with irrigation maintenance, overhead utility maintenance, and adjacent crop production.

To reduce the potential for the loss of burrowing owl nests due to inadvertent or intentional disturbance along existing roads and irrigation drainages, artificial burrows have been established in various locations throughout the Imperial Valley, including on the Refuge. Studies conducted in California indicate that burrowing owls readily occupy these artificial burrows and initial nesting success is followed by successful nesting in subsequent years (Trulio 1995). According to the CDFW, the best available science indicates that along with suitable foraging, wintering, and dispersal habitat, including an abundant and available prey base, essential habitat for the burrowing owl in California must include the presence of burrows, burrow surrogates, or presence of fossorial mammal dens (CDFG 2012). The artificial nesting burrows provided on the Refuge therefore address one of the important components needed to maintain a self-sustaining population of burrowing owls within the Imperial Valley.

Burrowing Owls Strategies

- Work with partners to annually inspect, clean, and maintain, as necessary, the existing nesting boxes on the Refuge.
- Prior to replacing an existing nesting box, conduct a literature search of current research related to nesting box design and maintenance needs in order to optimize nesting success and to reduce the need for annual maintenance.
- Continue to provide signage in the vicinity of nesting boxes to alert construction and utility workers of the presence of a nesting box.
- Periodically monitor the condition of the area around nesting box sites and if unauthorized disturbance has occurred, make any necessary repairs and implement measures to minimize the potential for any further disturbance.
- Continue to provide information at the visitor contact station about burrowing owls and the need to avoid disturbance to their burrows, particularly during the breeding season, expand public outreach about burrowing owls elsewhere in the community, and develop at least one interpretive sign for the interpretive trail in Unit 1 that addresses the importance of conserving areas to support burrowing owls.

***Objective 3.3*: Invasive Non-native Species**

Over the 15-year life of the CCP, implement an integrated approach to pest management to annually: control 95 percent of the non-native weedy species in managed agricultural lands; remove sufficient coverage of non-native, invasive vegetation in the water distribution system (e.g., water conveyance channels, irrigation ditches) to optimize water delivery and distribution on the Refuge throughout the year; and control at least 50 percent of the non-native woody species (e.g., salt cedar, common reed) present around the perimeters of the Refuge's managed wetland habitats.

Rationale:
The annual costs associated with invasive species, including environmental damage, agricultural impacts, and invasive species control are estimated at almost $120 billion per year in U.S. and approximately 42 percent of all threatened and endangered species are at risk primarily because of non-native species (Pimentel et al. 2005). Economic effects are easier to calculate than ecological consequences that are sometimes difficult to perceive, let alone quantify (Hanson and Sytsma 2001). According to the Service, invasive species have become the single greatest threat to the Refuge System. Rare species with limited ranges, small numbers, and restricted habitat requirements, such as the Yuma Ridgway's rail, are often particularly vulnerable. Invasive species can alter ecosystem structure and function, disrupt food chains and other ecosystem characteristics vital to wildlife, and alter key ecosystem processes such as hydrology, productivity, nutrient cycling, and fire regime (Randall 1996, Brooks and Pyke 2001).

A National Strategy for Management of Invasive Species (USFWS NWRS 2003) has been developed for the NWRS within the context of the National Invasive Species Management Plan, as called for by Presidential Executive Order 13112. This plan functions as the internal guidance document for invasive species management throughout the Refuge System. The plan has four goals: 1) increase the awareness of invasive species issues, both internally and externally; 2) reduce the impacts of invasive species to allow the Refuge System to more effectively meet its fish and wildlife conservation mission and purpose; 3) reduce invasive species impacts on the Refuge System's neighbors and communities; and 4) promote and support the development and use of safe and effective integrated management techniques to deal with invasive species. The proposal to address the problem of invasive species within the Refuge Complex will support these goals, and assist in achieving Statewide Conservation Action F in the California Wildlife Action Plan (CDFG 2007).

Invasive Non-Native Species Strategies

- Continue to control non-native weedy species in managed agricultural areas to optimize green forage production to support wintering geese.
- Continue no till practices in a portion of the managed agricultural areas to reduce the need for chemical control of invasive species.
- Control the emergence of cattails in seasonal wetland areas by temporarily increasing salinity levels.
- Implement an integrated approach to pest management that includes the use of physical, mechanical, and chemical controls, including the aerial application of herbicides in agricultural fields and dense salt cedar stands to improve overall coverage and effectiveness of control.
- Implement mechanical and chemical control of non-native woody species (e.g., salt cedar, common reed) in accordance with the Refuge IPM Plan to reduce the percent coverage of these species within the water distribution system.
- Implement best management practices, such as cleaning boots, tires, mower decks, and truck undercarriages following completion of activities in weed infested areas and mow weedy areas prior to seed set, to reduce the distribution of weed seeds into other areas of the Refuge.
- Opportunistically monitor Refuge areas for the presence of new invasive plant species in an effort to facilitate early eradication, avoiding the need for significant long-term control of the species on the Refuge, and share this information with other agencies in the region.

Goal 4: Work in partnership with other Federal, State, and local agencies and tribes to restore, enhance, and adaptively manage habitat functions that support fish and bird life, as well as to protect other resources of region-wide significance, in and around the Salton Sea.

***Objective 4.1*: Salton Sea Restoration Partnerships**
Over the next 15 years, continue to support existing partnerships and form new partnerships with Federal, State, local, tribal, non-profit, and other land managers to restore habitat functions in the Salton Sea that are being lost due to receding water levels and degradation of water quality.

Rationale:
Although it has only existed for about 100 years, the Salton Sea has become a critical resource for many species of resident and migratory birds due to the extensive loss of historic wetland habitat along the Pacific Flyway. Lower water levels and increasing salinities are reducing the habitat values within the Sea for these birds. Primary components of the Salton Sea food web, including pileworms and barnacles, have already been impacted by deteriorating water quality (USACOE and California Natural Resources Agency 2011), and the last remaining significant fish prey species, tilapia, is expected to be eliminated as early as 2018, when salinity levels in the Sea are predicted to exceed 60 ppt (USACOE and California Natural Resources Agency 2011). The loss of this fish population from the open water area of the Sea will likely eliminate use of the Salton Sea by fishing eating birds, such as pelicans, double-crested cormorants, and black skimmers.

Various proposals to restore open water habitat in areas where the Salton Sea has recently receded are currently under consideration and two of these proposals involve areas included within the Refuge boundary. Both projects represent multiple agency partnerships. As these projects move forward, they will provide important information about the benefits and constraints of implementing additional future projects around the Sea. The Service's involvement in these projects will enable the Refuge to continue to achieve those Refuge purposes related to the protection of habitat to support breeding and migratory birds.

Salton Sea Restoration Partnership Strategies

- Continue to work with partners, including the IID, to restore up to 420 acres of shallow (approximately 6 inches to a foot in depth), saline (20 to 30 ppt), unvegetated, open water habitat in the Red Hill Bay portion of the Salton Sea.
- Continue to work with partners, including USACOE, CDFW, and the California Resources Agency (State Department of Water Resources), on a proposal to restore deeper (generally 0 to 6 feet in depth with excavated holes up to 12 feet in depth), saline (typically 20 to 40 ppt, occasionally up to 50 ppt) water habitat in the Salton Sea that could potential result in the restoration of up to 1,600 acres within the Bruchard Bay portion of the Refuge.
- Once these restoration projects have been implemented, assist in the implementation of a monitoring program that evaluates issues related to bird use, prey base, water quality, and ease of water blending to achieve desired salinity levels.
- Encourage research that can benefit future management actions related to Salton Sea restoration.
- Participate with other partners in the dissemination of monitoring results and lessons learned.

***Objective 4.2*: Other Partnerships**
Over the next 15 years, work with a variety of partners to address regional resource issues related to habitat and species conservation, avian disease, air quality, and optimization of water use for a range of purposes including habitat restoration.

Rationale:
Coordination and communication among Federal, State, regional, and local agencies, tribes, water districts, air quality agencies, other municipalities, the geothermal industry, and private landowners with respect to the changes occurring in and around the Salton Sea is essential to meet the goals and objectives of the range of interests affected by these changes. Management efforts on the Sonny Bono Salton Sea NWR can benefit in a variety of ways through Refuge participation in region-wide issues related to resource protection, habitat restoration, water quality and availability, air quality, invasive species, and avian disease. Through the sharing of information, common issues can be addressed via joint projects, sharing of personnel, equipment, and/or volunteers, and partnering to secure grant funding needed to address area-wide problems. Participation by the Refuge and others will strengthen relationships, facilitate ongoing communication, and ensure long-term coordination on matters of regional importance.

Partnerships Strategies

- Coordinate with Imperial County APCD to address potential air quality issues related to prescribed burns within the Refuge's managed habitat areas, as well as exposed seabed, should any areas of currently submerged fee-title Refuge land be exposed as the Salton Sea continues to recede.
- Partner with others to optimize water use for agricultural and wildlife habitat purposes.
- Continue to partner with CDFW and others to monitor for avian diseases on the Salton Sea.
- Partner with USGS and the Service's Environmental Contaminants Division to monitor contaminants and potential bioaccumulation associated with habitat restoration in the Salton Sea.
- Work with partners in the region to develop and implement an Invasive Species Rapid Response Program to assist in addressing potential new invasive species threats.

***Objective 4.3*: Cultural and Paleontological Resources**
Over the next fifteen years, implement proactive management of cultural resources that focus on meeting the requirements of the National Historic Preservation Act and other cultural resource legislation, as well as manage paleontological resources using scientific principals and expertise, to address the protection, identification, inventory, evaluation, consultation and, when appropriate, interpretation of the Refuge's historical, archaeological, and paleontological resources.

Rationale:
It is the policy of the Service to identify, protect, and manage cultural resources located on Service lands and affected by Service undertakings. A number of cultural resources are known to be present in the vicinity of the Sonny Bono Salton Sea NWR, and it is likely that other sites may be present that have not yet been discovered or recorded. Cultural resources are not renewable, making protection an essential component of cultural resource management. To realize the full scientific and education value, or better understand the spiritual value of a cultural resource, it is important to preserve and/or record the context of the setting in which a cultural resource is discovered. This requires proactive management in which access is restricted in areas identified as having a high potential for undiscovered cultural resources.

Cultural resources possess scientific and educational value to tribes, archaeologists, historians, and many members of the public. Many cultural resources also have a spiritual connection to one or more tribes, providing important elements of individual and group identity. Cultural resources can connect us to our past, providing the means to study and reflect upon the events and processes that have shaped our nation, our communities, and ourselves.

The Paleontological Resources Preservation Act (PRPA) was enacted in 2009 as part of the Omnibus Public Land Management Act of 2009, (P.L. 111-011). It requires Federal agencies to manage and protect paleontological resources on Federal lands and to develop plans for the inventory, monitoring, and scientific and educational use of paleontological resources. To protect paleontological resources, the Society of Vertebrate Paleontology (SVP) has established standard guidelines (SVP 1995) that outline professional protocols and practices for conducting paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation (SVP 1991, 1996).

Cultural and Paleontological Resources Strategies

- Comply with all applicable cultural and paleontological resource regulations and policies prior to implementing projects that would disturb any surface or subsurface cultural or paleontological resources.
- Work with local tribes to develop a Memorandum of Understanding for implementing the inadvertent discovery clause of the Native American Graves Protection and Repatriation Act (NAGPRA).
- Following the guidelines established by SVP for identifying, protecting, and where necessary recovering fossils present on Federal lands.
- As necessary, seek funding to identify, evaluate, and protect important cultural and paleontological resources that may be identified on the Refuge.
- Any fossils identified on the Refuge would be preserved and made available for research and public education.
- Ensure that refuge staff receives training in cultural and paleontological resource preservation requirements, as well as NHPA, ARPA, NAGPRA, and PRPA.

***Objective 4.4*: Changing Conditions**
Within ten years of CCP approval, complete in partnership with others a general assessment of the anticipated changes over the next 25 years in the current abundance and diversity of birds and other wildlife within the Refuge as a result of reductions in water levels and overall water quality in the Salton Sea, as well as climate change, and following completion of the assessment evaluate how Refuge management might be modified to better achieve Refuge purposes.

Rationale:
As described elsewhere in this chapter, the Salton Sea is receding and water quality within the Sea is expected to reach a point at which it will provide little benefit to the resident and migratory birds it historically supported over the last hundred years (USACOE and California Natural Resources Agency 2011). In addition, the world climate is changing (Bierbaum et al. 2007) as indicated by increases in global surface temperature, altered precipitation patterns, warming of the oceans, rising ocean levels, increases in storm intensity, and changes in ocean pH. This is significant because "climate is a dominant factor influencing the distributions, structures, functions and services of ecosystems" (CCSP 2008). The potential effect of climate change (defined as any change in climate over time, whether due to natural variability or as a result of human activity (CCSP 2008) on the Imperial Valley is not fully understood, but what

changes do occur will interact with other environmental changes occurring in the area, primarily the changes occurring within the Salton Sea, to affect biodiversity and the future condition of ecosystems around the Sea. It is, therefore, essential to understand how these changes are and will continue to impact existing resources, and to develop strategies for protecting affected resources. The extent to which these resources are affected will depend on how and at what rate conditions change over time and the availability of adaptation options for effective management responses.

Changing Conditions Strategies

- By 2016, as part of a step-down Inventory and Monitoring Plan, identify the suite of species on the Refuge that are managed to achieve Refuge purposes or other Service mandates (i.e., federally listed species); evaluate the effectiveness of the actions currently being implemented to benefit these species and identify the desired future state of these conservation targets; and finally, through the development of an adaptive management framework determine if additional strategies are necessary to achieve the desired future state of the conservation targets, including designing an approach that focuses on monitoring the effectiveness of the alternative strategies.
- By 2022, in partnership with others, complete an assessment of anticipated future conditions in and around the Salton Sea over the next 25 years taking into consideration water quality and quantity issues in the Sea, water availability on the Refuge to support managed habitats, and the local and regional effects of climate change on species distribution. The assessment should also include the development of methods for monitoring and recording measurable change over time.
- By 2022, or sooner if warranted, prepare a step-down plan to evaluate the status of the lands currently being managed as part of the Refuge, including identification of any potential opportunities to: 1) exchange lands owned in fee title by the Service for other lands, including existing leased lands managed by the Service, to meet Refuge purposes; 2) dispose of any fee title lands or discontinue leasing any lands that are no longer needed to meet Refuge purposes; and/or 4) seek long-term lease agreements for those lands that are needed to meet Refuge purposes, goals, and objectives.

***Objective 4.5*: Environmentally Conscientious Refuge Operations**
Continue to implement energy conservation measures that will result in a 28 percent reduction in the Refuge's total energy consumption by 2020 (based on energy consumption rates for the Refuge beginning in FY 2008); by 2015, incorporate water conservation measures into existing and new facilities; strive to reduce the total amount of manufactured goods and materials used on the Refuge; and by 2015, develop an outreach program that will inform the public of these efforts and encourage them to implement similar practices.

Rationale:
Human activity and resource consumption are root causes of declines in abundance and diversity of wildlife and habitat. Consumption and the output of that consumption (e.g., garbage, air and water pollution, noise, night lighting) are detrimental to the abundance, diversity, and distribution of native wildlife, and reason for National Wildlife Refuges and other conserved lands. Our impacts on wildlife resources can be reduced by reducing the Refuge's own consumption of resources, and by choosing materials and practices that lessen impacts to wildlife and habitats worldwide.

Effects of climate change on vegetation and wildlife throughout California have already been documented (Kelly and Goulden 2008, Macmynowski et al. 2007, Barbour and Kueppers 2012) and these effects are expected to increase. The emission of GHGs through the combustion of fossil fuels (i.e., fuels containing carbon) in conjunction with other human activities, appears to be closely associated with changes in climate worldwide (California Office of Planning and Research 2008). By reducing our carbon footprint, we can assist in the efforts to address climate change.

To address GHG emissions at the Federal level, Executive Order 13514 was signed in 2009 that set measureable environmental performance goals for Federal Agencies, including reducing GHG emissions by 28 percent by 2020. There are many ways in which GHG emissions can be reduced, including reducing the amount of electricity and fuel consumed directly by refuge operations, as well as reducing the total consumption of goods and materials and purchasing locally produced products wherever possible.

The over consumption of potable water in southern California has far reaching effects on wildlife and wildlife habitat, such as impacts to listed species in northern California and the loss of wetland habitat at the Salton Sea (Salton Sea Authority 2006). By implementing practices that will reduce our consumption of potable water, as well as providing interpretation and environmental education regarding the need to conserve water, we can assist in reducing water consumption in the region.

Environmentally Conscientious Refuge Operations Strategies

- Continue to meet or exceed requirements for recycling and using recycled goods.
- Replace refuge vehicles with more fuel-efficient vehicles (e.g., hybrid, electric) as funding permits.
- Maintain existing solar panels to ensure maximum efficiency.
- As necessary, retrofit existing facilities and incorporate into new facilities, measures to increase energy efficiency (e.g., compact fluorescent bulbs, lighting timers, increased insulation, photovoltaic panels, energy efficient windows).
- Seek funding to incorporate effective water conservation measures into current and future Refuge facilities.
- Minimize the need for night lighting and where necessary install fixtures that are fully shielded.
- Reduce vehicle trips by using telephone or computer video conferencing whenever possible to reduce carbon emissions.
- Combine trips for refuge-related activities to reduce gas consumption.
- Whenever possible, purchase locally manufactured equipment/materials.

Goal 5: Enhance the public's awareness, appreciation, and enjoyment of the Refuge's biological resources by providing opportunities for compatible wildlife-dependent recreational uses.

***Objective 5.1*: Hunting**

Throughout the life of the CCP, continue to conduct a high quality waterfowl hunting program on the Refuge that provides opportunities for approximately 1,000 annual hunting visits (depending on season length and climatic conditions) on approximately 160 acres on the Union Tract and approximately 660 acres on the Hazard Tract.

Rationale:
Enactment of the National Wildlife Refuge System Improvement Act established compatible wildlife-dependent recreational uses, including hunting, as the priority general public uses of the NWRS. The Improvement Act, which specifies that priority general public uses receive enhanced consideration over other general public uses in planning and management, states that increased opportunities for families to experience compatible wildlife-dependent recreation shall be provided, particularly opportunities for parents and their children to "safely engage in traditional outdoor activities, such as fishing and hunting." Hunting is recognized by the Service as a healthy, traditional outdoor pastime, deeply rooted in the American heritage; an activity that can instill a unique understanding and appreciation of wildlife, their behavior, and their habitat needs.

Opportunities for waterfowl hunting will continue to be provided on the Sonny Bono Salton Sea NWR. The hunting program will be conducted in a safe and cost-effective manner and will be carried out consistent with State regulations. The Hunt Plan (Appendix I) was developed to provide safe hunting opportunities while minimizing conflicts with other priority wildlife-dependent recreational uses. Other visitor uses occur on different areas or at different times of the year, thereby minimizing potential conflicts with hunters. The Refuge hunting program complies with the Code of Federal Regulations (CFR) Title 50, 32.1 and is managed in accordance with Service Manual 605 FW 2, Hunting.

Hunting Strategies

- Continue providing hunting opportunities on the Refuge via the existing Cooperative Agreement with CDFW, who is responsible for implementing the Refuge's hunt program.
- Continue to provide opportunities for waterfowl hunting on the Hazard Tract and goose hunting opportunities on the Union Tract.
- Conduct an after season Junior Waterfowl Hunt on the Refuge.
- Work with the Refuge's Hunting Program Working Group (e.g., Friends of Wister) to maintain the Refuge's hunting program and associated facilities.
- Hire a dual function refuge manager/Federal wildlife officer to among other duties monitor activities associated with the Refuge's hunt program.
- Work cooperatively with CDFW wardens to enforce CFRs, State Fish and Wildlife hunting regulations, and Refuge-specific regulations to provide a quality experience for all visitors.

Objective 5.2: Wildlife Observation
By 2015, provide quality opportunities for 25,000 annual visits to the Refuge for the purpose of wildlife observation.

Rationale:
The overarching goal of the Refuge System's wildlife-dependent recreation policy (605 FW 1) is to enhance wildlife-dependent recreation opportunities and access to quality visitor experiences on refuges while managing refuges to conserve fish, wildlife, plants, and their habitats. New and ongoing recreational uses provide us with opportunities to introduce visitors to wildlife and other natural resources and to make visitors aware of resource issues, management plans, and how the refuge contributes to the Refuge System and Service mission. Wildlife-dependent recreational uses are the priority public uses that should be allowed on Refuges when they are determined to be compatible with Refuge purposes. The Sonny Bono Salton Sea NWR was established to protect birds and other wildlife. Conservation of these resources requires that the public understand and appreciate the need for their protection.

Achieving the objective of providing quality opportunities for wildlife observation will enable us to not only foster a connection between our visitors and the natural resources protected on the Refuge, but also to increase the public's appreciation for these resources.

Wildlife Observation Strategies

- Continue to support opportunities for wildlife observation from existing trails and observation platforms.
- Seek funding to improve the accessibility of Refuge trails that will increase the opportunities of all members of the public to observe the sights and sounds of the wintering, breeding, migratory, and resident bird life on the Refuge.
- Continue to provide opportunities for wildlife observation by conducting periodic guided birding walks on the Refuge.
- By 2017, develop a step-down visitor services plan for the Sonny Bono Salton Sea NWR.

***Objective 5.3*: Wildlife Photography**
By 2017, provide quality opportunities for 5,000 wildlife photography-related annual visits to the Refuge.

Rationale:
The Improvement Act identifies wildlife photography as a priority public use that should be allowed on Refuges when determined to be compatible with the purposes for which a Refuge has been established. Encouraging photography of wildlife, plants, landscapes, and other natural features provides Refuge visitors with the opportunity to focus on the smallest of creatures or to take in the full breadth and depth of the landscape before them. Achieving that special picture often requires stillness, silence, and patience, but also provides the opportunity to become completely engrossed in the part of the natural world visible through the camera lens. By providing safe, enjoyable, and accessible wildlife photography opportunities and facilities, Refuge visitors will have the chance to capture and take home their memories and observations of the Refuge and the resources it was established to protect.

Wildlife Photography Strategies

- By 2017, construct an additional photo blind in Unit 1 that will provide opportunities to photograph wintering geese, sandhill crane, and resident and migratory songbirds.
- On the Refuge website, provide information about wildlife photography opportunities on the Refuge, the best times and locations for photographing birds and landscapes, and photographer etiquette that emphasizes respect for Refuge resources through the minimization of visitor impacts.

***Objective 5.4*: Environmental Education**
Continue to implement multi-disciplinary environmental education programs on the Refuge to reach approximately 600 students, grades 3 through 12, and 50 college students annually.

Rationale:
Environmental education is a priority general public use of the Refuge System and should be provided when compatible with Refuge purposes. Environmental education programs teach awareness, understanding, and appreciation of our natural and cultural resources, as well as conservation history. Environmental education programs also allow program participants to demonstrate learning through refuge-specific stewardship tasks and projects that they can carry over into their everyday lives. Refuge environmental education programs are

encouraged to offer educational assistance and work closely with local school districts and community partners. An interdisciplinary approach that relies on existing curricula or a course of study involving natural and social sciences, history, and the arts is encouraged. Environmental education can be conducted on the Refuge and/or in the classroom.

Environmental Education Strategies

- Working with partners, contact local teachers regarding their needs and interests in the opportunities available on the Refuge for supporting environmental education programs.
- Work with local educators to identify an interdisciplinary approach to environmental education that relies on existing curricula or develop a course of study involving natural and social sciences, history, and the arts that when implemented can incorporate and benefit from the resources present on the Refuge.
- Post environmental education program offerings on the Refuge website.

***Objective 5.5*: Resource Interpretation**

Within five years of the CCP being adopted, develop and begin to implement an expanded interpretative program to serve 20,000 visits to the Refuge annually by 2018. The program would focus on Unit 1 of the Refuge, where multiple topics would be addressed to appeal to a broad spectrum of interests, age groups, and learning styles and abilities.

Rationale:

The Improvement Act identifies interpretation as one of the six wildlife-dependent recreational uses of the Refuge System that should be allowed on Refuges when it is determined to be compatible with Refuge purposes. Interpretation provides opportunities for visitors to make their own connections to Refuge resources and in so doing can provoke participation in resource stewardship. Interpretation can help refuge visitors understand the importance of protecting the resources on the Refuge.

Resource Interpretation Strategies

- As part of the step-down visitor service plan, develop an updated interpretive program focusing on Unit 1 of the Refuge that includes a combination of stationary interpretive elements distributed throughout the Refuge and interactive programs that can be adjusted to meet the demands of the audience in terms of theme, age appropriateness, interest, and other factors.
- Design, fabricate, and install interpretive panels and bird identification signs along the Unit 1 interpretive trail to interpret past and anticipated future conditions within the Salton Sea, the importance of the Salton Sea to migratory birds traveling along the Pacific Flyway, and Refuge purposes related to wintering geese.
- By 2022, include interpretive materials in the kiosk proposed for the seasonal birding trail in the Hazard Tract, and conduct occasional guided bird walks along the trail.
- Continue to maintain the existing interpretive signage along the Rock Hill Trail outside the Refuge headquarters, and the interpretive displays located within the visitor contact area of the Refuge headquarters.
- Pursue the establishment of a docent program to lead bird walks in various locations on the Refuge.
- Working with other partners in the Imperial Valley, pursue the development of an auto tour within the area to the south of the Salton Sea that interprets a variety of topics including but not limited to agriculture, water management and conservation, geothermal power, the changing Salton Sea, fish and wildlife, and geology.

***Objective 5.6*: Connecting People with Nature**
By 2017, develop and implement a minimum of two events per year targeting nontraditional users that are focused on connecting families with nature.

Rationale:
Research shows that children and parents are suffering from too much time inside, with children spending an average of 6.5 hours a day with electronics (e.g., television, computers, video games). If a child is raised with little or no connection to nature, they may miss the many health benefits of playing outdoors. Studies show that children's health is declining. Childhood obesity rates are increasing, as are the number of children taking prescription medications to treat Attention Deficit Hyperactivity Disorder (ADHD) and depression. Fortunately, research also shows that connecting children and families with nature can provide positive benefits leading to improved physical and mental health.

A connection with nature also helps children develop positive attitudes and behaviors towards the environment. Positive interactions with the environment can lead to a life-long interest in enjoying and preserving nature. People's interest in nature is so crucial to the Service mission of conserving, protecting, and enhancing fish, wildlife, plants, and their habitats, that in 2007, the Service declared that "connecting people with nature" is among the agency's highest national priorities.

Periodically conducting programs at the Refuge that focus on topics of interest to people who are less likely to come out to the Refuge initially to observe wildlife can result in an increased interest in the Refuge over time. Programs related to geological processes, cultural resources, history, agriculture, landscape painting, and many other topics could attract a range of first-time visitors who were previously unfamiliar with the opportunities available on the Refuge for enjoying the outdoors.

Connecting People with Nature Strategies

- Incorporate a connecting people with nature theme into at least two Refuge events per year, which could be conducted on or off the Refuge.
- Each year, host two activities, involving people who might not normally come to the Refuge, so they can experience their activity in a nature setting.

***Objective 5.7*: Volunteers**
By 2020, increase the number of volunteer hours provided on the Refuge to assist in various aspects of Refuge management such as resource surveys, Refuge clean-ups, trail maintenance, environmental education, interpretation, and visitor contact to approximately 90 volunteer eight-hour days per year.

Rationale:
The National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 (P.L. 105-242) strengthens the Refuge System's role in developing relationships with volunteers. Volunteers possess knowledge, skills, and abilities that can enhance the scope of refuge operations. Volunteers enrich Refuge staff with their gift of time, skills, and energy. Refuge staff will initiate, support, and nurture relationships with volunteers so that they may continue to be an integral part of Refuge programs and management. The volunteer program will be managed in accordance with the Fish and Wildlife Service Manual, Part 150, Chapters 1-3, "Volunteer Services Program", and Part 240 Chapter 9 "Occupational Safety and Health, Volunteer and Youth Program."

Volunteers Strategies

- Continue to implement a seasonal volunteer program to provide Refuge staff with assistance at the visitor contact desk and with guided walks during peak visitation months.
- By 2015, conduct at least one major volunteer workday event annually in an effort to recruit volunteers for other smaller events and/or projects.
- By 2017, conduct at least two opportunities annually for community organizations (e.g., youth groups, conservation organizations, nontraditional user groups) to assist in a volunteer project that would support Refuge management.

3.3.2 Coachella Valley NWR

The objectives established for meeting the goals of the Coachella Valley NWR and the strategies to be implemented to achieve these objectives are presented here.

Goal 1: Protect, restore, and enhance Refuge lands to contribute to the recovery of the federally threatened Coachella Valley fringe-toed lizard and endangered Coachella Valley milk-vetch, as well as to conserve other species of concern supported on the Refuge.

***Objective 1.1*: Coachella Valley Fringe-toed Lizard (Uma inornata)**
Throughout the life of the CCP, implement actions on the Refuge to maintain and protect high quality desert dune habitat over approximately 215 acres and an additional 2,290 acres of adjacent creosote bush scrub to support the long-term persistence of a self-sustaining population of the federally listed threatened Coachella Valley fringe-toed lizard on the Refuge, and by 2018, reduce the total coverage of Sahara mustard and other invasive, non-native plants within the active desert dune habitat to below 25 percent. At the northwest and western edges of the Refuge, where source sand for the active desert dune habitat accumulates and is blown downwind over the Refuge, reduce the total coverage of Sahara mustard and other invasive, non-native species to below 50 percent in the worst infestation areas by 2018.

Rationale:
Portions of the Coachella Valley NWR have been identified in the Coachella Valley MSHCP as core habitat areas for the Coachella Valley fringe-toed lizard, a highly specialized endemic lizard that inhabits wind-blown sand deposits (dunes) on the floor of the Coachella Valley. The Refuge's core habitat for this species is part of the largest remaining area of contiguous extant habitat for the Coachella Valley fringe-toed lizard. The lands within the Thousand Palms Conservation Area, of which the Refuge is a part, are also believed to support the most robust population of this species (USFWS 2010a); making protection of the Refuge lands a high priority for the conservation of this species.

Based on a model created by the CVAG for the Coachella Valley MSHCP, approximately 2,510 acres, including both desert dune and creosote bush scrub, have been identified for protection on the Refuge to support this species. The protection of these habitats on the Refuge will meet the Coachella Valley MSHCP objective of providing sufficient area and variety of habitat types to accommodate population fluctuations, allow for genetic diversity, and conserve the range of environmental conditions within which the lizard is known to occur (CVAG 2007b). The model includes areas that may not currently be occupied or are not particularly suitable for the species at the present time, but are expected to become periodically suitable as a result of the

input of new aeolian sand following significant storm events that deposit sand upwind of the conservation area (USFWS 2010a).

In recent years, the occurrence of the invasive weed, Saharan mustard, has significantly increased within areas set aside within the Coachella Valley to support the fringe-toed lizard, including the Refuge. This is of particular concern because the fringe-toed lizard requires open areas where it can thermoregulate in the direct sunlight. The presence of the thick canopy created by Saharan mustard and similar invasive species reduces the habitat quality of the area to the point that the lizard will not occupy heavily infested areas, thereby reducing the total area available to support the lizard (Barrows et al. 2009).

Coachella Valley Fringe-toed Lizard Strategies

- In partnership with others, annually monitor the Coachella Valley fringe-toed lizard population on the Refuge in accordance with the monitoring protocols developed and approved for this species in the Coachella Valley MSHCP's Aeolian Sand Communities and Species Monitoring Protocols (updated on March 8, 2012 and subject to future revision as deemed necessary by the MSHCP's adaptive management process).
- In partnership with others, annually monitor the desert dune and creosote bush scrub habitat conditions, recording changes in habitat conditions and/or distribution, including the estimated percent cover and species mix of non-native invasive species. Based on these observations, evaluate and adapt as warranted current management practices.
- By 2015, prepare a step-down habitat management plan for the Refuge that includes a discussion of the management practices to be implemented to maintain high quality habitat for the Coachella Valley fringe-toed lizard, as well as the potential for restoration of additional areas within the Refuge to support this species.
- Through a coordinated area-wide effort, implement actions to ensure the long-term control of Sahara mustard within the Thousand Palms Conservation Area.
- As part of an integrated approach to pest management, aggressively control small outbreaks of new invasive plants on the Refuge to avoid extensive control in the future.
- Coordinate with other MSHCP partners to provide and receive information about new invasive plant species detected in the region.
- Periodically survey the Refuge for the presence of feral dogs and cats and when present, implement actions in accordance with Service policy to remove them from the Refuge.
- Support research that addresses issues related to sand transport, invasive species control, climate change, and other issues that can benefit Refuge management and the species protected on the Refuge.
- Expand patrol and enforcement of illegal trespass onto the Refuge, particularly trespass involving off-road vehicle use.

***Objective 1.2*: Coachella Valley Milk-vetch (*Astragalus lentiginosus var. coachellae*)**
Throughout the life of the CCP, manage approximately 215 acres of high-quality desert dune habitat to maximize areas of active sandy substrate that will continue to support a self-sustaining population of the federally listed endangered Coachella Valley milk-vetch, and by 2018, reduce the total coverage of invasive non-native weeds (e.g., Sahara mustard, Mediterranean grass) in this habitat to below 25 percent.

Rationale:
Within the Refuge, Coachella Valley milk-vetch occurs exclusively within those areas mapped as desert dune habitat, and in surveys conducted in March 2011, of the approximately 530 individual plants present on the Refuge, 77 percent occurred on exposed or unstable dunes. To ensure the long-term conservation of this plant, it is necessary to protect the existing areas of active sandy substrate on the Refuge. Sahara mustard is currently the most serious threat to this and other dune-dependent species not only because it successfully competes with native annual forbs and grasses for space and water, but also because its presence in desert dune habitat can over time result in dune stabilization and the loss of habitat for blowsand species such as Coachella Valley milk-vetch (USFWS 2009b).

Although Coachella Valley milk-vetch is genetically self-compatible (i.e., capable of producing viable seeds from the union of pollen and ovules from the same plant), experiments conducted by Meinke et al. (2007) indicate that seed production for this species is highly dependent on pollinators. The Service's 5-year review for this species identifies the need to "incorporate management of native pollinators and their habitat into management strategies for the Coachella Valley milk-vetch as a recommendation for action over the next five years (USFWS 2009b).

Coachella Valley Milk-vetch Strategies

- Annually monitor the distribution of Coachella Valley milk-vetch on the Refuge, as well as the quality of the habitat supporting this plant, in accordance with the monitoring protocols developed and approved for this species in the Coachella Valley MSHCP's Aeolian Sand Communities and Species Monitoring Protocols (updated on March 8, 2012 and subject to future revision as deemed necessary by the MSHCP's adaptive management process).
- By 2015, prepare a habitat management plan for the Refuge that includes a discussion of future management actions to be implemented to maintain high quality habitat for Coachella Valley milk-vetch.
- Through a coordinated area-wide effort, implement actions to ensure the long-term control of Sahara mustard within the Thousand Palms Conservation Area.
- As part of an integrated approach to pest management, aggressively control small outbreaks of new invasive plants on the Refuge to avoid the need for extensive control in the future.
- Cooperate with and support, as feasible, the Coachella Valley Conservation Commission's (CVCC) effort to conduct specific studies as part of the baseline monitoring for the Coachella Valley milk-vetch to assess: viability of seed bank, substrate affinities, micro-habitat requirements, seed dispersal, pollination ecology, and impacts of invasive species within core habitat areas to ensure that the appropriate measures to support long-term conservation of this species are identified.
- Support research that addresses issues related to sand transport, invasive species control, native pollinators and their ecology, climate change, and other issues that can benefit Refuge management and the species protected on the Refuge.
- Expand patrol and enforcement of illegal trespass onto the Refuge, particularly trespass involving off-road vehicle use in an effort to minimize soil compaction and vegetation destruction.
- Where appropriate, restore areas of disturbed habitat on the Refuge to native species in part to increase the presence of native pollinators in the area, which could benefit Coachella Valley milk-vetch.

***Objective 1.3*: Conservation of Naturally Occurring Aeolian Sand Communities**
Throughout the life of the CCP, implement management actions to conserve and enhance approximately 220 acres of naturally occurring aeolian sand communities on the Refuge including active and stabilized dunes, characterized by at least nine feet of aeolian sand atop aeolian sand substrate, with active dunes supporting a mean shrub density of less than 0.005 shrubs per square meter, while stabilized dunes (also referred to as mesquite hummocks) support a mean shrub density of greater than 0.048 shrubs per square meter; and ephemeral and stabilized sand fields, characterized by 0 to about 6 feet of aeolian sand atop gravel and rocks and supporting a mean shrub density of greater than 0.049 shrubs per square meter and silt or cemented sands, supporting a mean shrub density of greater than 0.01 shrubs per square meter, respectively.

Rationale:
The aeolian sand communities of the Coachella Valley, particularly the active dune areas on the Refuge, are identified in the Coachella Valley MSHCP (CVAG 2007a) as core habitat for the federally listed Coachella Valley fringe-toed lizard and Coachella Valley milk-vetch. Other species of concern present in this area include the Coachella Valley giant sand-treader cricket, Coachella Valley Jerusalem cricket (*Stenopelmatus cahuilaensis*), flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse. The MSHCP also states that by virtue of protecting these active dune areas as core habitat for listed and sensitive species, habitat to support burrowing owls would also be protected. The proposal to conserve and enhance the habitat quality of the desert dune habitat on the Refuge is consistent with the goals of the MSHCP, particularly the goals related to maintaining or restoring self-sustaining populations or metapopulations of the species addressed in the Coachella Valley MSHCP.

Various factors contribution to degradation of habitat quality within the Refuge's aeolian sand communities, these include illegal off-highway activity, particularly from illegal access off of 38th Avenue; the increasing presence of non-native annual forbs and grasses that can lead to stabilization of blowsand habitat; a depleted groundwater table that has resulted in the loss of honey mesquite hummocks, important to the protection of dune habitat; and changes to sand transport processes that historically provided adequate sand to replenish sands blown further downwind of the Refuge. The Coachella Valley MSHCP presents the following actions to be implemented to achieve the conservation of the naturally occurring aeolian sand communities in the Coachella Valley: protection of the sand source/transport system to ensure sustainability of the sand dunes and sand fields; control activities that contribute to the loss, stabilization, or compaction of active dune habitat; control of invasive plant species; restoration of degraded habitat; and implementation of monitoring and adaptive management actions to ensure continued conservation of these natural communities (CVAG 2007a). In addition, the Service's 5-year review for the Coachella Valley fringe-toed lizard recommends the restoration of mesquite hummocks in the Thousand Palms Conservation Area to allow for the rejuvenation of dune habitat that supports the fringe-toed lizard (USFWS 2010a). Ball et al. (2010) also postulates that mesquite hummocks may be the only vegetation community within the Valley's conserved areas that reliably supports reproducing Coachella Valley round-tailed ground squirrels and provides essential refugium for this species during drought years.

Conservation of Naturally Occurring Aeolian Sand Communities Strategies

- Increase management, monitoring, and enforcement of trespass and other refuge regulations by hiring a collateral duty refuge manager/Federal wildlife officer.

- Expand current management activities to include gathering baseline information for and subsequent annual monitoring of sensitive native species present on the Refuge; installing and maintaining signs and fencing, and conducting surveillance and public outreach to minimize disturbance to sensitive habitats.
- Plant and irrigate clumps of honey mesquite within active sand dune and sand field habitats to allow for the rejuvenation of mesquite hummocks that support dune development and provide habitat for sensitive species.
- Conduct public outreach on and off the Refuge to inform the public of the importance of the habitats and species conserved on the Refuge, as well as to reduce current levels of disturbance to sensitive aeolian sand communities.
- Participate in an area-wide invasive plant species rapid response program to remain informed about the potential for future infestations on the Refuge.
- Through an integrated approach to pest management, prioritize and treat infestations of invasive vegetation to optimize habitat value for species of concern.
- Schedule annual treatment of invasive vegetation well in advance of seed set.
- Install appropriate native vegetation in areas where invasive species control has been conducted to reduce the potential for reinvasion.
- Work in partnership with other Coachella Valley MSHCP partners to ensure the protection of essential ecological processes, including sand source/transport systems, throughout the MSHCP preserve area.
- Implement maintenance and monitoring in accordance with the Valley Floor Reserve Management Unit (Unit 1) Reserve Management Unit (RMU) Plan.
- Support research and area-wide monitoring to determine the effects of the presence of Sahara mustard and other invasive plants on fire frequency and/or intensity.
- Support research to identify effective treatment methods for the control of invasive plants (e.g., Sahara mustard) that will not adversely affect other native species.

***Objective 1.4*: Climate Change**
Within five years of CCP approval, complete and begin to implement in partnership with others a long-term (25 years or more) strategy for monitoring, assessing, and ultimately addressing the effects of changing climatic conditions, if any, on habitat quality, habitat distribution, and listed and sensitive species population size and distribution.

Rationale:
Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying (Field et al. 1999, IPCC 2007b). However, predictions of climatic conditions for smaller sub-regions such as California remain uncertain (USFWS 2010b). If climate change results in extended drought conditions in the Coachella Valley, fluvial sand deposits could be affected. In the past, during periods of drought, fluvial sediment delivery to the Coachella Valley floor has declined, impacting the rejuvenation of decreasing dune systems (Griffiths et al. 2002). Drought conditions could also reduce forage for wildlife and moisture to support sensitive plant species (Durtsche 1995, Bolger et al. 2000). A wetter climate in this region could result in the proliferation of invasive plants, possibly leading to the stabilization of dune habitat (USFWS 1985), and/or the general degradation of habitat quality (Meinke et al. 2007, Barrows et al. 2009). To understand the effects of a changing climate on the habitats within the Refuge will require a long-term commitment to monitoring and adaptive management practices.

The RMU Plan for Unit 1 (CVCC 2012b) of the Coachella Valley MSHCP planning area identifies climate change as an important issue within the entire Colorado Desert including the Coachella Valley. In an effort to addressed changing habitat conditions associated with climate change, the RMU Plan recommends actions that will facilitate the movement of species over time to areas of the Coachella Valley with more favorable conditions.

Climate Change Strategies

- Continue to coordinate with the Valley Floor Reserve Management Unit Committee to ensure that adequate monitoring and research is carried out on the Refuge and throughout the Management Unit to inform management actions that may be needed to address the potential effects of climate change and assess the efficacy of management actions that may be taken.
- Ensure that fencing installed on the Refuge in response disturbance from off-highway vehicle trespass, dumping, or other activities provides for the movement of wildlife.
- When designing restoration or enhancement plans for the Refuge, consider the needs of species to shift their range in response to the effects of climate change.
- By 2022, in partnership with the CVCC and others, complete an assessment of anticipated future conditions within the Valley Floor Reserve Management Unit, including anticipated changes associated with existing ecological and geological processes over the next 25 years. Based on this assessment, identify those species and habitats most vulnerable to these changes, design methods for measuring and documenting anticipated changes over time, and identify actions that can be implemented over time to support vulnerable species.

***Objective 1.5*: Plant and Wildlife Surveys**

By 2016, initiate a step-down Inventory and Monitoring Plan (I&M Plan) for the Refuge that includes a proposal to implement, within five years of the approval of the I&M Plan, a minimum of five surveys on the Refuge to gather, for the propose of analysis and dissemination, scientifically rigorous biological data about the status, trends, and responses to management of the species and habitats within the Refuge; and annually conduct non-native invasive plant surveys for the purpose of updating existing mapping of infestation areas and identifying any new invasive species that may pose a threat to Refuge resources.

Rationale:

Knowledge of the distribution and abundance of species, species' needs, and status is critical for the management of the Refuge. Biological surveys are necessary to establish baseline information needed to assess population trends over time. Subsequent monitoring efforts will then enable us to more fully understand how species respond to specific management actions. Management effectiveness of both native and non-native species can be evaluated and corrected, if needed, based on a monitoring program.

Monitoring of some species will be implemented in accordance with protocols established as part of the Coachella Valley MSHCP and may be conducted by refuge staff, partners, contractors, and other researchers. Other monitoring efforts will be conducted to meet Refuge data needs. The results of these monitoring efforts will assist in evaluating both refuge-initiated management efforts and regional management and conservation efforts associated with the Coachella Valley MSHCP (CVAG 2007a). Monitoring results, which will be retained by the Service, as well as submitted for entry into the GIS database for RMU 1 and the Coachella Valley MSHCP area, may also provide some insight into the effects of changing climatic conditions at a regional and landscape level.

Plant and Wildlife Surveys Strategies

- By 2016, initiate an I&M Plan for the Refuge per the Service's Inventory and Monitoring Initiative.
- As part of the I&M Plan and in association with the larger ongoing surveying efforts conducted for RMU 1 per the Coachella Valley MSHCP, identify and prioritize surveys to be conducted on the Refuge within five years of I&M Plan approval that will best assist in the management of Refuge resources.
- Conduct annual surveys of the Refuge to map significant invasive plant species infestations, evaluate the effectiveness of past control efforts, and identify the presence of any new invasive organisms that require immediate attention.
- As part of the required monitoring under the Coachella Valley MSHCP, monitor listed and sensitive species in accordance with approved protocols.
- Collect standardized data for dissemination to all appropriate entities, including the Valley Floor Reserve Management Unit Committee, to facilitate the evaluation of management efforts at the local, regional, and landscape level.
- Hire a dual function refuge manager/Federal wildlife officer to monitor listed and sensitive species, conduct biological surveys, enforce access control, and assist in invasive species mapping and control.

Goal 2: Through participation in a coordinated management effort involving all of the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP) partners, sustain the ecological and evolutionary processes necessary to maintain the viability of the natural communities and habitats that support the species identified in the CVMSCP and manage these communities and habitats adaptively to be responsive to short- and long-term environmental change.

Objective 2.1*: *Coordinated Land Management
Over the next 15 years, continue Refuge involvement in the coordinated management of the conserved lands within the Valley Floor Reserve Management Unit of the Coachella Valley MSHCP planning area, meeting at least quarterly to review ongoing management efforts and issues, identify common information gaps, explore joint funding opportunities, develop coordinated monitoring and adaptive management strategies, and generally foster cooperation across jurisdictional and ownership boundaries.

Rationale:
Coordination among land managers has been shown to improve monitoring and management efficiencies for all participants. Through regular coordination and communication, land managers can identify gaps in knowledge and funding resources, leverage funds to realize greater benefits, and develop cost-effective cross-agency management strategies.

As part of the Coachella Valley MSHCP, a structure for coordinating management among the various entities responsible for managing reserve lands within the Coachella Valley MSHCP planning area has been established. This structure includes the creation of the Coachella Valley Conservation Commission and six RMU Committees. The Refuge is included in RMU 1 (Valley Floor). To provide guidance for coordinated management within RMU 1, a RMU Plan (CVCC 2012b) has been prepared to guide and prioritize management direction, as well as address issues such as funding and partnership opportunities, data storage and analysis, and procedures for annual reporting of management activities. The Refuge's participation on the

Valley Floor RMU Committee will strengthen relationships, facilitate ongoing communication, and ensure long-term coordination of regional management efforts.

Coordinated Land Management Strategies

- Continue to participate in quarterly Coachella Valley MSHCP Reserve Management Oversight Committee meetings, as well as in RMU 1 committee meetings.
- Provide input into the development of annual work plans for RMU 1.
- Continue to partner with the Center for Natural Lands Management on programs that build public support for the protection of the lands within the Thousand Palms Conservation Area.
- Hire a dual function refuge manager/Federal wildlife officer to among other duties coordinate patrol of the Refuge with other law enforcement agencies in RMU 1.

***Objective 2.2*: Research**

By 2015, in partnership with others identify research priorities relevant to the conservation and management of the species and habitats present within the Coachella Valley, as well as the ecological processes that support these species and habitats, and by 2017, develop and implement a strategy for facilitating research by USGS, graduate students, UC Riverside, CVCC, *and others.*

Rationale:

The needs and opportunities for research both on the Refuge and throughout the Coachella Valley MSHCP area are vast and it is only through partnerships that these needs can even begin to be met. For example, expanded partnerships with academic institutions, USGS, and others managers within RMU 1 and the larger Coachella Valley MSHP planning area could provide valuable data related to the life history of little-known species protected on the Refuge, while other research could answer questions related to which herbicides can be used safely in areas supporting rare plants or insects. Once research priorities have been identified, land managers and other partners can more effectively seek funding and research partners.

Research Strategies:

- Work with members of the Valley Floor RMU Committee, CVCC, and others to develop research topics relevant to the conservation and management of the species and habitats present within the Coachella Valley, including research suggested in relevant species recovery plans and research related to the control of non-native invasive plants.
- Develop and implement strategies among the entities participating in the Coachella Valley MSHCP and others to facilitate needed research to the extent that plan funding and leveraged outside funding sources allow.
- Continue to support and facilitate management-oriented research on wildlife and habitat, including monitoring the impacts of climate change.
- Continue to support and facilitate research focused on identifying habitat features important to the species that occupy the Refuge's aeolian sand communities.

***Objective 2.3*: Cultural Resources**

Over the next 15 years, implement proactive management of cultural resources that focuses on meeting the requirements of the National Historic Preservation Act and other cultural resource legislation, to address the protection, identification, inventory, evaluation, consultation and, when appropriate, interpretation of the Refuge's historical and archaeological resources.

Rationale:
It is the policy of the Service to identify, protect, and manage cultural resources located on Service lands and affected by Service undertakings. Limited information is available regarding the presence of cultural resources on the Coachella Valley NWR, however, there is the potential for one or more sites to be present that have not yet been discovered or recorded. Cultural resources are not renewable, making protection an essential component of cultural resource management. To realize the full scientific and education value, or better understand the spiritual value of a cultural resource, it is also important to preserve and/or record the context of the setting in which a cultural resource is discovered. This requires proactive management in which access is restricted or minimized in areas identified as having a high potential for undiscovered cultural resources.

Cultural resources possess scientific and educational value to tribes, archaeologists, historians, and many members of the public. Many cultural resources also have a spiritual connection to one or more tribes, providing important elements of individual and group identity. Cultural resources can connect us to our past, providing the means to study and reflect upon the events and processes that have shaped our nation, our communities, and ourselves.

Cultural Resources Strategies

- Comply with all applicable cultural resource regulations and policies prior to implementing projects that would disturb any surface or subsurface cultural resources.
- Work with local tribes to develop a Memorandum of Understanding for implementing the inadvertent discovery clause of NAGPRA.
- As necessary, seek funding to identify, evaluate, and protect important cultural resources on the Refuge.
- Ensure that refuge staff receives training in historic preservation requirements and of NHPA, ARPA, and NAGPRA.

Goal 3: Enhance the public's awareness, appreciation, and support for the Refuge's listed and sensitive species, as well as the ecological functions and geological processes that sustain these species, through compatible opportunities of environmental interpretation.

Objective 3.1*: *Environmental Interpretation
By 2018, develop a visitor services plan that includes innovative approaches for interpreting the plant and wildlife species present on the Coachella Valley NWR and fostering public support for the continued preservation of these species and the ecosystems in which they live that will reach some 10,000 individuals annually without the need for access onto the Refuge.

Rationale:
The Improvement Act identifies interpretation as one of the six wildlife-dependent recreational uses of the Refuge System that should be allowed on Refuges when determined to be compatible with the purposes for which a Refuge was established. Interpretation provides opportunities for people to make their own connections to Refuge resources and in so doing can provoke participation in resource stewardship. Interpretation can help people understand why and how to minimize their impact on sensitive resources.

As part of the larger Thousand Palms Conservation Area under the Coachella Valley MSHCP, the Coachella Valley NWR protects substantial acreage of core habitat for several listed and sensitive species covered by the MSHCP. To protect these species and the sensitive habitat on which they depend, general access to the area is limited. As a result, interpretation of the Refuge's resources is proposed to occur primarily at an off-site location within the Thousand Palms Conservation Area that receives significant visitation and is more easily accessed by the public. The Refuge proposes working in partnership with the Center for Natural Lands Management to provide interpretation of the Coachella Valley NWR at the Coachella Valley Preserve Visitor Center. At this location, a variety of interpretive elements could be provided that would assist the public in developing an understanding of why it is important to protect the plants, insects, reptiles, and birds supported within the dune habitat on the Refuge and elsewhere within the MSHCP planning area. Interpretive themes and content would incorporate innovative activities intended to reach new and non-traditional audiences. An additional traveling interpretive program is also proposed to further expand public outreach.

Environmental Interpretation Strategies

- By 2018, develop a step-down visitor services plan for the Coachella Valley NWR.
- Working with the Center for Natural Lands Management, the Valley Floor RMU Committee, and others, develop innovative interpretation of the resources on the Coachella Valley NWR for display off the Refuge.
- Design, fabricate, and install interpretive elements to foster public awareness and support for the protection of the habitats on the Refuge.
- Develop literature (e.g., flyers, booklets, coloring books) and a movable interpretive exhibit of sensitive Coachella Valley species and habitats that can be displayed at different locations throughout the community (e.g., libraries, schools, city halls).
- Provide opportunities for periodic special tours of the Refuge lead by qualified interpreters who can ensure minimal impact to sensitive species and habitats.

***Objective 3.2*: Equestrian/Hiking Trail**

Over the next 15 years, accommodate equestrian and hiking use within the designated route of travel approved as part of the Coachella Valley Preserve in 1990, including 1.86 miles along the northwest boundary of the Refuge and 1.5 miles across the northern portion of the Refuge that is compatible with Refuge purposes, does not result in any observable disturbance to habitat due to unauthorized off-trail activity by equestrians or hikers, and results in minimal (less than five annually)violations of trail restrictions, including no dogs on the trail.

Rationale:

In 1988, at the request of the Ivey Ranch Equestrian Center and CVAG, the BLM prepared a draft EA to analyze the potential environmental impacts of a proposed trail system on lands within the area then referred to as the Coachella Valley Preserve. The 1986 Coachella Valley Preserve Management Plan included the establishment of hiking and equestrian trail systems outside of sensitive habitats as a long-term goal of the plan. After a number of public meetings, a preferred alternative was developed that designated a trail along the northwest boundary of the Refuge, as well as an east/west oriented trail that crossed the northern portion of the Refuge. The trail system was intended to provide the public with an opportunity to experience the native habitats in the area, as well as to increase public support for the preservation goals of the Preserve. The Service issued a biological opinion in 1990 that outlined reasonable and prudent measures to be implemented to eliminate and reduce incidental take of listed species.

Equestrian/Hiking Trail Strategies

- Continue to allow compatible equestrian and hiking use on the approved trail that extends along the Refuge's northeast boundary and east/west across the northern portion of the Refuge.
- Enforce the reasonable and prudent measures outlined in the biological opinion for this trail including restricting all trail use to the designated corridor, clearly marking the trail corridor by posting signs every 250 feet, prohibiting dogs and other pets within the Refuge boundary, and periodically monitoring trail use for compliance of these regulations.
- Maintain bollards or other barriers, as well as fencing, when necessary, to prohibit off-road vehicle access onto the Refuge from the trail.
- Periodically patrol the trail and assess the area around the trail to determine if unauthorized activity is occurring off trail; if so, implement appropriate measures (e.g., signage, fencing, trail closure) to minimize off trail impacts from hikers and equestrians.
- Periodically survey the areas bordering the trail to identify any increase in invasive weed species along the trail; if necessary, take appropriate actions to reduce the introduction of weed species related to trail use.

3.4 Management of the Sonny Bono Salton Sea NWR

3.4.1 Refuge Management Overview

Since its establishment in 1930, the Sonny Bono Salton Sea NWR has been managed to support birds and other wildlife. Management actions have focused on providing foraging habitat for migratory birds and reducing depredation of adjacent private croplands by ducks and geese. As private agricultural development in the Imperial Valley increased and the amount of farmable land available to the Refuge between the Sea and the private lands decreased, Refuge staff increasingly focused on improving the productivity of the lands that were available to provide forage for wintering waterfowl. Considerable effort also went into identifying suitable farmland that could be acquired in fee title by the Refuge, although for the most part, these efforts were unsuccessful.

With the enactment of the ESA, management activities on the Refuge were expanded to include the protection of the endangered Yuma Ridgway's rail, and suitable nesting habitat was established to support nesting seabirds. The mid 1990s brought added responsibilities related to avian disease monitoring throughout the Salton Sea. Table 3-1 identifies important events related to the management of the Sonny Bono Salton Sea NWR. More information about the history of the Refuge is provided in Chapter 1.

Table 3-1
Timetable of Past Events Associated with the Sonny Bono Salton Sea NWR

Event	Timeframe	Additional Details
Refuge established (32,410 acres)	11/25/1930	Executive Order 5498 was signed by President Hoover
Original Refuge lands gradually inundated by the Salton Sea	Late 1930s to early 1940s	Raised need for the Refuge to identify farmable uplands for producing winter forage for waterfowl

Table 3-1 Timetable of Past Events Associated with the Sonny Bono Salton Sea NWR		
Event	**Timeframe**	**Additional Details**
Lands between the Salton Sea shoreline and private agricultural lands were leased from IID	1945, 1949	Acquired areas were farmed to produce grain crops and green forage for ducks and geese
Salton Sea water levels unstable	1940s through 1970s	Sea levels rising; flooding made it difficult to produce winter forage for waterfowl
Sea wall constructed along the south end of the Salton Sea	1980	This wall was intended to protect farm land from rising Salton Sea levels
Began managing habitat to support the endangered Yuma Ridgway's rail	1980s to present	Freshwater cattail marsh was established in impoundment areas on the Refuge
Headquarters office building constructed	1984	Consolidated Refuge administration and operations
Original observation deck/tower constructed at the Refuge headquarters	1986	Constructed to support wildlife observation; it was later replaced with an accessible deck
Sampling of irrigation drain waters to identify contaminant levels	1986	Joint effort of the Service, Bureau of Reclamation, and USGS to address potential health concerns to humans and wildlife
Observation deck erected at Unit 1	1990	Enhanced wildlife viewing opportunities
Farming program includes Sudan and rye grass, wheat, barley, and alfalfa	1990s	Over the years, various crops were planted in an effort to optimize foraging opportunities for waterfowl
Salton Sea water elevation "peaks"	1995	Between April and June 1995, the water level in the Salton Sea reached -226.6 feet MSL
Most significant disease outbreak among birds on the Salton Sea	1996	Smaller outbreaks of Type C botulism have occurred repeatedly at the Salton Sea
Refuge expands its role in monitoring bird and fish health on the Salton Sea	1997	Based on the Service's migratory bird responsibilities, the Refuge took the lead in a multiple agency effort to address disease outbreaks at the Salton Sea
Bird treatment field "hospital" and other facilities constructed to help manage avian disease outbreaks	1997	Enabled more thorough treatment of sick birds for eventual release to the wild
Airboats and other equipment acquired for enhanced management of disease outbreaks	1999	Substantially increased Refuge staff and cooperators ability to detect and respond to disease outbreaks in early stages
Salton Sea NWR renamed Sonny Bono Salton Sea NWR	1998	Congressman Sonny Bono played an active role in efforts to restore the health of the Salton Sea
Congressional funds appropriated to help address response to disease outbreaks	1998	Enabled the Refuge to devote more resources to the issue of avian disease outbreaks
Quantification Settlement Agreement results in long term water transfers from the Imperial Valley	2003	Transfers Colorado River water to San Diego and the Coachella Valley, eventually lowering water levels in Salton Sea

Table 3-1 Timetable of Past Events Associated with the Sonny Bono Salton Sea NWR		
Event	**Timeframe**	**Additional Details**
Headquarters office expanded to provide visitor contact space	2005	Improved ability of the Refuge staff to interact with Refuge visitors
Farming techniques modified to reduce carbon dioxide emissions, transition to minimum- or no-till farming	2009-2011	Reduces carbon emissions, conserves fuel, reduces soil disturbance to reduce weeds and improve air quality
Photo-voltaic panels installed on Refuge headquarters building	2010	Reduces the Refuge's carbon footprint
ADA accessible observation deck constructed at Unit 1	2011	Allow enhanced "over-water" wildlife viewing opportunities for all visitors

3.4.2 Previous Management Documents

A number of management plans have been prepared for the Refuge over the years, including the Land Use Plan for the Salton Sea NWR, approved in 1963, and the Salton Sea NWR Master Plan, approved in 1972. The primary objectives of the 1963 land use plan were to provide a sanctuary and feeding ground for wintering waterfowl and to minimize depredation of commercial crops in the area by ensuring that waterfowl remain in the Refuge to forage. Existing public use on the Refuge, which included hunting and wildlife observation, were described as limited (USFWS 1963). Although the 1963 land use plan was prepared some 50 years ago, much of its content is still relevant as weather and soil types that dictate habitat management options have not changed significantly over the years.

The objectives presented in the 1972 Master Plan were more extensive than those of the earlier plan. In addition to objectives related to providing feeding and resting areas for migratory waterfowl and preventing crop depredation, this plan also included objectives related to wildlife-oriented public uses (e.g., hunting, fishing, wildlife observation, and conservation education); preservation of endangered and special concern species; preservation of habitat to support wildlife diversity; and preservation of historic and geological features (USFWS 1972). The last management plan prepared for the Refuge was the 1972 Master Plan, although there have been a few updates to the Refuge goals and objectives over the years. Existing habitat management is also guided by the recommendations of a Cropland Management Review conducted in 2001.

A variety of laws, treaties, and Executive orders related to the conservation and protection of natural and cultural resources; applicable Service recovery plans; and programs and recommendations associated with ongoing migratory bird planning efforts all influence the management actions implemented on the Sonny Bono Salton Sea NWR. The most important orders and laws affecting the operation and management of NWRs include Executive orders 12996 (Management and General Public Use of the National Wildlife Refuge System) and 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds), NWRS Administration Act, as amended, Refuge Recreation Act, Endangered Species Act, and Fish and Wildlife Act of 1956.

3.4.3 Past Management Actions

Between 1930 and 1947, about 32,400 acres located in the southern portion of what is now the Salton Sea where managed to protect waterfowl and shorebirds. In 1930, about 60 percent of the Refuge consisted of open saline lake with the balance of the area comprised of shoreline alkali flats, freshwater wetlands, native desert scrub, and agricultural fields (USFWS 1972).

With the impending inundation of the original Refuge lands by the Salton Sea, the Service began to look for other lands in the vicinity where migratory bird foraging habitat could be created (USFWS 1963). In 1945, the first of the IID lands to be leased for Refuge purposes were acquired under the authorities of the Migratory Bird Conservation Act. These leased lands, located in what is referred to today as Unit 1, had either never been farmed or had not been farmed since 1924. As a result, major work (e.g., land leveling, ditch and canal construction) was required to prepare these lands for cultivation. Additional lands that were already in agricultural production were leased for Refuge purposes in 1949. These lands, located within the area referred to today as Unit 2, were used to cultivate cereal grains (e.g., barley, milo) that provided foraging habitat for wintering geese (USFWS 1963). During this time, the water level in the Salton Sea continued to rise.

Between 1947 and 1963, the areas leased from the IID were gradually submerged below the rising waters of the Salton Sea, reducing the area available for producing forage for wintering geese to about 4,415 acres. As more land was lost to the Sea, Refuge staff found it difficult to provide adequate foraging and resting areas to support the area's transient and wintering waterfowl. This situation was of particular concern during the 1940s and 1950s when waterfowl crop depredation in the Imperial Valley was a serious problem for farmers. By 1963, only 1,630 acres were still suitable for farming or marsh management, and the size of the wintering Canada goose flock was increasing. In fact, the goose flock increased from 1,000 geese in 1959 to 9,000 geese in 1966.

By the 1960s, the Refuge was cultivating barley, millet, and bulrush, all to support wintering geese and waterfowl. The type of crop selected for cultivation was directly related to the salinity levels in the soil, with barley planted in areas with the lowest salinity levels. All farming operations were performed by Refuge personnel and involved two types of operations, the production of cereal grains primarily in the form of green barley for forage and management of artificial impoundments to produce millet, bulrush, and cattails (USFWS 1963). The planting of barley was timed to ensure that adequate forage was available as soon as the geese arrived in the area. A few areas were also planted with millet, and in some years, other crops such as alfalfa, milo, and other sorghums were planted in some tracts.

In 1962, the Refuge implemented an experimental artificial marsh project in Unit 1 in an effort to supplement available forage for waterfowl. Alkali bulrush (*Schoenoplectus maritimus*) was planted within this 80-acre impoundment. The project was very successful in attracting foraging ducks and geese. In 1964, the Service, under an agreement with the State, began managing wetland areas within the Hazard Tract (located in the eastern portion of Unit 2) to support waterfowl. This agreement enabled the Refuge to better achieve its purpose of reducing depredation on commercial cropland.

In 1968, the State of California enacted a statute (Stats 1968, Ch. 392, Sec. Z) declaring the collection of agricultural drainage water, seepage, leaching, and control waters as the primary use of the Salton Sea, formally recognizing the Salton Sea as a repository for agricultural drainage. As a result, during the late 1970s and the early 1980s, agricultural drainage in the Salton Sea increased and, between 1983 and 1988, discharge from the New and Alamo Rivers into the Sea nearly doubled. The combination of increases in total discharge into the Sea from agricultural uses and above average precipitation within the Salton Basin resulted in excessive water levels.

In 1972, the manageable part of the Refuge was a narrow corridor of land bordering the southern shoreline of the Sea where about 1,500 acres of farmed crops and marsh habitat were maintained to provide forage for wintering waterfowl. Ryegrass, barley, and milo were planted under a system of double cropping. Because of the limited area available to provide green browse, the

Refuge was at the time also distributing harvested grain in the fields to supplement the available food for waterfowl in an effort to achieve the Refuge purpose of reducing depredation in adjacent private farm fields (USFWS 1972). The planting and maintenance of alkali bulrush in areas too saline to grow green forage, which was initiated in 1962, continued and was of adequate success that millet production in these areas was reduced.

In 1974, the Refuge partnered with IID to construct a seawall at Unit 2. Another wall was constructed in 1987 in Unit 1 with the Westmorland Duck Club to keep the expanding Salton Sea from flooding productive refuge habitats. Areas saved from flooding by the Salton Sea included impoundment areas and croplands in Unit 1 and the Refuge office facilities and surrounding cropland acreage at Unit 2. In 2004, it was estimated that the Refuge office would be inundated with two to three feet of water should the seawall fail.

In 1984, the water elevation was 226.0 feet below sea level, the highest elevation attained in the Sea since its formation in 1905. The results of this increase in elevation were inundation of existing private structures, loss of productive agricultural lands, impacts to recreational facilities, and a renewed call for water conservation to stabilize the water level within the Sea. As discussed in Chapter 4, by about 1995, as a result of successful water conservation measures and the initiation of water transfer agreements, this trend in increasing water elevations had reversed. As of September 2013, the water elevation in the Sea had dropped to 232 feet below sea level.

In the 1970s and 1980s, the Refuge acquired a number of parcels in fee-title, which allowed the Refuge to increase the total acreage available for producing green forage for wintering geese and other waterfowl.

In 1988, Ducks Unlimited assisted the Refuge in restoring wetlands in Unit 1 (Tracts 1A and 2B). These wetland units had been terraced by small levees and had been partially inundated by the Salton Sea. Land leveling and levee construction reduced the number of impoundments from about 19 in each tract to about four, greatly reducing the amount of salt cedar control needed on levees and expanding the pond sizes for improved waterfowl use. These tracts were renamed in the early 1990s to "A" ponds and "B" ponds. From 2006 through 2011, Ducks Unlimited also helped improve wetland management in the Hazard Tract by improving pond drainage and water delivery, constructing islands for waterfowl loafing, and adding a new pond at the north end of the tract.

Restoring wetlands in partnership with others (USFWS)

Avian disease has been documented at the Salton Sea since 1917. As is the case in many other western wetland areas, avian botulism type C is the primary disease affecting birds at the Salton Sea. Avian mortality has fluctuated between decades from high to low with no apparent pattern.
However, in the 1990s the magnitude of bird losses exceeded all prior records, with the frequency of large scale and individual disease events and the variety of avian diseases greater than all other previous decades.

In 1989, salmonellosis was first diagnosed in the Salton Sea ecosystem. In 1992, an unknown disease killed approximately 155,000 eared grebes (*Podiceps nigricollis*) and 45,000 ruddy ducks (*Oxyura jamaicensis*). Again in 1994, approximately 20,000 grebes died of an unknown disease. In 1996, about 20,000 eared grebes died from avian botulism, along with over 8,500 American white pelicans and over 1,100 California brown pelicans (*Pelecanus occidentalis*). The first case of Newcastle Disease in the Salton Sea was documented in 1997, when approximately 2,500 double-crested cormorants died. Avian cholera killed approximately 8,000 birds in 1997.

The cause for this increased prevalence of avian disease at the Salton Sea has not been specifically determined, however, suspected stressors and contributors include the high use of this wetland by migratory birds (which helped to spread disease), degraded environmental quality of the Salton Sea (e.g., increased salinity, excessive nutrients) and harsh physical conditions (e.g. hot summer temperatures). In response to the increased incidence of avian disease at the Salton Sea, the Refuge established a Site Health and Safety Plan and defined Airboat Operating Procedures specific to avian disease monitoring; entered into a Memorandum of Understanding (MOU) with the Salton Sea Authority for sustained disease monitoring on the Salton Sea; and set up regular coordinated patrols with the CDFW Imperial Wildlife Area to search for sick and dead birds and remove them from the environment.

The areas and acreages that have been managed to support wetlands or farmed to produce green forage have changed throughout the years due to various factors. Many changes were due to the recurring flooding and drying cycles of the Salton Sea and budgetary constraints. Refuge records indicate multiple instances of Refuge lands being flooded and crops lost, as well as detail efforts made by IID to remedy flooding. Previously farmed lands that were flooded by the rising Salton Sea and then left to dry when the Sea receded were often too salty for cultivation. To address this situation, Refuge staff would attempt to reclaim these lands by leaching salts from the soils with irrigation. Although for the most part, the Refuge has had sole responsibility for managing and cultivating winter foraging areas, the Refuge farming program has also gone through cycles of cooperative farming, whereby neighbors or other cooperators would farm Refuge lands under agreements that allowed some use of their crop for wildlife.

As of 2012, the Sonny Bono Salton Sea NWR included about 1,785 acres of manageable habitat; the remainder of the Refuge remains inundated by the waters of the Salton Sea. As the Sea continues to recede, additional areas of Refuge land may be exposed. Of the manageable habitat areas, approximately 904 acres are managed as wetlands to support resident and migratory birds, another 870 acres are farmed to provide forage for wintering geese and other migratory birds, and approximately 500 acres represent recently exposed playa proposed for restoration to shallow water habitat. The remaining areas of the Refuge located above the current level of the Salton Sea include dikes, roads, administrative facilities, shoreline, nesting islands, and salt flats.

With respect to public uses, when the Refuge was established in 1930, the intent was to set aside the original acreage as a reserve and breeding ground for birds and wild animals, with little if any public use. As this area became inundated and other lands were acquired through leases to meet Refuge purposes, the potential for providing opportunities for public use was greater.

Duck and goose hunting has occurred on portions of the Refuge at various times over the years and is currently permitted on some portions of the Refuge today. In the 1960s, participation in wildlife observation, particularly birdwatching, began to expand. In the early 1970s, the need for an office and interpretive center, public parking area, and foot trails to specific observation areas was acknowledged. The 1972 Master Plan for the Salton Sea (USFWS 1972) included the following objective and rationale for the objective:

Provide opportunity for quality wildlife-oriented public enjoyment based on natural beauty, unique environment, and compatible wildlife management objectives.

Since the Refuge is located within a two-hour drive of population centers of San Diego and Los Angeles, the public's demand for the wildlife-oriented activity could easily reach 50,000 to 100,000 visitors annually.

The Refuge continues to provide opportunities for hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Interpretive signage and guided nature walks are provided for visitors, and historically, the bird life on the Sonny Bono Salton Sea NWR has attracted local, regional, national, and international visitors throughout the year.

3.4.4 Ongoing and Future Refuge Management Actions and Programs

After considering the results of the analysis conducted as part of the draft CCP/EA, as well as reviewing and considering the input received during the public review process, we selected Alternative B from the range of alternative identified in the draft CCP/EA for implementation on the Sonny Bono Salton Sea NWR. We determined that Alternative B would most effectively achieve the Refuge purposes, goals, and objectives. The details of the selected plan are illustrated in Figures 3-1 through 3-5 and described here.

3.4.4.1 Wildlife and Habitat Management

The majority of the habitat management actions implemented on the Refuge involve highly managed systems with specific wildlife species and habitat purposes. These managed habitats include: 1) agricultural fields maintained for the primary purpose of providing forage for wintering waterfowl; 2) seasonal shallow water wetlands that support alkali bulrush and other vegetation to provide additional forage for waterfowl; 3) freshwater impoundments that support cattails and other freshwater emergent vegetation to provide habitat for the endangered Yuma Ridgway's rail and a number of other secretive marsh birds; and 4) permanent open water areas that provide habitat for shorebirds, seabirds, and other waterbirds, including nesting areas for terns and gulls. Other areas on the Refuge consist of the open waters within the Salton Sea; riparian areas located along the New and Alamo rivers and the various drains and irrigation channels present on the Refuge; tree rows that consist of native and non-native desert trees; and Salton Sea desert scrub habitat.

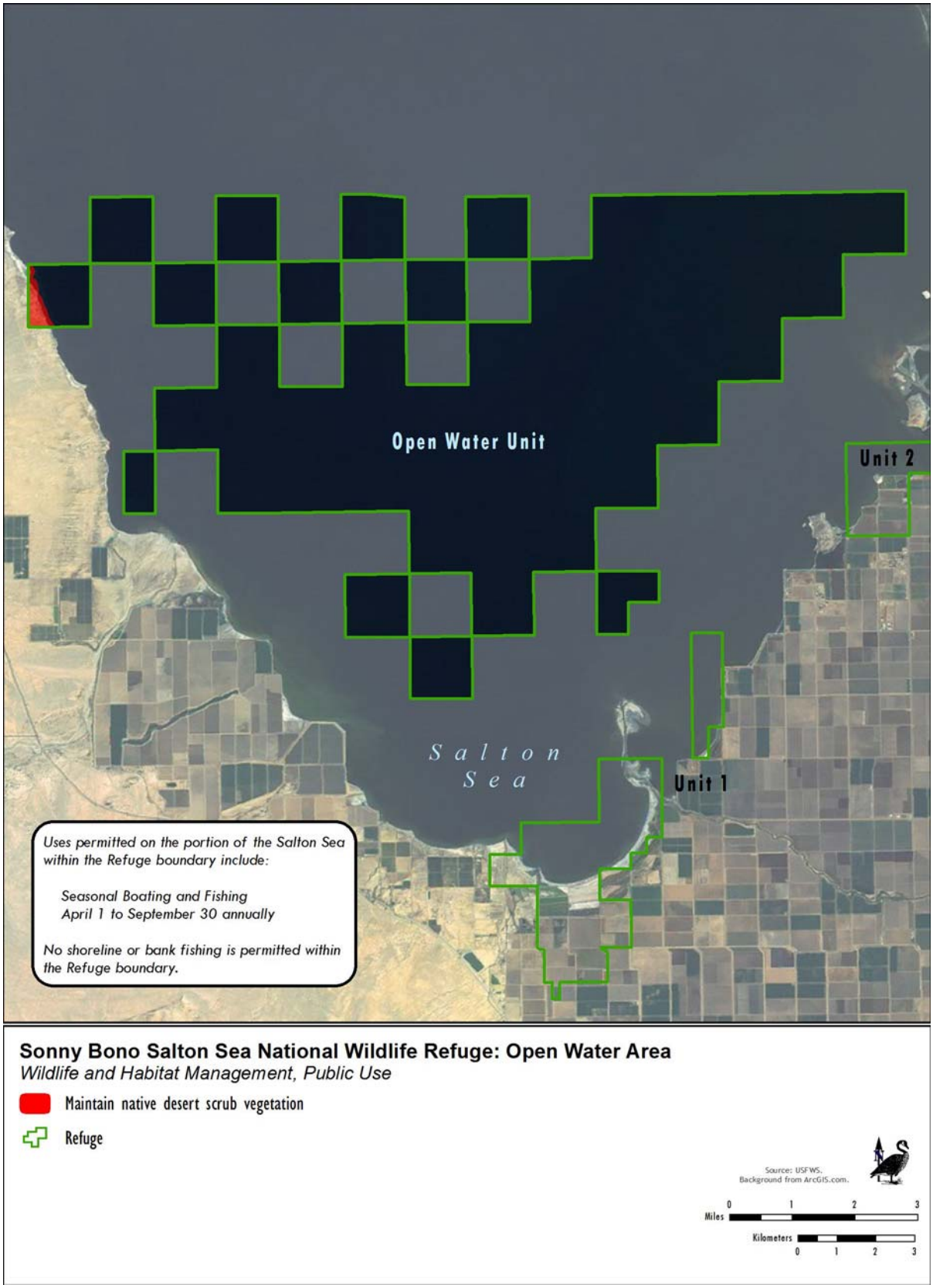

Figure 3-1. Management Plan for the Open Water Area - Sonny Bono Salton Sea NWR

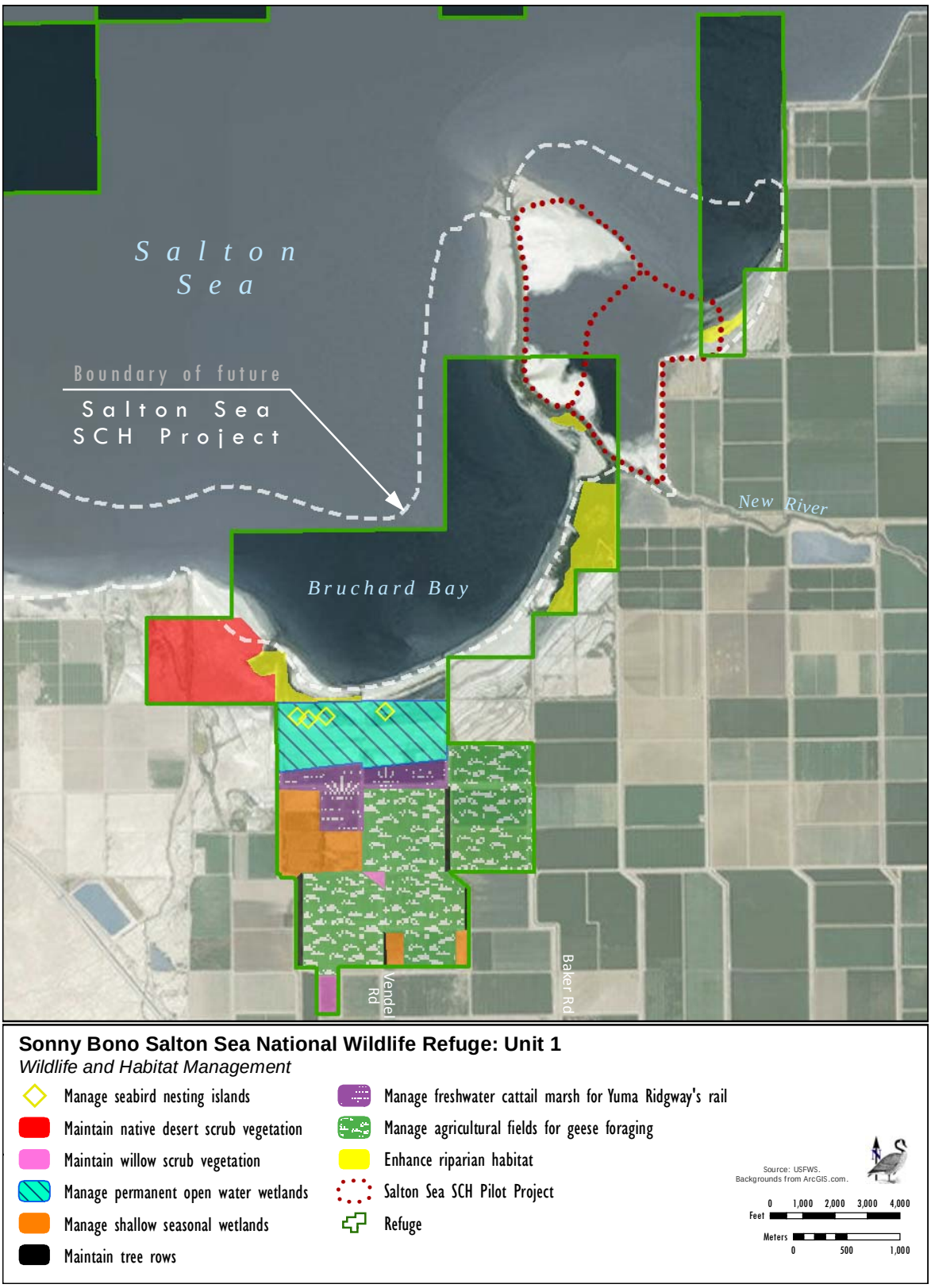

Figure 3-2. Wildlife and Habitat Management Plan - Sonny Bono Salton Sea NWR, Unit 1

Sonny Bono Salton Sea National Wildlife Refuge: Unit 2

Wildlife and Habitat Management

- Manage seabird nesting islands
- Maintain native desert scrub vegetation
- Manage permanent open water wetlands
- Manage shallow seasonal wetlands
- Maintain tree rows
- Manage freshwater cattail marsh for Yuma Ridgway's rail
- Manage agricultural fields for geese foraging
- Enhance riparian habitat
- Red Hill Bay Restoration Project
- Refuge

Source: USFWS.
Imagery from ArcGIS.com.

Feet: 0 1,000 2,000 3,000

Meters: 0 500 1,000

Figure 3-3. Wildlife and Habitat Management Plan - Sonny Bono Salton Sea NWR, Unit 2

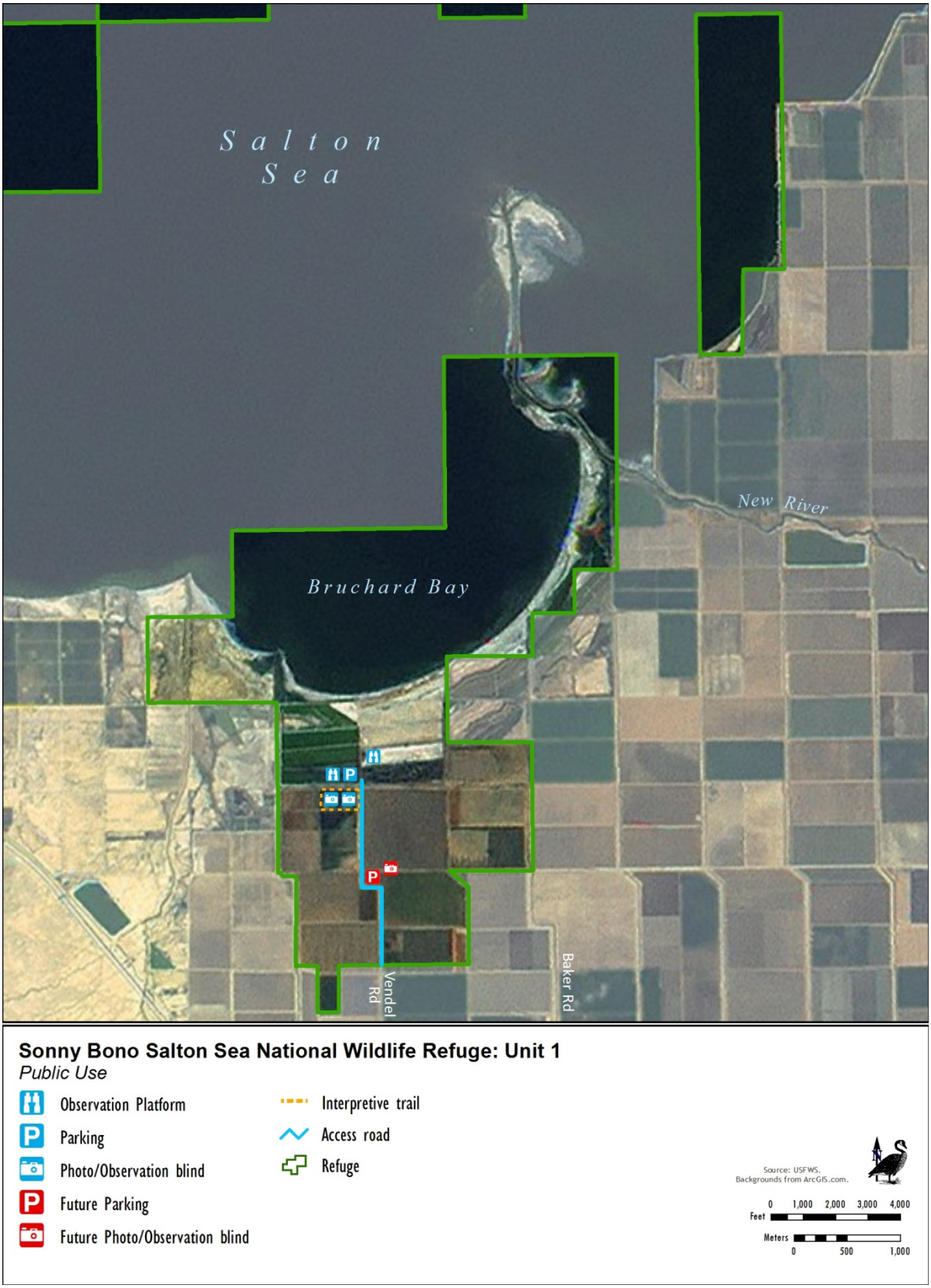

Figure 3-4. Public Use Plan– Sonny Bono Salton Sea NWR, Unit 1

Sonny Bono Salton Sea National Wildlife Refuge: Unit 2
Public Use

- Observation Platform
- Parking
- Refuge headquarters/Visitor contact station
- Future Parking
- Waterfowl hunting
  Open Wed., Sat. and Sun. during the hunting season
- Viewpoint trail
- Interpretive trail
- Future year-round birding trail
- Future seasonal birding trail
- Refuge

Source: USFWS.
Backgrounds from ArcGIS.com.

Feet: 0 1,000 2,000 3,000
Meters: 0 500 1,000

Figure 3-5. Public Use Plan – Sonny Bono Salton Sea NWR, Unit 2

Habitat Management

Managed Agricultural Fields. Approximately 850 acres (refer to Figures 3-2 and 3-3), the majority of which are leased from IID, are farmed annually to provide foraging habitat for wintering geese (e.g., snow geese, Ross's geese). This activity is conducted to achieve the Refuge purpose of reducing depredation of commercial cropland in the Imperial Valley by wintering waterfowl. Over the years, Refuge management practices have been and continue to be effective at enticing most geese and ducks that winter in the northern part of the Imperial Valley away from private farmlands.

Preparing the fields for winter foraging geese (Mark Stewart/USFWS)

Maintaining these agricultural fields is an energy intensive process involving significant labor hours and fuel. Productivity in these fields is also dependent upon an adequate supply of irrigation water. Field management includes disking and seed drilling, the delivery and distribution of irrigation water, and the as needed use of herbicides and fertilizer.

Factors affecting productivity include the presence of heavy clay soils that can become highly compacted, as well as the tendency for salts to accumulate in the soil. Subsurface tile drainage systems, which have been installed under the Refuge's agricultural fields, allow salts that accumulate below the surface to drain away from production areas. These systems, which result in an increase in overall crop productivity, require regular inspection and maintenance to ensure that they continue to function properly.

A wide range of crops has been cultivated on the Refuge over the years. Some crops have required greater management than others. In addition, the cultivation of some crops has resulted in concerns by adjacent farmers. For instance, alfalfa is no longer grown on the Refuge because surrounding farmers had concerns that weeds and insect pests in the Refuge fields were impacting their crops.

To address these concerns and receive input on how best to optimize forage production on the Refuge, the Refuge conducted a farm review in 2002. This review involved interested farmers, the Imperial County Farm Bureau, and various interested agencies and organizations such as Service staff, CDFW, Ducks Unlimited, and California Waterfowl Association.

Based on the discussions and information obtained during the farm review, Refuge staff determined that when provided in combination with nearby wetland plant forage, the production of annual rye grass would provide an appropriate level of forage for the geese. The advantage of cultivating annual rye grass over other crops, such as alfalfa, is that far less use of pesticides, fertilizers, and herbicides is required. In addition, herbicides formulated to kill invasive broadleaf species need only be applied once a year. This reduces costs and allows Refuge staff to focus on other management issues on the Refuge.

Agricultural fields are prepared for planting starting in late spring and continuing throughout the summer months. Annual preparations have historically included disking fields (usually twice), leveling the fields by tri-planing, and placing borders in the fields to control flood irrigation water. To reduce fuel consumption, carbon dioxide ($CO_{2)}$ emissions, and other pollutants, Refuge staff has been experimenting with the practice of no till or limited till soil preparation. Under the no till or limited till method, the previous crop is left standing and a special high ground pressure no-till seed drill is used to penetrate the soil when seeding is required. This practice, which omits the process of disking the soil, has been performed successfully at other farms in the Imperial Valley. It has proved successful on the Refuge as well, resulting in a significant reduction in diesel fuel consumption (fuel use was reduced from 10,000 gallons per year to 5,000 to 7,000 gallons per year) because far less tractor use is required under no till practices.

As of 2012, the practice of no till farming included about half of the Refuge's farm field acreage. Continuous monitoring of the crop is required to ensure that a high level of crop productivity is maintained. Disking or tilling of the soil helps ensure healthy robust root development in otherwise heavy silty clay soils. On the Refuge, alternating disking with a one, two, or three-year cycle of no-till farming for rye grass has maintained a satisfactory productive crop. Staff observations indicate that this practice also benefits passerine birds and waterfowl during the spring, when residual grass cover in the no-till fields provides insect foraging opportunities, and possibly appropriate nesting sites for some species. Refuge staff will continue to evaluate the effectiveness of the current no till practices and if deemed appropriate, this practice will be expanded over time to include more of the Refuge's managed farm fields.

Also proposed for the managed agricultural fields is laser leveling. Laser leveling of the various wintering geese foraging fields on the Refuge, which will be implemented in phases per available funding, will allow for more uniform water coverage during irrigation. This will in turn increase water use efficiency. Optimizing water coverage through laser leveling is also expected to improve plant forage production throughout the fields. Another benefit of level farm fields is the need for less surface manipulation with tractor-pulled implements thereby reducing both dust generation and carbon emissions.

In an effort to optimize annual crop yields, Refuge managers are continually making adjustments in how and when seed, fertilize, and apply herbicides to the site. For several years, rye grass seed was distributed within the prepared fields at the beginning of September at a rate of 40 to 50 pounds per acre. This was followed by fertilizing the fields with liquid urea ammonium nitrate. The fertilizer was applied by adding it to irrigation water at about 312 pounds per acre to achieve a desired target of 100 pounds of nitrogen per acre (liquid fertilizer contains about 32 percent available nitrogen per pound). In 2012, slight adjustments were made to this practice that resulted in significant improvements in crop yield. These adjustments included reducing the rate of seeding to about 35 pounds per acre and increasing the fertilizer to about 150 pounds of nitrogen per acre. Due to the success of these adjustments, it is likely that these procedures will continue.

Fields are irrigated after seeding at least once a month during the fall and then as needed into the winter, depending on weather. Approximately four acre-feet of water are used to irrigate each acre of farm ground for the duration of the crop. Irrigation usually ends by late February as the geese begin to migrate north.

The use of liquid nitrogen fertilizer enables the Refuge to continue growing green forage during the cool winter months after the geese have consumed the initial growth that began in the warmer months of October and November. Without fertilizer, goose forage would be completely consumed well before the geese were ready to migrate north, thereby putting the nearby commercial crops in jeopardy of depredation.

Broadleaf weeds growing in these fields are controlled with herbicides. The primary products used in these fields in 2013 included WEEDAR 64 (active ingredient: 2,4-D DMA), Milestone VM (active ingredient: aminopyralid), and Clarity (active ingredient: dicamba). These products control noxious and invasive broadleaf species and other problem weeds. WEEDAR 64, which is tank mixed with Clarity, is applied in late fall or early winter. Milestone VM, when used, is usually applied in fields when weeds begin to compete with rye grass after the grass has developed secondary roots and can tolerate the effects of the herbicide. This normally occurs in November. Problem grasses (mainly Bermuda grass) are controlled with glyphosate herbicide before rye grass is planted. If disking is proposed in a field, this activity takes place after the geese have migrated from the Imperial Valley, usually in June, when soil moisture is still adequate to allow easy disking.

The main goal of managing these agricultural fields is to maintain good forage productivity for geese that spend the fall and winter months in the Imperial Valley. This can be a challenge during the late winter months when rye grass growth slows down. With timely management actions, the Refuge has and expects to be able to continue to support almost all of the wintering geese population in the area. The total numbers of geese present in the valley have varied considerably over the years and Refuge staff is continually evaluating management effectiveness and the capability of the agricultural fields to support the winter goose population.

Another option for managing some or all of the Refuge's agricultural fields in the future involves potential cooperative farming agreements. Various forms of cooperative farming have been implemented in the past, including double cropping in the Refuge's farm fields. Under this scenario, in exchange for the use of some or all of the farm fields for cultivating a crop that could be planted in the spring for harvest in mid-summer, a farmer would plant annual rye grass in the fields immediately upon harvesting the summer crop. The timing of the summer planting of rye grass would have to ensure that adequate forage was available for the geese upon their arrival in the Imperial Valley.

Another potential arrangement under a cooperative farming agreement might allow sheep or cattle grazing in the fields once the geese have migrated north for the summer. Grazing in the fields would assist in reducing the remaining grass stubble and any broadleaf weeds that germinate following the winter rains. Prior to implementing a cooperative farming program, an analysis of the water needs and the environmental and financial costs and benefits to the Refuge of implementing such a program would be conducted.

Seasonal Shallow Wetlands. The establishment of seasonal shallow wetlands on the Refuge to support migratory and wintering birds began in the 1940s when farmable land on the Refuge was limited due to rising water levels in the Salton Sea. These brackish wetlands were established in impoundments created in fields with salinity levels too high to produce green forage (e.g., barley, milo, alfalfa) for geese. The intent was to provide wetland plant forage such as alkali bulrush for waterfowl to supplement the green forage provided in the agricultural fields. Management of seasonal wetland areas continues today with various wetland plants providing forage for geese and other waterfowl.

Approximately 560 acres of the Refuge (refer to Figures 3-2 and 3-3) are managed as seasonal shallow wetlands, however, the types of wetland plants provided throughout this acreage vary depending upon the soil conditions. These managed wetland areas, which also represent important foraging and resting areas for migratory shorebirds, are flooded in the late summer to provide shallow open water or mixed marsh areas in various locations throughout the Refuge. To keep these wetlands productive from September through March, as well as to ensure the growth of emergent vegetation for food and cover in late spring and early summer, about five to six acre-feet of water is required per year per acre of wetland.

A greater yellowlegs takes advantage of the Refuge's managed seasonal shallow wetlands (Jenny E. Ross)

Some of the Refuge's seasonal wetland areas require little effort to grow waterfowl food plants. Generally, these ponds have been constructed on previous agricultural land or other land that has been previously tiled to flush salts from the soil profile. In these wetlands, food plants typically germinate after the spring drawdown in March or April. Two or three irrigations are provided afterwards in May and June to promote growth. Usually the crop in these ponds, which include watergrass, Mexican sprangle-top (*Leptochloa uninervia*), and swamp timothy, are mature by the end of June or early July.

A number of the Refuge's other seasonal wetland area have not been capable of producing typical wetland plants that grow in other western U.S. wetlands. These wetland impoundments are not located on previous farmland and have not had the benefit of the salt flushing; instead, they consist of heavy clay, saline-sodic soils with significant salt accumulation. As a result, it is difficult to keep the pond soils in a moist condition suitable for wetland plant germination and development. In an effort to overcome these inherent soil conditions, Refuge staff have tested the soils and sought advice of specialists.

The practice of disking the dry pond bottoms to break up the extremely hard soil was first described and implemented by former Refuge Manager John Nowak in 1963. This practice, which was still implemented as of 2013, helps to provide a "wet edge" for plant germination. Once disked, the ground is "corrugated" into rows approximately ten inches deep. The furrows that are created are able to hold a pool of water when flooded so that even when hot windy conditions evaporate a half inch of water or more per day, a wet edge is more easily maintained. The management strategy has proven productive at growing normal seasonal wetland food and cover vegetation on wetland basins where no plant growth occurred previously.

Maintaining a flat-bottomed pond with a quarter to a half inch of water is much harder in the Imperial Valley's hot environment, so corrugating helps to minimize the effect of evaporation, allowing the soil to remain moist enough to facilitate wetland plant germination. Desirable food plant seeds such as watergrass and alkali bulrush are broadcasted on the pond bottom and fall into the crevices of the soil. Based on soil testing results, gypsum has been prescribed to help loosen the hard soil, release salts, and improve soil friability, enabling successful seed germination. A convenient and beneficial substitute for gypsum has been a mix of urea sulfuric acid fertilizer (15-0-0 16S). When introduced into the first application of irrigation water, the

diluted sulfuric acid combines with excessive calcium ($CaCO_3$ = limestone) to form a diluted solution of calcium sulfate, or gypsum. The result is a deep, thorough, penetrating application of gypsum to positively affect soil development and productivity. The added urea provides a boost of nitrogen to promote growth of newly sprouted plants. The liquid fertilizer is introduced into the irrigation water. As the mixture flows down the furrows, the clods of dirt dissolve over the seeds. In about ten days, plants become visible and water is kept in the furrows to promote growth. It is expected that over time sufficient soil improvements will be accomplished so that periodic irrigations can be provided in between drying periods until a mature crop with full seed heads have developed.

A third seasonal wetland strategy implemented on the Refuge involves growth of alkali bulrush, a preferred food plant of snow geese. Pond soils of adequate quality that are kept very wet can produce nearly pure stands of alkali bulrush. This strategy involves keeping the ponds flooded with a skim of water in early summer until residual tubers in the soil sprout and develop mature plants. The longer the crop is kept wet, the more each plant can multiply by root. These ponds can be allowed to dry for the remainder of summer, and then be flooded again in the fall. As the ponds slowly flood, new plants sprout from each existing stalk, adding to the available foraging crop. Geese prefer the green plants, therefore, the Refuge attempts to time crop growth so that a mature green crop is available for the geese when they arrive in late October. Providing this crop requires the use of more water than a typical seasonal wetland.

Permanent Cattail Marsh. Approximately 200 acres of permanent cattail marsh are managed on the Refuge. These freshwater marsh areas, which support a variety of secretive marsh birds (e.g., endangered Yuma Ridgway's rail, black rail [*Laterallus jamaicensis*], Virginia rail [*Rallus limicola*], sora [*Porzana carolina*], least bittern [*Ixobrychus exilis*]), are located in portions of Unit 1 and Unit 2 (refer to Figures 3-2 and 3-3). Management of these areas involves periodic irrigation to maintain optimum water levels for the Ridgway's rail. Periodic invasive plant control is also required, particularly around the perimeter of the marsh areas.

Of the management actions implemented in these areas, the most important is providing adequate water to support the vegetation. Approximately 12 acre-feet of water per acre is needed to maintain these wetlands throughout the year. Water flows into and out of the ponds by way of concrete water control structures. Periodic maintenance of these structures is required, along with periodic maintenance of the levees that form the impoundment areas. Invasive plant control within the permanent cattail marsh habitat focuses on control of salt cedar and common reed, but also involves attempts to reduce the coverage of a variety of other weedy species. Maintenance involving the clearing of vegetation within a radius of approximately five feet around the water structures is necessary to ensure free water flow and safe working conditions for employees who might otherwise encounter snakes, spiders, and ants. Vegetation in these areas is mechanically cleared using a backhoe or controlled with the herbicide glyphosate. Each water structure is cleared approximately two times each year.

As these wetlands age, cattail vegetation becomes very dense and can no longer regenerate. The result is a decline in habitat structure and productivity. For rails, this means a decrease in food and shelter. Excessive accumulation of vegetation typically occurs about five to seven years after the marsh is initially developed. To re-establish good habitat quality in the marsh it is necessary to let the marsh dry out following the end of the breeding season. As the marsh dries out, rails and other marsh birds and wildlife will move to an adjacent marsh area. Once dried out and abandoned, the overgrown vegetation can be burned off in accordance with the requirements of a prescribed burn or it can be mechanically removed.

Planning for a prescribed burn requires consideration of various issues including potential effects to Ridgway's rails and other wildlife, and impacts to air quality. Past actions demonstrate that in response to these dry pond conditions, Ridgway's rails and other species relocate into adjacent wet pond areas. Burning off the old-dead cattail structure renews the marsh, giving the still viable rootstalks an opportunity to regenerate without competing with decayed old growth. A marsh that is burned in December or January will regenerate a new crop of cattails by the summer, at which time the marsh is repopulated with birds and other wildlife.

To optimize habitat quality for Yuma Ridgway's rails and other secretive birds, the Refuge will explore the benefits of periodically rotating managed cattail marsh habitat areas and managed seasonal shallow wetland areas. Under this proposal, a seasonal shallow wetland area located adjacent to existing cattail marsh would be converted to cattail marsh habitat in anticipation of the existing cattail marsh vegetation becoming too dense. Once the new habitat is established, the overgrown cattail marsh would be allowed to dry out following the end of the nesting season.

As the marsh dries out, rails and other marsh birds would be expected to migrate into the adjacent newly established cattail habitat. After surveys indicate that all marsh birds have abandoned the dried marsh, it would be cleared through the mechanical harvesting of vegetation or through the use of a prescribed fire. The old marsh site would then be managed as a seasonal shallow wetland area. The specifics of this new management direction for cattail marsh and shallow seasonal wetland areas will be fully developed and described in a future step-down Yuma Ridgway's rail management plan, which is discussed later in this chapter.

Permanent Open Water Wetlands. The permanent open water wetlands maintained on the Refuge are located just to the south of Bruchard Bay in Unit 1, to the north of the Refuge headquarters in Unit 2, and within the Hazard Tract in Unit 2 (refer to Figures 3-2 and 3-3).

Permanent open water habitat in D Pond (USFWS)

Western gull-billed terns and black skimmers have been nesting on small islands in the open water wetlands located to the north of the Refuge headquarters since the early 1990s. Originally, the 30-acre "D" pond (Figure 3-6) was managed as a seasonal waterfowl pond. In 1995, the pond was converted to a year-round open water area that included areas to support nesting seabirds (e.g., gull-billed terns, black skimmers, Caspian terns) whose nesting areas were being lost to rising waters of the Salton Sea.

Foraging black skimmer (Mark Stewart/USFWS)

Today, water levels in these open water areas are maintained using water collected from the outflow of an adjacent permanent cattail marsh. Because the water in the marsh has been subject to evaporation, the outflow water has relatively high mineral and salt content. Once distributed into the pond, the water has salinity levels high enough to discourage the growth of emergent vegetation such as cattails and rushes. Some site management is however required to control salt cedar around the perimeters of the nesting islands.

Five of the earthen islands located in "D" pond were colonized by seabirds during the first nesting season following permanent inundation of the pond. The same seabird species continued to successfully fledge young for several subsequent years. Black-necked stilts (*Himantopus mexicanus*) and American avocets (*Recurvirostra americana*) also nested on the islands during that first year and in subsequent years. In 2005, electric fencing was installed around the pond's perimeter to deter mammalian predators, primarily raccoons and coyotes, from entering the ponds and accessing the nesting islands. This fencing continues to be maintained, although its effectiveness appears to be limited. In an effort to improve fledging success at these and other nesting islands on the Refuge, control of offending mammalian predators will be implemented during the nesting season. More information is provided later in this chapter regarding predator management.

In consideration of the conservation status of the western gull-billed tern and black skimmer (identified by the Service as Birds of Conservation Concern), the Refuge developed new nesting islands in Unit 1, including a single large island in pond B4 in 2001 and several small islets in pond A4 in 2006. The locations of the nesting areas within Ponds A4 and B4 are illustrated in Figures 3-7.

Western gull-billed tern (Matt Sadowski)

The primary management action, which continues today, simply involves maintaining adequate water levels in these areas during the hot summer months. The water in these ponds is provided from the outflow of upstream permanent cattail marshes. Other management needs include annual removal of salt cedar from island perimeters and maintaining the electric fence installed around pond A4 to discourage mammalian predators from entering the pond. Islands need to be cleared of large vegetative growth to facilitate seabird nesting and without electric fences to limit access; mammalian predators would have easy access to islands, where they could prey on bird eggs and chicks.

Figure 3-6. Nesting Islands in Unit 2 of the Sonny Bono Salton Sea NWR

Figure 3-7. Nesting Islands in Unit 1 of the Sonny Bono Salton Sea NWR

The remaining 22 acres of permanent open water wetlands are located on the Hazard Unit, adjacent to the Alamo River. These two wetlands (Oxbow Lake and Hazard Lake) receive water from the Alamo River. In addition, Hazard Lake also receives freshwater outflow from Hazard pond 7. As the Salton Sea recedes and the subsequent lowering of the Alamo River follows, input from the Alamo River may be completely eliminated, requiring water flow from Hazard pond 7 to serve both Oxbow Lake and Hazard Lake if they are to be maintained as permanent open water wetlands.

The Refuge will also include portions of two permanent open water wetlands proposed for the south end of the Salton Sea. These projects include:

Salton Sea Species Conservation Habitat (SCH) Project – Within Unit 1, near the Bruchard Bay area, the U.S. Army Corps of Engineers (USACOE) and State of California's Natural Resources Agency have prepared and the State has certified the Final EIS/EIR for the Salton Sea SCH project. The draft EIS/EIR included various alternatives to achieve the project goals of both providing a partial in-kind replacement for some of the near-term habitat losses at the Salton Sea and answering key questions regarding the development of shallow water habitat as part of a long-term restoration program for the Salton Sea.

The USACOE selected Alternative 3 (New River, Pumped Diversion + Cascading Ponds) as the preferred alternative (U.S. Army Corps of Engineers and California Natural Resources Agency 2013). Under this alternative, approximately 3,770 acres of shallow ponds, contained within low berms, would be created on either side of the New River at elevations less than -228 feet mean sea level (Figure 3-8). The ponds would be supplied with a combination of brackish and saline water. This water would be pumped from the New River and Salton Sea, respectively, and blended to maintain an appropriate salinity range.

American white pelicans and other fishing-eating birds will benefit from deep-water restoration in the Salton Sea (Mark Stewart/USFWS)

The Salton Sea SCH Project is designed as a "proof-of-concept" project in which several project features, characteristics, and operations could be tested under an adaptive management framework. The proof-of-concept period would last for approximately 10 years after completion of construction. By that time, managers would have had time to identify those management practices that best meet the project goals. After the proof-of-concept period, the project would be operated until the end of the 75-year period covered by the Quantification Settlement Agreement (2078) or until funding is no longer available. The ponds would be constructed and operated by CDFW, on behalf of the California Natural Resources Agency, who would be responsible for ensuring that mitigation measures are implemented prior to, during, and after construction of the Project.

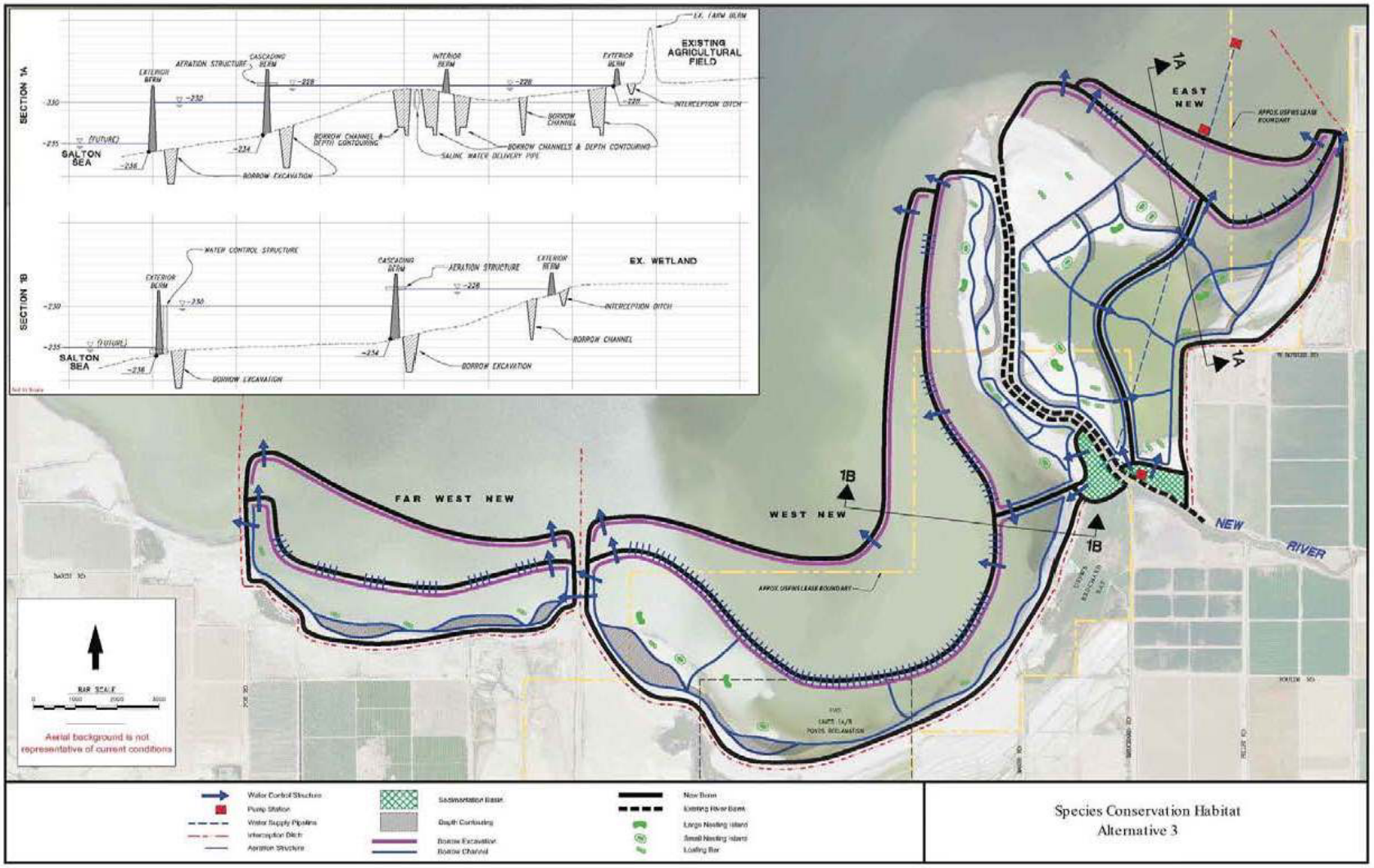

Figure 3-8. Preferred Alternative for the Salton Sea SCH Project

The initial phase of the Salton Sea SCH project is a pilot project that will restore 640 acres to the east of the New River (Figure 3-9). The Natural Resources Agency is the lead agency for this project, which will provide a range of aquatic habitats to support fish and wildlife species dependent on the Salton Sea. When completed, this project will provide feeding, resting, and breeding habitat for birds, particularly migratory fish-eating birds whose habitat is deteriorating quickly as the Sea recedes and becomes saltier. Innovative features of this project will include loafing islands, deeper water retreat habitat for fish, predation exclusion structures, and integrated sedimentation basins. Construction on this pilot project is expected to begin in mid-2014.

An adaptive management and monitoring plan for this pilot project will generate information to guide ongoing management decisions. Lessons learned from adaptive management may then be applied to future restoration or habitat conservation actions at the Salton Sea. More information about the Salton Sea SCH project and access to the draft and Final EIS/EIR are provided at http://www.water.ca.gov/saltonsea/#eir.

As a portion of the Salton Sea SCH Project will be located within the Refuge boundary, a Special Use Permit and Memorandum of Understanding involving the Service, California Natural Resources Agency (including CDFW and Department of Water Resources), and USACOE would be prepared that addresses how and by whom project construction, habitat management, and monitoring would be implemented and funded.

Red Hill Bay Restoration Project – The Red Hill Bay Restoration project site encompasses about 420 acres along the southeastern section of the Salton Sea (portions of Sections 22 and 27, Township 11 South, Range 13 East), immediately west of Garst Road and south of Red Hill Bay Marina Road (Figure 3-10). The site is bordered on the south by a portion of the Salton Sea levee system and adjacent farmland and on the west by the Salton Sea. To the southwest is Rock Hill.

The Red Hill Bay project will restore important foraging habitat for American avocets and other migratory shorebirds (Mark Stewart/USFWS)

The project site includes a portion of the Refuge that is leased to the Service from IID, as well as areas located outside the Refuge boundary that are owned and maintained solely by IID. IID is a partner in this restoration project and is participating in the planning, design, and implementation of the project.

Purpose. The purpose of the Red Hill Bay Restoration Project is twofold: 1) to reestablish the Red Hill Bay area as an important saline shallow water shorebird habitat, and 2) to cover the playa area with saline water and decrease particulate matter that become airborne during wind events. Up until a few years ago, this area was inundated by the Salton Sea and supported a variety of aquatic organisms and migratory birds. As a result of new conservation measures implemented in the Imperial Valley to conserve water for transport to the San Diego region, this portion of the Sea has receded exposing the sea floor and eliminating shallow water habitat.

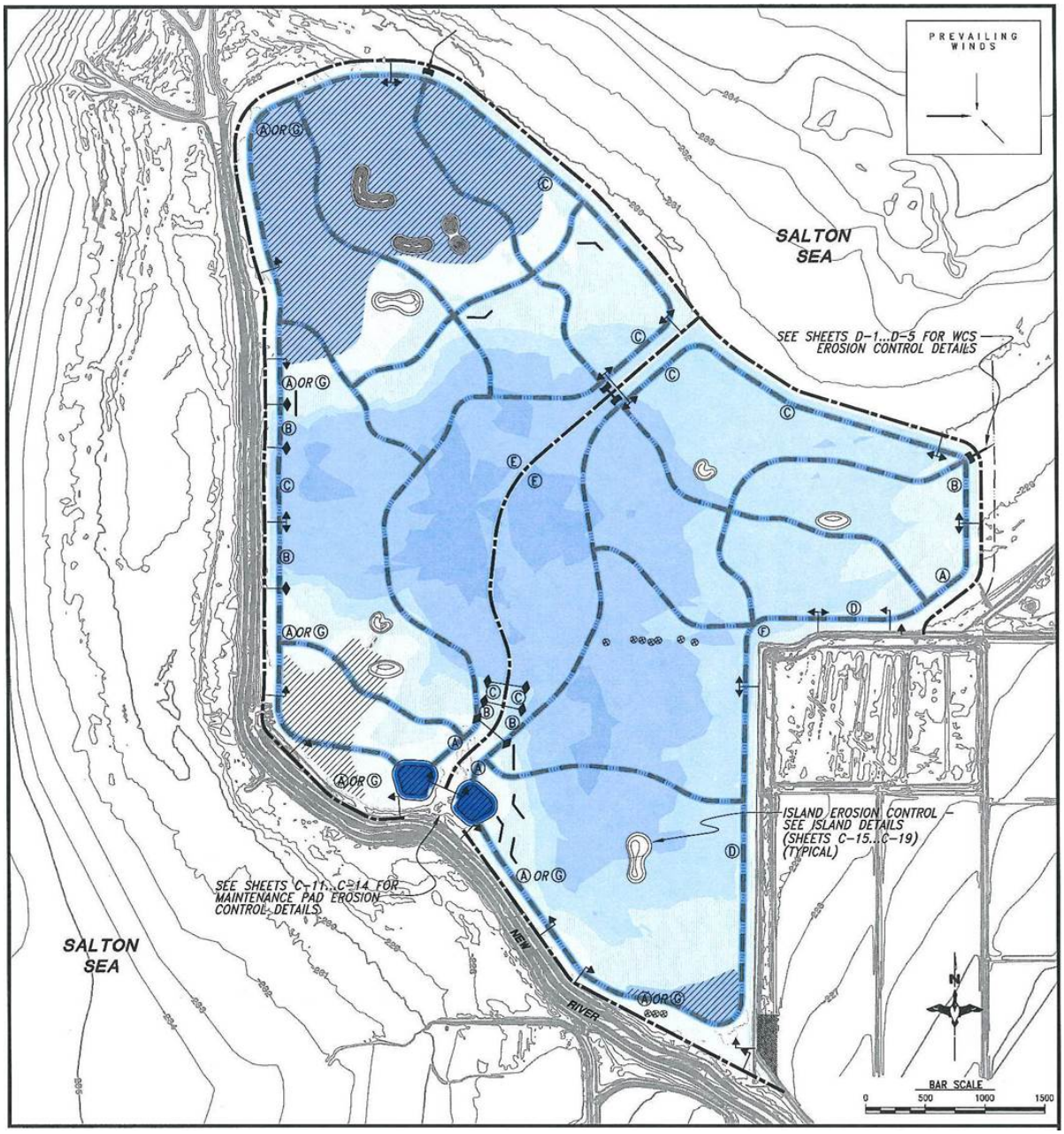

Figure 3-9. Preliminary Design for the 420-acre Salton Sea SCH Project, Pilot Project

Figure 3-10. Red Hill Bay Restoration Project Location Map

Project Overview. Implementation of this project would include the construction of a set of low (approximately three feet high) berms across portions of Red Hill Bay to form a pair of cells that would hold impounded shallow saline water at a target salinity of 20,000 mg/l in the first cell and 30,000 mg/l in the second cell (Figure 3-11). The shallow impoundments would provide habitat for wading birds and shorebirds in the currently exposed playa areas. The berms would be constructed using excavators, a dredge, and/or bulldozers. Additionally, loafing and nesting islands, snags for bird perches, deeper water channels and culverts to support invertebrates (and potentially fish) would be constructed within the project site.

Two pre-cast concrete vault structures and a trash rack will be installed in the approach channel to stabilize flows from the Alamo River. An unlined open channel will convey the water to a siphon under Red Hill Marina Road into a 1,900-foot-long, open channel to Red Hill Bay. The open channel will be approximately 10 feet wide with a water depth of two to three feet. Approximately two functioning 10 cubic feet per second (cfs) vertical centrifugal screw pumps will be installed in a concrete vault structure that will support all pumping facilities at the northeast corner of the Red Hill Bay restoration site (refer to Figure 3-11). One pump will lift Alamo River water and the other will lift Salton Sea water. The Alamo River water discharge will be routed into a mixing basin where it will blend with Salton Sea water. A small sediment basin may be constructed south of the Alamo River after the pump plant to help remove sediment before water flows to the first cell. Two existing pumps intermittently discharge water to the Alamo River from the freshwater Refuge ponds east of Red Hill Bay. The discharge from these two pumps will be diverted (via a culvert under Garst Road) and discharged into the Alamo River/Red Hill Bay delivery ditch to help reduce pumping needs at the new main pump location.

The saline water intake alignment will access the Salton Sea on the north side of the project, near the southern edge of Red Hill and will extend to the edge of the Salton Sea until water flows into the channel. Initially, this channel will be about 15 feet wide at the top and approximately ten feet below existing grade. The saline water inlet will require periodic cleaning and extension as the Sea's elevation drops. Eventually, the elevation of the saltwater intake pump will be too high to receive saltwater from the Sea. At that point, either the intake channel will need to be excavated deeper and the pump lowered to lift saltwater into the Bay, or a separate lift pump station will have to be constructed near the junction of the current saltwater intake channel at the Salton Sea shoreline to lift water into the original intake channel. This added intake lift pump could be powered by an extension of the grid electricity currently at Garst Road or by a photovoltaic system occupying an adjacent area of approximately 150 feet by 350 feet. Ultimately, a longer channel will be needed to access the saltwater source and its function and appearance will be similar to the original intake channel.

Dredge material from the excavation of the intake channel will form drivable berms on either side of the channel. It will extend approximately 5,800 feet east to the northeast corner of the project where the Salton Sea water will be lifted up about three feet with a screw-type pump and blended with the flows from the Alamo River.

The water delivery and drainage infrastructure will be constructed with tracked excavators and bulldozers. Additionally, rubber tire backhoes and/or excavators and haulage trucks may be utilized in the placement of the pumps, inlet and outlet structures, and water control devices. Where necessary, the inlets and outlets of the delivery system will be armored or otherwise protected from erosion.

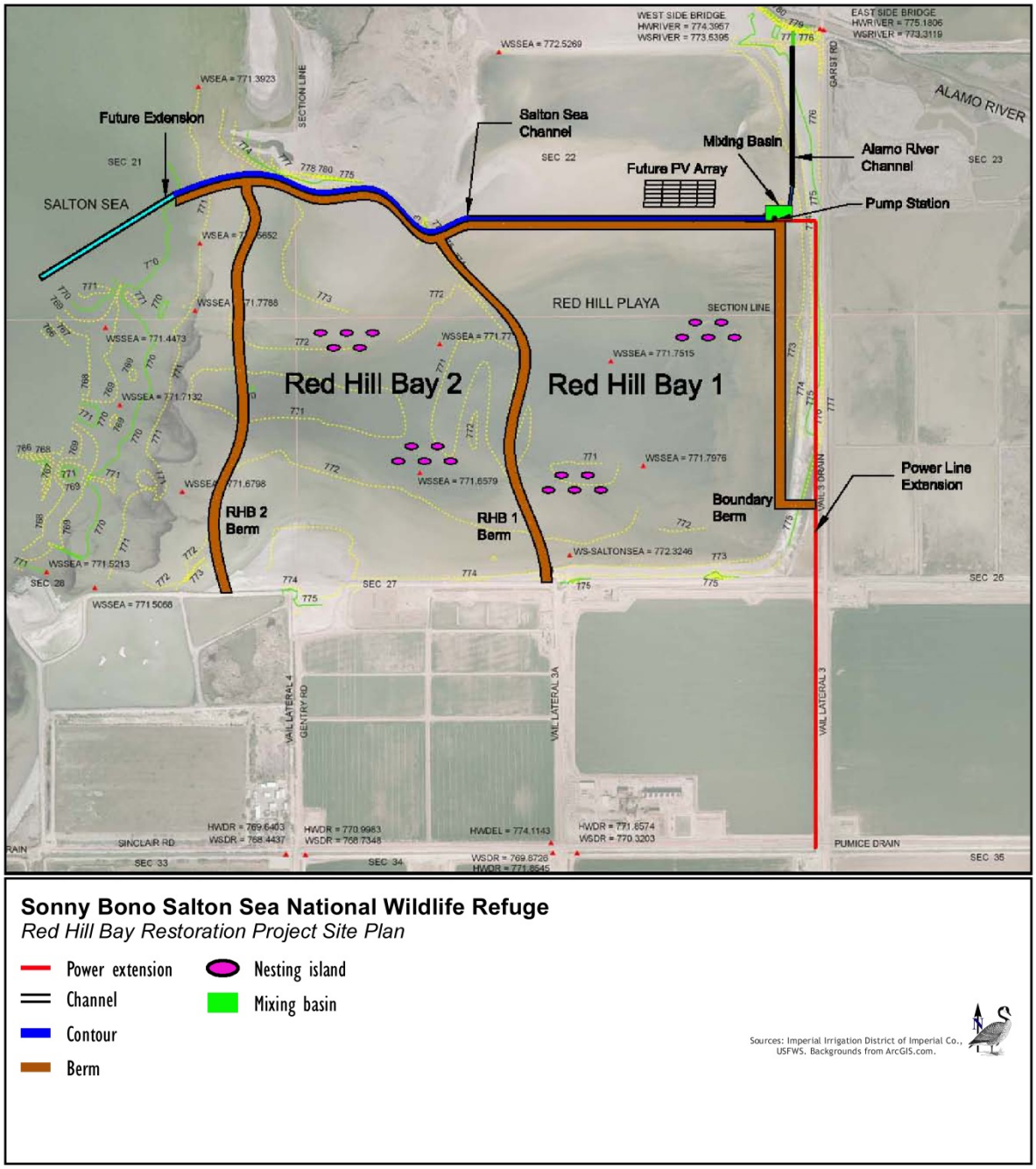

Figure 3-11. Red Hill Bay Site Plan

Water Impoundment Cell Development. Four berms would be constructed to create two water cells (water impoundments). The berms are designed to be three feet high and about 20 feet wide on the top. The sides of the berms would be sloped to achieve an 8:1 slope gradient on the water side of the impoundment berm and a 4:1 slope gradient on the outside slope. In Phase 1, a north-south trending berm about 4,800 feet long, would be constructed as shown in Figure 3-11 and another north-south trending berm about 5,000 feet long would be constructed just to the west of Garst Road. The berm that would extend parallel to Garst Road would be made available to the public for bird watching, while the northern berm would be part of the saltwater conveyance system. Finally, a 5,800-foot-long east-west tending berm would be constructed along the northern perimeter of the restoration site, adjacent to the channel that would convey water from the Salton Sea to the project.

Cell berms would be constructed from material obtained onsite. Construction equipment would include D-4 to D-8 bulldozers, tracked excavators, rubber tire excavators, and ancillary support equipment. Where moisture conditions allow, the berms would be pushed into placed with in situ soils. Compaction of the berm material would be accomplished by repeated tracking of equipment across the berm material and, if necessary, the addition of water during compaction. Where the substrate is too wet for repeated equipment movement, tracked excavators would excavate shallow borrow pits adjacent to the berm alignment and place the excavated material along the berm. Once the material is dry enough to access, bulldozers would be used to level and compact it.

In Phase 2, an additional berm would be constructed across the mouth of Red Hill Bay. It is anticipated that this berm would be constructed within 100 feet of the sand bar shelf that has formed at the edge of the bay. This sand bar is currently inundated with about one foot of water and with the steadily declining Salton Sea water elevations will soon be exposed. As this area becomes accessible for construction, the western berm would be constructed using tracked excavators or a dredge. The material to construct the berm would be excavated from either side of the area proposed to support the berm.

Within each cell, deeper pools (about six feet in depth) would be excavated to create invertebrate and potential fish habitat. The spoil would be used elsewhere in the cell to create loafing and nesting islands. Individual pools may be linear or oval, depending on the ease of construction, but would likely not be more than 2,000 square feet in area. About ten islands would be constructed in each cell for bird loafing and nesting. The shape of the islands is expected to be elliptical, similar to islands used by nesting seabirds such as gull-billed terns and black skimmers in other permanent open water habitat within the Refuge.

Electrical Power. There is limited electrical power available for the operation of the required water pumps; therefore, the pump operation at the Alamo River inlet would be timed to avoid use when the existing pumps to the east of Red Hill Bay in the Hazard Tract are operational. Use of the new waters pumps would require processing an application with IID for the approval of two new electrical hookups. To operate the 20 horsepower screw pump at the Alamo River inlet would require the use of the available single-phase electrical power line located near the site.

The water pump that would move water originating from the Salton Sea would also require electrical power. Based on current estimates of saltwater use, a 15 horsepower pump would likely be required. A three-phase extension from the IID grid at Garst Road would be run from near the Refuge's northern boundary in Red Hill Bay west into the dry

eastern edge of Red Hill Bay for a distance of about 400 feet where the saltwater pump would be located. This power supply would be utilized primarily at night and during the day on an as-needed basis. Ultimately, a photovoltaic array (125 feet by 325 feet in size) would be installed immediately to the northwest of the pump station to power the saltwater pump during daylight hours.

Operations and Maintenance. The cells within the project site would be operated as saline impoundments primarily to provide foraging and loafing habitat for migrating waterbirds, but also to eliminate the potential for emissive dust from the exposed playa that would result if the project were not to be implemented. The proposal to create a saline environment, rather than a freshwater environment, would reduce the potential for vegetation growth in the cells, minimizing long-term maintenance costs and reducing the potential for providing habitat suitable for mosquito breeding. The project design calls for salt concentrations within the cells to be approximately 20 ppt to 30 ppt. Water depths would vary depending on the existing topography of the bay substrate. The deepest areas would likely range from one to two feet and would occur along the centerline of the cells and adjacent to the constructed berms. Water depths would decrease along the eastern edge of the cells. In addition, deeper areas will be scattered within the cell in locations where borrow material was excavated for the construction of the berms.

The cells would be constructed as a flow through design in which outlets would discharge water from the cells into the Salton Sea. In Phase 1, outlets constructed in the western berm of the Phase 1 cell would allow water to sheet flow onto the exposed playa areas to the west, ultimately discharging into the Salton Sea. Once Phase 2 is implemented, the western cell would receive water from the Phase 1 outlets.

The ponds will be operated and maintained by the Sonny Bono Salton Sea NWR staff unless it is determined later that a contract operator is preferred.

Monitoring. To better understand the many uncertainties associated with blending Alamo River water and Salton Sea water to create wildlife habitat, the Red Hill Bay restoration project includes a multiple year monitoring program. This monitoring program, which would include input from the Service's Environmental Contaminants Program, is intended to provide additional data to supplement and expand upon the results of research conducted at the USGS Reclamation Saline Habitat Ponds between 2006 and 2009 (Miles et al. 2009). This effort would provide an opportunity to further address areas of uncertainty and ultimately inform adaptive management of this and other similarly created habitats within the receding Salton Sea. In line with the Salton Sea Ecosystem Monitoring and Assessment Plan (MAP) (Case et al. 2013), monitoring at this site would address the biotic and abiotic functions of the created habitat. Water quality (e.g., pesticides, selenium, nutrient levels), bird use, and fish and invertebrate colonization would be monitored during the initial two years of operation, and this monitoring effort would follow survey protocols identified in the MAP document.

As part of this monitoring plan, USGS would be contracted to investigate selenium and pesticide exposure risk. Twenty sediment samples from the project site would be analyzed by the USGS Pesticide Fate Research Group (PFRG) in Sacramento, California for current-use and legacy pesticides. This data would inform Refuge staff of potential hazards that may be exposed with different construction methods and allow staff to make adjustments in the construction design or methods, if necessary. Water samples collected from the Alamo River every two weeks for a full year would be sent to PFRG for current-

use pesticide analysis. This sampling effort is intended to provide a snapshot of variations in concentration of 90 current-use pesticides and may identify potentially dangerous spikes or seasonal patterns of pesticide presence in the Alamo River water and suspended sediments within the river. To address selenium, USGS Western Ecological Research Center (WERC) would conduct sample collection and selenium analysis in water, sediments, and invertebrates on a bi-annual basis for at least two years. During the breeding season, additional selenium monitoring to include bird eggs and nesting success would be implemented. As sufficient selenium data is collected a risk assessment would be made and used to advise future management and continued monitoring needs.

Comprehensive bird surveys would be conducted at least three times per season; the seasons being identified as late winter, spring migration, breeding season, and early fall to best capture bird use/phenology of the site during key periods of the year. Surveys of colonial nesting birds (i.e., gull-billed terns, black skimmers) would be conducted weekly throughout the breeding season to identify numbers of breeding pairs, fledgling success, and evaluate nesting island design. Monthly fish surveys would be similar to those conducted by Saiki et al. (2011), using 1/8 inch minnow traps, placed strategically throughout the site and at inlets and outlets to provide an index of fish abundance and diversity with approximately 10 percent of each species measured for size class distribution. Benthic and water column invertebrates would be sampled quarterly for two years by WERC and enumerated by lowest practical taxonomic group. The data provided from this monitoring program would be used to inform current and future management decisions.

Required Permits and Approvals. Implementation of this project will require compliance with the variety of Federal, State, and local regulations, as described below.

1) NEPA - Because the proposed project is a component of the larger CCP planning process for the Sonny Bono Salton Sea NWR, the Service has complied with NEPA through the processing of this CCP and accompanying EA.

2) CEQA – The project will be funded in part by a grant from the State of California, therefore, the project requires review and analysis in accordance with the California Environmental Quality Act (CEQA). IID will be State lead agency for the project.

3) Compliance with Section 7 of the Federal Endangered Species Act - Evaluate the potential effects, if any, on the endangered Yuma clapper rail and endangered desert pupfish.

4) Section 404 of the Clean Water Act - Based on the USACOE determination that the Section 404 Ordinary High Water Mark is the average elevation of the Salton Sea from the previous year, the proposed project is located within the ACOE jurisdictional boundaries and requires a Section 404 permit to allow the discharge of dredged material into Waters of the U.S.

5) Section 401 Water Quality Certification - A Water Quality Certification in accordance with Section 401 of the Clean Water Act is required from the Colorado River Basin RWQCB.

6) Section 106 of the NHPA - Compliance with Section 106 has been completed.

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6) Section 106 of the NHPA - Compliance with Section 106 has been completed.

Step-Down Habitat Management Plan. A step-down habitat management plan (HMP) for the Refuge is expected to be completed by FY 2018. This plan will "step down" the direction presented in the CCP to provide specific guidance for the implementation of habitat management strategies on the Refuge. Key components of the HMP include prioritizing objectives and annual work actions; identifying and prioritizing potential resources of concern; identifying priority habitats and the habitat requirements of resources of concern; refining and prioritizing strategies; and using adaptive management to assess and modify management strategies and prescriptions, as necessary.

Endangered Species Management

Two federally listed endangered species are present on the Refuge: Yuma Ridgway's rail and desert pupfish.

Yuma Ridgway's Rail. The presence of Yuma Ridgway's rail at the Salton Sea was first documented in 1931 (USFWS 2009a), and in 1944, Grinnell and Miller described the distribution of the Yuma Ridgway's rail as including areas at the Salton Sea. Today, the Salton Sea population of Yuma Ridgway's rail occurs almost exclusively in created and managed marsh habitat. The managed areas, which include the freshwater cattail marsh areas of the Refuge and marshes on the Imperial Wildlife Area, support one of the three core populations of Yuma Ridgway's rail (USFWS 2009a). The densities of Yuma Ridgway's rails supported in Refuge managed marshes are some of the highest throughout its range.

Yuma Ridgway's rail is one of several at-risk species supported on the Refuge (USFWS)

Management for this species began in 1988 when about 60 acres of habitat were set aside for the development of freshwater cattail marsh habitat. Early on, management of this species was implemented opportunistically as areas capable of supporting freshwater marsh habitat were identified. As of 2013, about 200 acres of permanent cattail marsh are managed on the Refuge to provide habitat for the Yuma Ridgway's rail. Rail habitat on the Sonny Bono Salton Sea NWR will continue to be actively managed, as described previously, to retain its quality for Yuma Ridgway's rails and other secretive marsh birds.

The long-term management of the Yuma Ridgway's rail population on the Refuge, including management and maintenance of high quality habitat to support the species, will be further addressed in a step-down management plan to be completed by 2016. This step-down plan, which will be prepared per the guidance provided in the draft Yuma Clapper Rail Recovery Plan (USFWS 2009a), will address among other topics habitat development; maintenance of suitable habitat conditions; protection of habitat from human disturbance; and the need and procedures for rotating marsh habitat areas to optimize foraging and nesting conditions.

Working with partners, this step-down plan will explore the potential threats to adult rails and recruitment of young rails from existing and predicted selenium levels in current and future rail habitat areas on the Refuge, and, if appropriate, develop recommended actions for minimizing this threat. The Refuge will also seek funding to study the movement of Yuma Ridgway's rails between established cattail marshes on the Refuge, the effect that prescribed burns may have on rail movement and productivity, and the effects, if any, of hunting-related disturbance on rail populations in marshes located near waterfowl hunting areas.

Annual secretive marsh bird surveys on the Refuge will continue to be conducted three times a year between March and May. These surveys are conducted as part of the National Marshbird Monitoring Program. Because of the presence of the endangered Yuma Ridgway's rail within the Refuge marshes, these surveys emphasize monitoring of the existing rail population, and include an annual spring call playback survey, consistent with the recommendations in the draft Yuma Clapper Rail Recovery Plan (USFWS 2009a). Monitoring data are shared with partners and maintained at the Refuge office for use in comparing population levels from year to year and over extended periods.

Desert Pupfish. The primary action related to desert pupfish on the Refuge is to minimize the potential for effects to desert pupfish while implementing various Refuge management actions. This species currently occurs in the Salton Sea, drainage ditches connected to the Salton Sea, and has been observed in one of the Refuge managed water areas. To avoid any adverse effects to this species, a monitoring program will be developed for the Refuge in partnership with CDFW to verify the presence or absence of desert pupfish in wetland areas within the Refuge. Working with CDFW desert pupfish discovered in managed wetland areas would be relocated to appropriate habitat on or off the Refuge.

Management of Other Species of Concern

Nesting Seabirds of Conservation Concern. Nesting areas, including artificial nesting platforms, within the Refuge's permanent open water areas are managed to support nesting habitat for seabirds, particularly gull-billed terns and black skimmers, both designated as Birds of Conservation Concern by the Service (USFWS 2008a). In an effort to reduce mammalian predation of gull-billed tern and black skimmer chicks and eggs, the Refuge maintains electric fencing around potential nesting areas and beginning in FY 2014 will implement predator management actions when necessary.

Gull-bird terns and black skimmers nest on small islands in D Pond (USFWS)

Also to improve seabird fledging success, the Refuge will maintain water levels in managed permanent open water ponds that support seabird nesting islands at a depth of at least 18 inches throughout the breeding season; install motion-activated cameras in nesting areas during the breeding season to identify predators and other causes of disturbance to nesting colonies; develop a monitoring

program to evaluate the extent of predation and/or disturbance from California gulls on nesting gull-billed terns and black skimmers; and evaluate the benefits of modifying nest site substrates on selected islands to discourage competing Caspian terns and California gulls from establishing nesting colonies in nesting areas favored by gull-billed terns and black skimmers.

Refuge staff will also seek funding to study the physical and biological factors that contribute to nest site selection by gull-billed terns and black skimmers at the Salton Sea. Based on the findings of this study, changes to the configuration of the islands located in Unit 1 could be implemented, changes the depth or salinity levels of the open water area may be initiated, nesting substrate on the islands may be enhanced, or other improvements may be made in an effort to encourage these species to reestablish nesting colonies on the islands located within Unit 1. In addition, the Refuge will create new nesting islands within the Red Hill Bay Restoration project and encourage nesting island creation in the Salton Sea SCH project.

The Refuge currently supports annual monitoring of these nest sites. Data gathering includes species presence and abundance, number of gull-billed tern and black skimmer nests, chicks, and successful fledges, and any information available regarding adult, chick, and/or egg mortality and/or predation. Gull-billed tern breeding surveys are conducted annually from April through August. These surveys also include incidental counts of associated breeding seabirds.

Chick banding to assist in monitoring tern movements and survival is conducted only when colony disturbance would be minimal. Monitoring and banding data are shared with various partners and maintained at the Refuge office for use in comparing population levels and productivity from year to year and over extended periods.

Predator Management Plan - Consistent with the purposes of the Sonny Bono Salton Sea NWR, the Refuge will implement, per available funding, a comprehensive and integrated predator management program that includes a range of management actions including vegetation control, nesting habitat enhancements, implementation of non-lethal (deterrence) control of avian and mammalian predators, and implementation of lethal control of individual mammalian predators (e.g., coyotes, raccoons, feral dogs and cats) that pose a threat to ground nesting birds. The primary purpose of this predator management plan is to improve productivity for the western gull-billed tern and black skimmer, both of which annually nest on the Refuge. Both species are identified by the Service as Birds of Conservation Concern (USFWS 2008a) and by the Service's Migratory Bird Program as Birds of Management Concern (USFWS 2011). In addition, the gull-billed tern is included on the Migratory Bird Program's list of focal species (USFWS 2011). Focal species, a subset of the Birds of Management Concern, are those species that the Migratory Bird Program believes need additional investment of resources to address pertinent conservation or management issues.

The most effective, selective, and humane techniques available to deter or remove individual predators that threaten nesting gull-billed terns and black skimmers will be implemented under this plan. The direct control of individual problem mammalian predators will be implemented as necessary to protect gull-billed tern and black skimmer breeding adults, chicks, and eggs. The primary measure to be used to deter predators will include maintenance of electrical fencing around nesting areas. The program is described in detail in the Predator Management Plan (Appendix H).

Other Species of Concern. Although a number of management actions implemented on the Refuge are intended to protect and support specific listed or sensitive avian species, many of these and other management actions also provide direct and indirect benefits to a variety of other avian species listed as threatened or endangered by the State and/or identified by the State or Service as species of concern. For instance, the State endangered Gila woodpecker (a rare sighting on the Refuge during migration) and particularly the little willow flycatcher (*Empidonax traillii brewsteri*) (often observed on the Refuge during spring migration) benefit from the management activities occurring within the Refuge's riparian habitat. Wintering greater sandhill cranes, a State threatened species, derive benefits from the Refuge's efforts to provide winter forage for waterfowl, and a variety of shorebirds identified as Birds of Conservation Concern benefit from the foraging and resting opportunities provided within the seasonal shallow wetlands and permanent open water wetlands that are managed and maintained on the Refuge. The Refuge's cattail marsh areas provide habitat for the State threatened California black rail, as well as the least bittern, a Bird of Conservation Concern.

General Wildlife Management

The Refuge implements various actions to support native birds, reptiles, and other wildlife. These include maintaining tree rows, providing nest boxes for burrowing owls, and replacing salt cedar with stands of mesquite and Goodding's black willow. Refuge staff will also work with IID to identify appropriate actions for reducing the incidence of bird strikes on existing power lines on the Refuge. Through a contract with the California Conservation Corps, the phased removal of salt cedar is underway. The project with the goal of restoring 100 acres of native riparian shrub vegetation, including Goodding's black willows and mesquite, near Bruchard Bay in Unit 1 will support resident birds, as well as visiting Neotropical species.

Bird Surveys. In addition to species monitoring, aerial waterfowl surveys are conducted by Refuge staff for the Salton Sea and surrounding areas monthly between November and February of each year. Refuge staff also conducts annual sandhill crane surveys monthly between October and March and partners with CDFW to conduct monthly waterbird surveys on the Salton Sea. Refuge staff will also seek funding and/or partners to develop a robust program for monitoring species abundance and diversity within the Refuge's various managed habitats. The results would then be used to identify trends and variations overtime that may be attributable to changing conditions in the Salton Sea, climate change, and/or modified management practices.

Wildlife Monitoring. Through partnerships with other entities, baseline productivity data will be established for the various managed habitats within the Refuge, as well as for implementing subsequent periodic monitoring to identify trends and variations in species abundance and diversity over time. In addition, a monitoring plan will be designed and implemented for the Red Hill Bay Restoration project to document bird use and fish and invertebrate colonization. This effort will allow for adaptive management of the restored shallow water habitat. Finally, the Refuge will seek partners to monitor changes in avian and fish species composition and abundance in and around the Salton Sea to better understand and address the effects of receding water levels and climate change on the diversity and abundance of migratory and resident bird species in the region.

Monitoring Avian Disease on the Salton Sea. Until the early 1990s, the Refuge did not provide any management within the Salton Sea. However, in 1992, a disease outbreak effecting eared grebes resulted in 200,000 deaths. There is no confirmed cause for these deaths, although there is some thought that it might have been related to excessive blue-green algal toxins in the Sea. In the mid-1990s, thousands of California brown pelicans and American white pelicans

died of avian botulism. As a result of these and other events, the Refuge, CDFW, USEPA, USGS, Bureau of Reclamation, and Salton Sea Authority in the late 1990s developed a plan for avian disease monitoring and response.

The Refuge also established a Site Health and Safety Plan, defined Airboat Operating Procedures specific to avian disease monitoring, entered into a Memorandum of Understanding with the Salton Sea Authority for sustained disease monitoring on the Salton Sea, and set up regular year-round coordinated patrols with CDFW to search for and remove sick and dead birds. Sick birds are provided with rehabilitation, and dead birds are promptly disposed of to reduce the potential for spreading disease. The Refuge maintains various facilities to assist in response and care, including a hospital, recovery cages, and incinerators to properly dispose of carcasses. This active program requires staff time commitments primarily in the summer, but winter work is also necessary. This coordinated effort appears to be working because there have been no major disease outbreaks since it started. The Refuge will to continue to partner with the State in this effort, per available funding.

As the water levels in the Salton Sea continue to recede, it will become more difficult to launch the boats used in avian disease surveillance. Therefore, the Refuge will coordinate with other agencies to identify and construct a sustainable launching site.

Integrated Pest Management

An Integrated Pest Management (IPM) Plan has been prepared and approved for the Sonny Bono Salton Sea NWR Complex (Appendix G). In accordance with the IPM Plan, an integrated approach to pest management will be utilized, where practicable, to eradicate, control, or contain pest and invasive species (herein collectively referred to as pests) on the Refuge. Implementing the IPM Plan will involve using methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to non-target species and the refuge environment.

Under the IPM Plan, pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. If a pesticide is necessary for use on the Refuge, the most specific (selective) chemical available for the target species will be used unless considerations of persistence or other environmental and/or biotic hazards would preclude it. In accordance with 517 DM 1, pesticide usage will be further restricted because only pesticides registered with the USEPA in full compliance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and as provided in regulations, orders, or permits issued by USEPA may be applied on lands and waters under refuge jurisdiction. The types of pesticides that can be used on the Sonny Bono Salton Sea NWR are also limited to those products available for sale in the State of California. Before a pesticide product can be sold or offered for sale in California, is must be approved and registered by the State's Department of Pesticide Regulation.

The IPM Plan (Appendix G) provides a detailed discussion of IPM techniques, including the selective use of pesticides for pest management on the Refuge, when deemed necessary. Throughout the life of the CCP, all pesticides proposed for use on the Refuge, with the exception of mosquito-related pesticides that are addressed through a separate process, will be evaluated by the IPM Regional Coordinator for potential effects to refuge biological resources and environmental quality. The results of this evaluation, including the potential effects of each product, will be documented in "Chemical Profiles." Chemical profiles have already been completed for those pesticides that are currently approved for use on the Refuge and are available for review in Attachment B of Appendix G. Only those pesticides that are likely to

result in only minor, temporary, and/or localized effects to species and environmental quality based upon non-exceedance of threshold values in Chemical Profiles will be approved for use on the Refuge. In all cases, BMPs will be implemented during the handling and application of pesticides, and in some cases, non-exceedance of threshold values may be achieved through the implementation of additional BMPs that further define how, when, where, and to what extent a specific pesticide may be applied.

Control of pest species is necessary when these pests are causing environmental harm. Environmental harm by pest species refers to a biologically substantial decrease in environmental quality as indicated by a variety of potential factors including declines in native species populations or communities, degraded habitat quality or long-term habitat loss, and/or altered ecological processes. In the case of this Refuge, environmental harm may be a result from direct effects to cultivated foraging plants or managed habitats that are managed to meet specific Refuge purposes (i.e., reducing depredation by foraging geese of private agricultural fields, protection of habitat to support listed species and migratory birds).

Environmental harm may involve detrimental changes in ecological processes. For example, invasive nonnative plant species such as salt cedar and common reed can outcompete and ultimately replace native species such as willows and mesquite, altering the function of the historic plant community. Environmental harm may also cause or be associated with economic losses and damage to human, plant, and animal health.

Invasive plant control in the form of mechanical and chemical control is currently implemented on the Refuge. In 2013, woody invasive species that occur adjacent to wetlands and within the water delivery ditches that provide water to the farm fields and managed wetlands was controlled with glyphosate or imazapyr. Although the practice of no till in the farm fields has reduced the numbers of weeds, there is still as need to control broad-leafed invasive weeds in managed agricultural fields. In 2013, the herbicide Milestone was used most often to control broad-leafed weeds in these areas.

All herbicides used on the Refuge must be reviewed and approved as part of the Service's Pesticide Use Proposal System (PUPS). The PUPS identify specific pesticides approved for use on each Refuge, and includes details on target pests, products applied, application dates, rates, methods of use, number of applications, site description, sensitive habitats, and best management practices (BMPs) to avoid impacts to sensitive resources. The herbicides approved for use on the Refuge in 2013 through the PUPS process are listed in Table 3-2. This table also provides information regarding the target weeds and modes of application for each of the approved products.

Pesticide use is regulated at both the Federal and State level (California Department of Pesticide Regulations 2011). The Imperial County Agricultural Commissioner (ICAC) also regulates the use of Restricted Use Materials, including the herbicides used on the Refuge. A user permit is required for lands on which restricted pesticides are to be applied. This permit defines the manner, method and approximate time of the proposed application (ICAC 2008). All agricultural and commercial pesticide applications are randomly monitored to ensure that pesticides are handled in an environmentally safe manner.

One or more methods may be employed to meet the objectives of the IPM Plan, including cultural, physical/mechanical, biological, and/or chemical control. These methods are summarized below and presented in detail in Appendix G.

Table 3-2
Pesticides Approved for Use in 2013 on the Sonny Bono Salton Sea NWR

Active Ingredient	Glyphosate (terrestrial)	Glyphosate (aquatic)	Dicamba	Imazapyr	Triclopyr	2,4-D DMA	Tribenuron-methyl	Halosulfuron-methyl	Aminopyralid
Product Name(s)	Razor Pro	AquaNeat	Clarity	Stalker	Garlon 3A	WEEDAR 64	Express	Sandea	Milestone VM
Target Pests	cheeseweed, Bermuda grass, goosefoot; applied on dry ditch banks and in managed agricultural fields	cattail, salt cedar, Bermuda grass; applied in water ditches and wetland units	broadleaf plants; applied in managed agricultural fields	salt cedar; applied wherever control of salt cedar is required, not used in managed agricultural fields	sesbania; applied in dried seasonal wetlands, except those supporting Yuma Ridgway's rail	broadleaf plants (cheese-weed, lambs-quarter, Sahara mustard); applied in managed agricultural fields	Sahara and black mustard, London rocket; applied in managed agricultural fields	yellow nutsedge; applied in managed agricultural fields	cheeseweed, goosefoot, London rocket, puncturevine; applied in managed agricultural fields
Treatment Site	terrestrial	aquatic	terrestrial	terrestrial, aquatic	terrestrial	terrestrial	terrestrial	terrestrial	terrestrial
Treatment Area	200 ac.	800 ac.	900 ac.	200 ac.	50 ac.	850 ac.	900 ac.	900 ac.	900 ac.
Application Method(s) **Application Rate(s)** **Application Equipment(s)**	foliar 5 qt./ac. tractor sprayer	foliar 2 qt./ac. backpack sprayer	foliar 32 oz./ac. boom sprayer	foliar 64 oz./ac. boom sprayer cut stump 64 oz./acre hand-held sprayer	foliar 0.67 gal./ac. boom sprayer	Boom sprayer 2 pints/ac.	aerial 1 oz./ac. boom sprayer ground 1 oz./ac. tractor, ATV, backpack sprayer	aerial 1 oz./ac. boom sprayer ground 1 oz./ac. tractor sprayer	aerial 7 oz./ac. boom sprayer
Applications per year	1	3	2	1	1	1	1	1	1

Cultural control can involve the management and manipulation of competitive interactions so that weeds are placed at a disadvantage. This type of cultural control includes a broad range of normal management practices that can be modified or manipulated to manage one or more pest problems, either by minimizing the conditions those pests need to live (e.g., water, shelter, food), or minimizing opportunities for introduction. Cultural control can also mean modifying human behavior or activities in an effort to avoid invasive seed transport and the improper disposal of non-native and pest plant debris.

Physical control involves the removal, destruction, disruption of growth, interference with pest reproduction using treatments that can be accomplished by hand and hand tools (manual), power tools (mechanical), and the physical removal of plants by pulling, grubbing, digging out root systems, cutting plants at the ground level, and removing individual competing plants around desired species. Other methods may include "topping" annual weeds prior to seed set, placing mulch around desired vegetation to limit competitive growth, tilling/disking, cutting, swathing, grinding, sheering, girdling, mowing, or mulching of the pest plants. Other types of physical control could include solarization, prescribed fire, and the use of flamers, where permitted. Typically, mechanical methods used to remove invasive plants on the Refuge include, but are not limited to, digging by hand, a nylon filament trimmer (weed "whacker"), chainsaw, uprooting the plant with a jack or hand pulling, and tilling. Other methods of control may include increasing salinity levels in seasonal ponds to control cattail growth and prescribed burning to remove salt cedar, common reed, and other unwanted vegetation.

Classical biological control involves the deliberate introduction and management of natural enemies (e.g., parasites, predators, pathogens) to reduce pest populations. The Service strongly supports the development, and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and non-indigenous or pest species. To date, the intentional use of biological control agents has not been implemented on this Refuge.

Under the IPM, pesticides may be used where physical, cultural, and biological methods or combinations thereof, are impractical or incapable of providing adequate control, eradication, or containment. If a determination is made that the most appropriate control for a particular pest or group of pests on the Refuge is the use of a pesticide, the most specific (selective) chemical available for the target species(s) will be used unless considerations of persistence or other environmental and/or biotic hazards would preclude its use.

Throughout the life of the CCP, pesticides proposed for use on the Refuge will be evaluated by the IPM Regional Coordinator for potential effects to refuge biological resources and environmental quality and the results of this evaluation, including the potential effects of each product, will be documented in "Chemical Profiles." The product will also require approval through the Service's Pesticide Use Proposal System process.

When addressing the use of herbicide, it is also important to consider the method of application to be used. Liquid or powder pesticide formulations are normally applied to the target site in a mixture of water, pesticide active ingredient, other ingredients that make up the pesticide formulation, and adjuvants such as wetting agents, surfactants, and drift control agents. Water frequently constitutes 97 percent or more of the total mixture on a volume for volume or weight basis. Liquid formulations can be delivered or applied to a target site by many different application tools. They may be applied from the air by helicopters or on the ground by hydraulic sprayers mounted to tractors, trucks or ATVs, or with hand-held sprayers. The application method chosen depends upon the treatment objective (removal or reduction); the accessibility, topography, and size of the treatment area; the characteristics of the target

species and the desired vegetation; the location of sensitive areas and potential environmental impacts in the immediate vicinity; the anticipated costs and equipment limitations; and the meteorological and vegetative conditions of the treatment area at the time of treatment.

The IPM also discusses aerial applications of certain herbicides on the Refuge. The products most likely to be applied aerially include Milestone VM (active ingredient: aminopyralid), WEEDAR 64 (active ingredient: 2,4-D DMA) Clarity (active ingredient: dicamba), and Stalker or Habitat (active ingredient: imazapyr). Other products may be considered for use in the future and will require updated Chemical Profiles. Aerial applications of herbicides will most often be conducted via helicopter, but could involve fixed-wing aircraft as well. All aerial applications are conducted by a licensed aerial applicator. Helicopter applications are generally made using a boom sprayer. All aerial spraying is regulated by the USEPA, the State of California, and the Imperial Valley Agricultural Commission. Applications must be conducted in accordance with the specifications provided on the herbicide product label, which generally address under what conditions (e.g., wind speed, temperature, air inversion, precipitation) applications are permitted to occur, as well as all applicable Federal, State, and local regulations.

Approximately 870 acres of managed agricultural fields (refer to Figures 3-2 and 3-3), as well as areas supporting large infestations of salt cedar, such as adjacent to the Alamo River, along the Salton Sea shoreline, and within irrigation drains, could be aerially treated. Aminopyralid and dicamba will be used to control broadleaf weeds such as cheeseweed, goosefoot, puncture vine, and London rocket (*Sisybrium irio*) in agricultural fields and imazapyr will be used to control salt cedar. A mixture of the approved herbicide, as well as a surfactant and water conditioner (buffer) will be applied. In the case of Milestone VM, a surfactant (e.g., Agridex, Mor-Act) and a water conditioner (a combination of ammonium sulfate and Quest) will be included in the application mixture to enable the herbicide to stick to and penetrate the broadleaf weeds. Surfactants and water conditioners will also be used in aerial applications of imazapyr. A 100-foot buffer zone is required between treatment areas and existing tree rows or wetland areas. The required buffer zone between treated areas and adjacent commercial cropland is generally a quarter mile, although larger buffers may be required when sensitive non-target crops are located in proximity to treatment areas. Aerial applications, which occur between November and February, are conducted once a year at each treatment site.

The location of pesticide handling and mixing operations prior to application varies according to the method of application. Mixing and handling operations for ground and aerial applications occur on the Refuge. Helicopters and hydraulic sprayers will be accompanied by nurse trucks that supply bulk water for mixing with the pesticides and adjuvants on site (Technical Learning College 2011). The pesticides are either be mixed directly with water in a bulk tank, or poured into a small vessel connected to an injection system that automatically mixes the pesticide(s) with bulk water as the water flows through the application equipment to the spray nozzles. Cleaning aerial application equipment and disposal of any chemical residues occur at the contract applicators primary mixing, handling and storage facilities that are located off-refuge. For ground application equipment, cleaning and disposal of residues occurs within the Refuge headquarters area.

There are several drawbacks and limitations to herbicide use. Herbicides have the potential to injure or kill non-target plants even when the herbicide is not applied directly to the plant, through drift, runoff, and possibly through root leakage. The herbicides considered for use on the Sonny Bono Salton Sea NWR are regarded as posing relatively low risk for use in natural

areas because they are not likely to contaminate groundwater if used properly and are of low toxicity to animals.

Restricted use herbicides must be applied by someone with a California Restricted Use License, or by a person under their direct supervision. Federal law states all herbicides must be applied according to the label. Herbicide treatments on the Refuge will be combined with other control methods, and may use any of the application methods listed above, depending on the situation. All applications will be conducted in accordance with the specifications described in the chemical profile and/or PUPS approval, and will adhere to any special BMPs listed in the Chemical Profile.

Due to differences in species tolerance and the variety of habitats within the Refuge, the ability to use a number of different herbicides is necessary in order to choose the one that is most effective for a particular species in a particular environment. The potential for weeds to develop a resistance to a particular herbicide over time is another reason for developing a variety of herbicide options, as rotating herbicides with different biochemical pathways (from different herbicide groups) can help delay the development of herbicide resistance.

Compounds referred to as adjuvants are often added to the herbicide formulation or tank mix to facilitate the mixing, application, or effectiveness of that herbicide. Spray adjuvants often improve spray retention and absorption by reducing the surface tension of the spray solution, allowing the spray droplet to spread more evenly over the leaf surface. Herbicide absorption may be further enhanced by interacting with the waxy cuticle on the leaf surface. They are sometimes included in the formulations of herbicides (e.g., RoundUp), or they may be purchased separately and added into a tank mix prior to use (Tu et al. 2001).

Adjuvants are chemically and biologically active compounds. Some adjuvants have the potential to be mobile and pollute water. The Material Safety Data Sheet for an adjuvant and the herbicide label (if the adjuvant is included in the formulation) should be checked for conditions in which the adjuvant should not be applied. If such conditions exist, the application of the product would be adjusted accordingly (e.g., by incorporating the appropriate buffers).

An essential element of the IPM Plan is monitoring the results of all activities implemented under the IPM Plan. Ongoing monitoring of invasive species' response to IPM treatment is critical in order to evaluate the effectiveness of different treatment methods and to apply adaptive management practices when deemed necessary.

Upgrading the Refuge's Water Delivery System

The Refuge will evaluate and where feasible construct independent water delivery and drainage ditch systems for various managed habitat areas on the Refuge to better distribute and conserve water within these management areas. Such a system will be particularly beneficial in Unit 2's Hazard Tract, where water for the pond complex is currently distributed by delivering water to the uppermost pond where it is then distributed via gravity flow from one pond to the next. With an independent water delivery system, water will be provided to each pond, resulting in a more efficient use of the water needed to support the desired habitats in each management area. More efficient use of water could also be accomplished in Unit 1's A and B ponds, where an independent drainage system would allow excess water from one pond to be fed into a downstream pond as needed, reducing the need to add new irrigation water into the downstream pond.

Refuge staff will identify those existing irrigation and drainages ditches providing water to ponds or between ponds that could be converted to pipelines to reduce erosion and water loss due to seepage and evaporation, as well as reduce overall ditch maintenance costs in terms of staff time and money. New pipelines would typically be buried no deeper than the existing ditches and would be placed in the same footprint as the previous infrastructure. The cost associated with the installation of these pipelines in 2012 was approximately $34 per linear foot for a 24-inch polyvinyl chloride (PVC) pipe.

Other water conservation measures that may be evaluated in the future include exploring the potential for using groundwater to provide water for some management areas; adding drainage boxes in the fields to allow tailwater to flow from one field to the next and/or to facilitate the pumping of tailwater back into the fields; using drain water from the managed ponds to irrigate farm fields; and blending Colorado River water with adequate quality drain water to increase the quantity of water available on the Refuge for habitat management.

Secure an Adequate Long-Term Water Supply for the Refuge

The majority of the management practices conducted on the Refuge, as described here, require the use of irrigation water to maintain appropriate levels of habitat quality. To ensure the efficient use of irrigation water within the Refuge, measures will be developed and implemented to conserve water use without compromising habitat quality. Although the Refuge has been receiving water from IID since about 1930, reliable water delivery to meet the Refuge's needs in the future is uncertain. In years when the expected water consumption within the entire IID is above its legal allocation, an Equitable Distribution policy will be implemented which will limit IID customers, including the Refuge, to approximately 5.45 acre-feet per acre, which is slightly less that the Refuge could use to optimize habitat quality for listed and sensitive species.

As the Salton Sea continues to recede, the wetland habitats on the Refuge will become increasingly more important to resident and migratory birds. To provide better assurance that the Refuge will be able to achieve its wildlife purposes, the Refuge will work with IID to identify and develop water management practices that will improve water use efficiency throughout the Refuge and to ensure an adequate supply of water of appropriate quality will continue to be available to support the managed cattail marsh habitat on the Refuge, per the recommendations in the draft Yuma Clapper Rail Recovery Plan (USFWS 2009a).

3.4.4.2 Public Use

The public use program on the Refuge includes opportunities for hunting, fishing, wildlife observation and photography, environmental education, and interpretation. Facilities that support these uses are provided in both Unit 1 and Unit 2 (refer to Figures 3-4 and 3-5).

Unit 1 welcome sign, located adjacent to managed cattail habitat (USFWS)

In 2012, an estimated 12,000 visitors stopped at the visitor contact station, but the total number of visitors to the Refuge is likely on the order of 25,000 visits per year, since many birdwatchers visit Unit 1 (which has no counter) and do not stop by the visitor contact station during their stay. Visitors come from the local community, the larger metropolitan areas to the west (San Diego), northwest (Los Angeles), and east (Phoenix/Tucson), and from throughout the U.S. Identified as one of the top 50 birding hot spots in the nation by WildBirds and one of the top 200 North American Birding Hot Spots by birding.com, this Refuge also attracts a large number of international visitors. Based on the information provided by visitors who sign the Refuge guestbook, individuals from more than 20 countries annually visit the Refuge. Although the majority of the visitors to the Refuge are present during the winter months, because the Refuge is recognized as important birding area year-round, visitors may be present even on the hottest of summer days.

Public Access

Specific areas of the Refuge are available for public access, while the remainder of the Refuge to closed to public use to provide sanctuary areas for birds and other wildlife. Those areas of the Refuge open to the public include the main portion of the Refuge that was inundated by the Salton Sea in the 1940s (this area is only accessible by boat); the visitor area, observation platform, and interpretive trail to Rock Hill located adjacent to the Refuge Complex headquarters in Unit 2; approximately 480 acres within the Union Tract and the Hazard Tract of Unit 2, which are accessible during the hunting season for purposes of waterfowl hunting (refer to the discussion of waterfowl hunting); and the main entry road, parking area, observation decks, and interpretive trail in Unit 1. There are also plans to provide additional bird watching opportunities in Unit 2, as described later in this section.

As funding permits, Refuge staff will upgrade existing public access and traffic control measures on the Refuge to ensure that visitors can easily identify those areas open for public use and those areas that are closed to all vehicular and pedestrian travel. These measures, which could include the installation of new gates, fences, and/or signs, will reduce the potential for disturbance to migratory birds and impacts to sensitive habitat areas.

Waterfowl Hunting

Two areas of the Refuge are open seasonally for waterfowl hunting including approximately 350 acres on the Hazard Tract and 130 acres on the Union Tract (refer to Figure 3-3). Within the Union Tract, the primary target is white geese (snow geese and Ross' geese), while a wider range of waterfowl are present within Hazard Tract. Hunting has been occurring in this area since at least 1953 according to Refuge records. The hunting program generally accommodates about 1,000 hunter visits per year. With this level of use, about half of the blinds are not filled during most of the season on the Hazard Tract. The Union Tract hunting blinds are filled more frequently, reaching 100 percent capacity on all open hunt days late in the season.

CDFW administers the Refuge's hunt program and operates the check stations under a cooperative agreement with the Service. Hunting is permitted on Saturdays, Sundays, and Wednesdays during the open season, and only ducks, geese, American coots, and common gallinules (moorhens) may be hunted. Hunters must comply with the State of California's "Waterfowl and Upland Game Hunting & Department Lands Public Use Regulations," which are updated annually, including the specific regulations addressed in the section entitled, *National Wildlife Refuges with DFW Hunting Programs*.

A total of 80 hunters can be accommodated on the Refuge during a hunt day. Hunting blinds are assigned to those holding advance reservations, which are issued by CDFW. Hunters with reservations must present them at the Wister Check Station no later than 1.5 hours before shooting time. Vacancies occurring from no show reservation holders and from hunters leaving the area are filled according to the order established in the previous night's drawing at the Wister Check Station. Hunters must obtain a permit at the Wister Check Station, which is to be in the hunter's possession while hunting on the Refuge. Hunters are permitted to enter only the assigned blind site for which the permit is issued. A fee is required for all persons 16 years and older. All hunters are required to check out at the Wister Check Station, report hunting results, and return their permits before leaving the area.

Only the use of shotguns and steel or other nontoxic shot, as approved by the Service, may be used on the Refuge, and a hunter may not possess more than 25 shot shells while in the field. Firearms must be unloaded when being transported between parking areas and blind sites. No camping or use of trailers is allowed on the Refuge. As of 2012, Refuge staff did not include a Federal wildlife officer; therefore, monitoring of compliance with Refuge hunting regulations involves periodic visits from both the Service's Southern California zone officer and CDFW wardens.

On the Hazard Tract, hunting opportunities are provided at about one hunter party (i.e., up to four hunters per blind) per 20 acres. There are 18 duck hunting blind sites in this area, each consisting of a double set of buried concrete pit blinds capable of hosting up to four hunters per site. Hunters may hunt from within 100 feet of their assigned blind sites or stakes, and can only leave this area to retrieve downed birds. Northern pintail, green-winged teal, and northern shoveler are common species taken at these blind sites. About six inches and no more than one foot of water is retained in the ponds within the Hazard Tract to float decoys.

The Union Tract, which consists of the farm fields located to the south of the Refuge headquarters, provides an opportunity for goose hunting three days a week. In this area, goose hunting usually does not begin until mid-November when rye grass is better established and greater numbers of geese have arrived in the Imperial Valley.

The arrangements for hunting blind sites on this tract are generally the same as those described for the Hazard Tract, although these sites provided more space for hunters to decoy in geese. Four hunt sites are available in these fields and free roam hunting is not permitted. Hunters are required to hunt only from within their blinds, except to retrieve downed birds. Two hunting blind sites on the Hazard Tract and another on the Union Tract are available for use by disabled hunters by priority on Wednesday and Saturday. Accessible parking is provided at this site. If there are no disabled hunters requesting this site, it is open to all requesters. On Sunday, there is no priority on any of these blinds.

Fishing

The only part of the Refuge that is open to fishing is the area of the Refuge located within the Salton Sea, which is considered a navigable water of the U.S. No bank fishing or fishing in water drainage channels is permitted. The sea is closed to fishing during the winter months (October 1 to March 31) to protect waterfowl from disturbance. There are no buoys in the sea to delineate the Refuge boundary. Use of the areas within the Refuge for fishing is limited, and as a result, disturbance to Refuge trust species is low. Refuge waters are patrolled by Refuge staff using an airboat.

Wildlife Observation

The Sonny Bono Salton Sea NWR provides a variety of opportunities for wildlife observation on Unit 1 and Unit 2. In Unit 1, two observation platforms, an interpretive loop trail, and two blinds are provided (refer to Figure 3-4). The newest observation deck is accessible and provides views of the Refuge's managed seasonal wetland areas and cattail marshes. The other observation tower provides views of adjacent freshwater cattail marsh habitat where the occasional call of a Yuma Ridgway's rail can be heard. Distance views of open water habitat and the Salton Sea are also provided. A range of migratory and resident birds can be observed from these facilities. Secretive marsh birds are more likely to be heard than seen. In addition to waterfowl, shorebirds, and seabirds, there are also seasonal opportunities to see and hear a variety of Neotropical songbirds.

Accessible observation deck, built in 2011, provides views into shallow seasonal wetlands and cattail marsh habiat (USFWS)

Unit 1 includes a one-mile interpretive loop trail (the Michael Hardenberger Trail) that extends around existing freshwater marsh habitat and shallow seasonal wetland areas (refer to Figure 3-5). Two photo blinds have been constructed along the trail that accommodate opportunities for both photography and wildlife observation. This trail begins near a small, unpaved parking area at the end of Vendel Road. Additional opportunities for wildlife observation are available from Vendel Road.

Photo blinds are provided along the Michael Hardenberger Trail (USFWS)

Opportunities for wildlife observation are also available in Unit 2, primarily in the vicinity of the Refuge headquarters, located at the intersection of West Sinclair Road and Gentry Road. The two-mile round-trip Rock Hill Trail leads from the Refuge headquarters' visitor parking area to the top of Rock Hill. Along the route, there are opportunities to view wildlife in a variety of managed habitats including farm fields that provide forage for geese; open water habitat that supports shorebirds, seabirds, and other waterbirds; and nesting areas that support tern colonies in the summer. Near the start of this trail is an elevated observation deck that provides views of the farm fields and distant views of the Salton Sea.

Funds will be sought to improve accessibility along these existing interpretive trails. The trail in Unit 1 is relatively flat, but would benefit from resurfacing to ensure a firm and stable surface. The same is true for the interpretative trail in Unit 2 that leads from the visitor parking lot to the base of Rock Hill. Trail resurfacing will be implemented using appropriately

sized tractors and trucks that can travel along the existing trail alignment. Minor grading to smooth the existing trail surface may be necessary in some locations. This would be followed by the placement and compaction of four to six inches of stabilized soil over the existing trail alignment in a manner that results in a trail tread that is outsloped at 1.5 to 3.0 percent to allow for sheet flow across the trail.

The CCP also proposes the development of several new opportunities for wildlife observation on the Refuge, as described here.

Seasonal Birding Trail in Unit 2. A route for a 1.4-mile seasonal birding loop trail will be established within the Hazard Tract utilizing existing dirt roads (refer to Figure 3-5). The trail alignment will prepared to provide a firm and stable surface with an appropriate cross slope to ensure a sustainable trail. Other associated improvements include a four to six-car, unpaved parking area along Garst Road and a small kiosk for posting trail regulations, birding tips, and other information.

Once established, the trail will be open for use between March 1 and September 30 of each year. The closure period will ensure that any potential conflicts between trail use and hunting activities are avoided, and will provide wildlife using the area with a month of no disturbance immediately following the close of the hunting season.

Red Hill Bay Birding Trail. The design for the Red Hill Bay Restoration project will incorporate an opportunity for bird watchers to observe birds in the restored habitat to the west of Garst Road (refer to Figure 3-5). The preliminary restoration design includes the construction of a berm along the eastern edge of the project (approximately 400 feet to the west of Garst Road). This berm will incorporate a public use trail designed to accommodate bird watching. An all-weather surface will be provided on the top of the berm. The parking area proposed for the new Hazard Tract seasonal birding trail would also accommodate bird watchers using the Red Hill Bay Birding Trail. This trail will be available for use year-round.

Birding Area along Vendel Road. To provide bird watchers with an opportunity to observe native and migratory songbirds utilizing a recently restored three-acre willow grove along Vendel Road in Unit 1, a small public parking lot and viewing area will be constructed on the Refuge adjacent to Vendel Road (refer to Figure 3-4). From this location, visitors will also have the opportunity to observe wintering geese and sandhill cranes in the adjacent managed farm field. Funding will also be sought to construct a bird observation blind in this location.

Photography

Two photo blinds are present along the interpretive trail in Unit 1 (refer to Figure 3-4). Use is on a first come, first served basis. One blind is situated alongside a pond managed to support shallow seasonal wetland habitat. The opening in the blind faces a small island and tree snag where birds often perch, making for a good photo opportunity. Shorebirds and waterfowl can be observed and photographed from this spot. The other blind is located among the cattails in the middle of freshwater marsh habitat. When the blind was constructed, the surrounding habitat consisted of open water habitat, however, over time this area converted to freshwater marsh habitat. Today, this blind would more likely be used as a listening blind where visitors can hear the calls of Yuma Rigdway's rails and other secretive marsh birds.

Opportunities for wildlife photography are also available along the roadway leading to Unit 1 where during the appropriate season there is a high potential to spot shorebirds, geese, and sandhill cranes.

Environmental Education

Environmental education tours for third through eighth grade students from local schools have been conducted annually on the Refuge, and will continue per available funding and staff. Staff from the Refuge also visit local schools to provide information to the students about the resources present in and around the Refuge. With challenge cost share money, which has paid for buses and drivers, the Refuge has been able to host 60 to 70 sixth graders two days a week (about 560 students a year) during the school year. This is a joint project with the Imperial Valley Regional Occupation Program and the Refuge. Various funding options, including challenge cost share grants, will continue to be sought to accommodate this activity. Special tours for Imperial Valley Community College and other educational institutions have also been accommodated on the Refuge, and Refuge staff participate in various off-refuge events such as Earth Day events and school nature curriculum programs.

Expansion of the current environmental education programs provided by Refuge staff is proposed. This would require assistance from an Outdoor Recreation Planner, who would be responsible for developing and implementing a volunteer training program to assist in environmental and interpretive programs. Topics to be addressed through these programs would include migratory birds, endangered species, climate change, and the changing conditions in the Salton Sea. In addition, volunteers would be recruited to help facilitate programs focusing on connecting children with nature.

Interpretation

Interpretive panels are provided along the Rock Hill Trail in Unit 2 that address a variety of topics including the cultural and geologic history of the area, the Refuge's diverse bird life, Refuge management actions, organisms in the Salton Sea, and geothermal and earthquake activity in the area. Interpretive signs are also provided along the loop trail in Unit 1. Here the primary focus is on bird life.

Interpretive sign at the start of the Rock Hill Trail in Unit 2 (USFWS)

The interpretive panels in Unit 1 are in need of updating, therefore, funding will be sought to design, manufacture, and install four new interpretive panels and two bird identification panels along the trail. In addition, funding is needed to create two or more interpretive panels for the recently constructed accessible observation deck in Unit 1. Topics that may be addressed include the purpose of the managed habitats on the Refuge, the importance of the Salton Sea to birds migrating along the Pacific Flyway, the Refuge's endangered species, the changing conditions in the Salton Sea, resident species, and bird foraging opportunities on the Refuge. Seek funding to update the interpretive signs provided along the trail in Unit 1.

Funding will also be sought to create and install interpretive panels along the proposed Red Hill Bay Birding Trail that will address issues related to the purpose of the restoration project and its relationship to the receding Salton Sea, the past and anticipated future conditions within the Salton Sea, the effect to migratory birds of these changes, and the Refuge's role in ensuring the availability of habitat essential to these species.

Guided interpretive group tours are also provided on the Refuge throughout the year, although more commonly in winter and spring. Arrangements for group tours are made in advance and generally involve Refuge staff; however, trained docents could also provide this function.

Research

Over the years, the Refuge has supported various research projects and resource surveys conducted in association with graduate work at various universities and/or implemented by other public (e.g., USGS, CDFW), private, and non-profit researchers. All research conducted on the Refuge is evaluated to ensure that the work being conducted is compatible with Refuge purposes and is likely to result in benefits to Refuge management and/or Refuge resources. Work conducted on the Refuge by outside individuals, organizations, or agencies that is not directly related to Refuge management may only be conducted after a Special Use Permit (SUP) has been issued by the Refuge Manager that documents the purposes of the work to be conducted and includes specific conditions intended to protect trust resources and ensure adherence to applicable Refuge regulations and policies.

Refuge will continue to develop research partnerships with academic institutions, and other public (e.g., USGS), private, and non-profit researchers. The focus of this research will be on topics that can benefit Refuge management, Refuge resources, and multiple-partner management of resources within the Salton Sea. Potential research topics include but are not limited to the effects of climate change and the receding Salton Sea on the diversity of avian species present at the Salton Sea over time; Yuma Ridgway's rail response to habitat modifications within managed cattail habitat; and nesting site selection by gull-billed terns and black skimmers. Other potential cooperative research projects may include working with researchers at USGS and/or CDFW to facilitate genetic studies of desert pupfish and the migration patterns of secretive marshbirds, and selenium monitoring in Refuge habitats including the restored Red Hill Bay.

3.4.4.3 Refuge Operations

Staffing

In 2012, the Refuge was managed with assistance from 11 permanent full time employees, two full time term employees, and one student participating in the Service's Student Temporary Employment Program. Four additional positions were included on the approved organizational chart, but had not been filled, including Park Ranger (term position), Biological Technician (term position), Irrigation System Operator (term position), and Tractor Operator (term position). Refuge Complex office and associated facilities are located in Unit 2 of the Refuge.

A review of the proposals and programs described in the CCP indicates that successful implementation of all of the proposals would require filling those positions in the organization chart that have not been filled, as well as expanding the current organizational chart to include a few additional positions. The unfilled and new positions are described below.

- **Irrigation Systems Operator** (1 FTE) - Needed to implement the responsibilities related to irrigation and water movement throughout the Refuge to achieve Refuge purposes related to waterfowl management, as well as to implement the new water management requirements associated with the Red Hill Bay Restoration project (under this proposal, the temporary full time irrigation system operator [GS 5/6] position on the Refuge Complex organization chart would be filled, per available funding, as a permanent full time position).

- **Biological Technician** (1FTE) - Needed to meet current wildlife disease outbreak monitoring and response requirements (under this proposal, a temporary full time biological technician [GS 5/7] position on the Refuge Complex organization chart would be filled, per available funding, as a permanent full time position).

- **Outdoor Recreation Planner** (1FTE) - Needed to develop and formalize an expanded environmental education program for the Refuge, to assist with visitor contact, and expand the Refuge volunteer, docent, and public outreach programs (this is a new permanent full-time position that would be added to the Refuge Complex organization chart and filled per available funding).

- **Facilities Manager** (1 FTE) - Needed to manage and ensure appropriate maintenance of the Refuge headquarters facilities and other infrastructure throughout the Refuge (this is a new permanent full-time position that would be added to the Refuge Complex organization chart and filled per available funding).

Refuge Facilities

Refuge Headquarters. Refuge complex administrative offices (headquarters) include a 2,300-square-foot building with five staff offices, a file/copy area, two staff restrooms, a visitor contact station, and two visitor restrooms with access from outside the building. Refuge visitors enter the headquarters and visitor contact station from the junction of West Sinclair Road and Gentry Road. A paved parking lot with 25 parking stalls is provided for visitors. Adjacent to the parking lot is a 450-square-foot shaded picnic area and a wheelchair accessible observation deck. This area connects to the Rock Hill Trail. From the parking lot, visitors also have access via a concrete walkway to the restrooms and visitor contact station that is part of the administrative offices.

The visitor contact station provides the public with the opportunity to interact with Refuge staff. The Refuge relies on a combination of staff members and volunteers to staff the visitor contact station, with volunteers available from October through April. During that time, the volunteers work Friday, Saturday, Sunday, and Monday. These seasonal volunteers are permitted to stay at the Refuge in their recreational vehicle (RV), which is accommodated within the Refuge compound at a designated RV pad with full hook-ups. Refuge staff assists at the visitor contact station on Tuesday, Wednesday, and Thursday during the season and on weekdays between May and September.

Also included within the Refuge headquarters compound is a four-bedroom residence built in 1952. Housing a Refuge staff member at this location helps to facilitate visitor and facility security. The Refuge compound also includes two bunkhouses to accommodate researchers and temporary employees. The bunkhouse built in 1999 has five bedrooms and the one built in 2005 has three bedrooms.

A bird recovery and avian disease management area is located at the north end of the compound yard. This facility is intended to provide staff with a place to provide initial treatment of sick birds picked up on the Salton Sea and minimize the spread of contagion in the environment. Included in this part of the facility is a 360-square-foot triage/hospital building. Next to the hospital is a shaded outdoor holding pen where birds can recover and be released back into the wild or be taken to a licensed rehabilitation facility. This area can hold up to 100 pelican-sized birds at any one time. Also part of the facility is a small research building with instrumentation to help visiting researchers study diseases and other organisms of the Salton Sea. As part of the Refuge's role in attempting to contain avian disease agents, two propane-fired incinerators capable of burning up to 120 pounds per hour are available to incinerate dead birds and disease organisms they may be carrying. Two storage barns (one five-bay barn and another three-bay barn) provide shelter for airboats and space for a refuge woodshop.

Staff prepares to release a California brown pelican after it was successfully treated at the Refuge's rehabilitation facility (Mark Stewart/USFWS)

Also located with the compound is a maintenance building that provides workspace and tools to help maintain refuge vehicles and equipment. The maintenance building consists of four work bays with roll-up doors and office space for maintenance staff. Fuel storage is provided to accommodate the fuel needs of refuge vehicles and farm equipment.

Attached to the roofs of four buildings and a parking shade structure are approximately 250 photovoltaic solar panels that annually generate up to 80,000 useable kilowatt hours of electricity during daylight hours or the equivalent of about 87 percent of the Refuge compound's electrical needs.

The CCP identifies a number of improvements to existing facilities to address Refuge management and visitor services needs. These improvements, which are described here, will be provided as funding sources are identified.

- **New Storage Facility** - The Refuge will seek funding for new prefabricated, stand-alone, steel chemical and flammable liquids storage buildings to improve storage and insure compliance with health and safety and environmental compliance requirements.

- **Carport Replacement** - Funds will be sought to replace the Refuge's existing Service vehicle carport to better protect vehicles from sun, heat, and wind damage.

- **Improved Security** - Measures such as improved lighting, fencing, and installation of security cameras will be implemented per available funding to improve security at the Refuge headquarters compound and within the visitor parking area. In addition, the installation of a secure, fenced area in Unit 1 that can be used to store tractors and other farm equipment is proposed.

- **New Public Restroom(s)** - The Refuge will seek funding to expand and/or refurbish the one-room public restroom at the visitor contact station.

- **Replace/Repair Public Walkway** – Funding will be sought to repair or replace the walkway that extends from the visitor parking lot to the visitor contact station and around to the public restroom.

- **Shaded Visitor Parking** – A shade structure in the visitor contact station parking lot to provide shade for five visitor parking spaces will be designed, manufactured, and install, per available funding.

Other Refuge Facilities. Other facilities that will continue to be maintained on the Refuge include roads, primarily unpaved, water pumps, irrigation gates, and other irrigation equipment, drainage channels, and unpaved parking areas to serve hunting and other visitor service purposes. The Refuge also maintains a permanent portable restroom in Unit 1 near the observation tower and temporary restrooms during the hunting season on the Hazard and Union Tracts.

Land Tenure

The vast majority of the original area included within the Refuge was inundated by the Salton Sea in the 1940s. Only a small portion of this land, approximately 140 acres located along the western edge of the Salton Sea, was never inundated. Lands currently included within the Refuge boundary represent a combination of Federal fee-title lands, leased lands, and other government lands managed by the Refuge through agreement or other arrangement.

Approximately 690 acres of upland to the south of the Salton Sea are owned in fee title by the United States and under the jurisdiction of and managed by the Service, although the mineral rights on various parcels within this area are retained by the prior private property owner. These lands were acquired in the 1970s and 1980s, as described in Chapter 1, for the purpose of providing foraging habitat for wintering geese.

The original leases with IID for approximately 2,500 acres of the Refuge to the south of the Salton Sea have expired and as of 2012, IID was not interested in entering into any new long term leases for these areas; as a result, through 2013, Refuge has been operating on a year-to-year lease. The Refuge continues to coordinate with IID in an effort to once again enter into a long-term lease agreement for all or a portion of these lands.

Geothermal interests own subsurface geothermal resources in and around the lands leased to the Refuge by IID. The Refuge recognizes IID's need to provide access through these lands for geothermal wells and piping, and as the Salton Sea recedes, there will likely be requests from geothermal interests to place or relocate pipelines and access facilities. Some of the areas affected could include lands currently leased by the Service, requiring potential changes in the current Refuge boundary.

With respect to the Hazard Tract, located in Unit 2, the Service has managed this area under a permit with CDFW for many years. The land covered by the permit, which was originally approved in the 1960s, includes waterfowl hunting areas and several Yuma Ridgway's rail management areas. Although the permit has expired, the Service and State are in the process of renewing the agreement. In the meantime, the Service continues to manage the habitat and the State continues to manage the site's hunting program.

In addition to the fee title lands and IID leased lands, approximately 240 acres (the Caltrans Fields) in Unit 1 is managed under an agreement with the California Department of Transportation (Caltrans), which owns the land. This land has been managed as part of the

Refuge for goose forage since 1992. As part of an agreement between Caltrans and the Service's Ecological Services program, these lands were to be deeded to the Refuge as part of a mitigation plan for nearby Caltrans projects. Although the land ownership transfer has not yet occurred, the Refuge continues to manage these lands for goose forage. These fields represent some of the most heavily foraged fields within the Refuge. The Refuge will continue to work with interested parties to either acquire the land or obtain the necessary agreements to manage it on a long-term basis.

The preparation of a step-down plan to evaluate current and future land and water needs for the Refuge in light of the changing circumstances in and around the Salton Sea (e.g., receding water levels, increased salinity levels, potential reductions in water availability) is proposed with completion of this plan expected by 2022. Issues that would be explored in this step-down plan include potential land transfers and/or the removal of some lands from the Refuge boundary due the inability of these lands to support Refuge purposes.

Lands that might be considered for transfer to the Refuge would be those located between Refuge's submerged lands and the lands leased by the Refuge from IID. These areas are slowly being exposed as the Sea recedes. As the sediments on the sea floor are exposed, the potential for air quality impacts are expected to rise. The creation of shallow water wetlands in these areas would reduce the potential for air quality impacts, while also providing important habitat for shorebirds and other waterbirds that would be displaced as the waters of the Salton Sea continue to recede.

In the meantime, Refuge staff will continue to work to resolve outstanding land status issues such as renewal of a long-term lease with IID; renewal of the lease with CDFW for the Hazard Tract; extension of the lease agreement or acquisition of the Caltrans properties in Unit 1; and potential elimination of some IID land from future leases.

Law Enforcement

Law enforcement on the Refuge is the primary responsibility of the Service's uniformed Federal wildlife officers, although CDFW wardens also provide assistance, particularly during the hunting season. Federal wildlife officers enforce Federal wildlife laws on Service-owned lands within the National Wildlife Refuge System. They are charged with protecting wildlife and wildlife habitat, protecting Service facilities, and ensuring employee and visitor safety. Duties may include patrols, surveillance, investigations, apprehensions, seizures and arrests, and interaction with the judicial system. Refuge officers often work with other Federal, Tribal, State and local law enforcement agencies that have overlapping jurisdiction within and adjacent to NWRs. Currently, the Refuge Complex organizational chart does not include a Federal wildlife officer, therefore, law enforcement is provided by the Southern California zone officer, who is stationed at the San Diego NWR Complex.

Fire Management

The Fire Management Plan prepared for the Sonny Bono Salton Sea NWR in 2001 was prepared as an operational guide for managing the Refuge's wildland fire and prescribed fire programs. It defines levels of protection needed to help ensure safety, protect facilities and resources, and restore and perpetuate natural processes, given current understanding of the Refuge relationships in natural ecosystems.

The Fire Management Plan adheres to the Service's policy and regulations pertaining to fire management activities and supports the enabling legislation of the Sonny Bono Salton Sea NWR. All fire management plans must comply with a Service-wide requirement that Refuges

with burnable vegetation develop a fire management plan (620 DM 1). The DOI Manual states the following regarding wildland fires: "Wildfires may result in loss of life, have detrimental impacts upon natural resources, and damage to or destruction of man-made developments. However, the use of fire under carefully defined conditions is to be a valuable tool in wildland management. Therefore, all wildfires within the Department will be classified either as wildfire or as prescribed fires."

The objectives of the Refuge's Fire Management Plan (USFWS 2001) are:

- To protect life, property, and natural resources from unwanted fire;
- Use prescribed fire to accomplish resource management objectives within the context of a natural ecological process;
- Develop and implement a process of collection, analysis, and application of fire management information needed for sound management decisions, and
- Use prescribed fire to manage and enhance the habitat as research and experience demonstrates the need.

The Refuge Fire Management Plan describes the responsibilities of various Refuge personnel for the implementation of the Plan. The Sonny Bono Salton Sea NWR does not have a dedicated fire management staff; therefore, the Project Leader is responsible for planning and implementing the fire management program on the Refuge. The Zone Fire Management Officer (FMO) located in San Diego is responsible for fire management program over- site and coordination. The Project Leader has assigned fire management responsibilities to staff, who possess appropriate training, experience, and incident qualifications. Pre-suppression planning and work is accomplished by Refuge staff in accordance with national and regional fire management direction under guidance from the Zone FMO. Emergency fire management actions are handled by Refuge staff according to training and incident qualifications. The Zone FMO is to be immediately notified of all actions.

Cooperative agreements with various Federal, State, and local agencies generally provide that resources of each agency are available to assist in initial attack efforts. The primary emergency wildland fire management contact for Sonny Bono Salton Sea NWR is the Cleveland National Forest Emergency Command Center (ECC) located in El Cajon, California. The ECC handles wildland fire emergency dispatching for the Refuge under a cooperative agreement. Westmoreland Volunteer Fire Department is the fire department responsible for structural fire protection on the Refuge. The BLM's California Desert District is also considered a cooperator due to their proximity to the Refuge and their ability to provide resources. Additional information about these cooperating agencies, and additional information and direction related to fire response, are provided in the Refuge Emergency Fire Plan, which is included in the Complex's Fire Management Plan.

Historically, wildfires on the Refuge have been very rare. When they have occurred, they usually involve stands of salt cedar. Due to the limited value of salt cedar as wildlife habitat, most of these fires are extinguished only when initial attack will be most effective, such as along breaks or clearings in stands of vegetation. However, the fire may be more aggressively attacked if it threatens higher value habitat or resources such as private property, croplands, or cattail ponds during nesting season, where important species could be adversely affected.

The Sonny Bono Salton Sea NWR has been conducting prescribed burns for at least 12 years. As of 2001, on average, two prescribed fires covering 100 acres were conducting on the Refuge annually. In recent years, the use of prescribed fire on the Refuge has been limited to once every few years, as needed to improve habitat in cattail marshes. When a prescribed fire is conducted on the Refuge, it is managed by the Service fire crew based out of the San Diego NWR Complex.

Prescribed burns, conducted by Refuge firefighters, are effective in controlling invasive shrubs and overgrown vegetation on the Refuge (Mark Stewart/USFWS)

All prescribed burns are conducted in accordance with the approved Fire Management Plan and applicable County and air basin regulations. In past years, fire has been used to improve habitat quality by creating open areas within dense cattail stands. This action has been conducted most often to improve conditions for the Yuma Ridgway's rail. Prescribed fire has also been implemented in the past to remove stubble vegetation in managed agricultural fields in an effort to return nutrients to the soil and remove decadent grassland cover. This activity improves the vigor and quality of foraging crops cultivated to attract geese to the site.

Prescribed burns may also be used to treat and remove exotic vegetation (e.g., salt cedar, common reed). Such burns are typically carried out as a "pile" burn and are generally located in dry, open ponds or disced agricultural fields where there is very little risk of unwanted fire spread.

Prescribed burns involve the use of fire as a tool to achieve management objectives. Research burning may be conducted when determined necessary for accomplishing research project objectives. Actions included in the prescribed burn program include the selection and prioritization of prescribed burns to be carried out during the year; prescribed burn plans; burn prescriptions; burn operations; documentation and reporting; and burn critiques. Measures to ensure the successful implementation of the prescribed fire program include:

- Conducting a vigorous prescribed fire program with the highest professional and technological standards;
- Identifying the prescribed burn type most appropriate to specific situations and areas;
- Efficiently accomplishing resource management objectives through the application of prescribed fire;
- Continually evaluating the prescribed fire program to better meet program goals by refining prescriptions treatments and monitoring methods, and by integrating applicable technical and scientific advancements;
- Preparing prescribed burn plans with a review by a qualified Prescribed Fire Manager/ Prescribed Burn Boss, and approval by the Project Leader; and
- Conducting prescribed burns with an adequate number of qualified personnel to conduct the burn as well as to mop-up.

All prescribed fire activity is implemented in compliance with applicable Federal, State, and local air quality laws and regulations. The Imperial Valley Agricultural Commission, which regulates the prescribe burn program for the Imperial Valley APCD, approves annual burn permits for the Refuge and specific requests for a prescribed burn on the day of the burn.

Mosquito Management

As of 2013, mosquito monitoring and control was not conducted on the Sonny Bono Salton Sea NWR.

Cultural Resource Management

Cultural resources, including both archaeological and historic sites, are known to occur in the vicinity of the Refuges within the Sonny Bono Salton Sea NWR Complex. Some of the known archaeological sites have been previously evaluated to determine if they are eligible for inclusion on the National Register of Historic Places (NRHP), while others have not yet been evaluated. It is also likely that sites are present that have not yet been detected and/or recorded. Therefore, in accordance with Service policy, Section 106 of the National Historic Preservation Act (NHPA), Presidential Memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments," and Executive order 13175 "Consultation and Coordination with Indian Tribal Governments," the Service will continue to identify, protect, and manage cultural resources that could be affected by Service undertakings and will engage in government to government consultation with tribes throughout the process where tribal culture or resources could be affected by actions proposed on these Refuges.

Because cultural resources are known to be present in the area, any Refuge project that would result in subsurface disturbance of previously undisturbed soil or disturbance that would extend below the depth of previous disturbance (e.g., below soils historically disturbed by agricultural activities), or would impact a structure that is considered more than 50 years old must be reviewed by the Service's Cultural Resources Program for compliance with Section 106 of the NHPA. The review process involves the preparation of a Request for Cultural Resources Compliance, which is submitted, to the Regional Cultural Resources Office for review. With information about the project location and extent of the proposed ground-disturbing activity, the Cultural Resources Office will determine the potential effect of the proposal on cultural resources. Those projects that are not likely to affect subsurface materials could fall under the Service's programmatic agreement with the State Historic Preservation Office (SHPO), while other projects requiring greater ground disturbance could require SHPO review and concurrence. When there is a potential for disturbance to cultural resources, consultation with federally recognized Tribes, interested parties, and SHPO is implemented, as required by the NHPA.

The CCP requires that prior to implementing a new ground-disturbing project within the Sonny Bono Salton Sea NWR Complex (ongoing disturbance related to site preparation in managed habitat areas do not fall into this category), Refuge staff will coordinate with the Service's Regional Cultural Resources team and the appropriate Tribal governments when deemed necessary in accordance with Service policy and other Federal regulations. The Sonny Bono Salton Sea NWR Complex will also work with the Regional Archaeologist to develop procedures (that would be formalized through a Memorandum of Understanding with the appropriate tribal representatives) to be implemented in the event of a NAGPRA-related discovery on lands managed by the Refuge.

Environmental Contaminants Coordination

The Service's Environmental Contaminants Program assists the Refuge Manager in issues related to contaminants, including seeking funds to conduct contaminant assessments, monitoring, and other studies related to the effects of contamination on Refuge trust resources. The Carlsbad Fish and Wildlife Office's Contaminants Program has assisted in addressing potential contaminants issues on the Sonny Bono Salton Sea NWR on several occasions, including on issues related to selenium. The accumulation of selenium in Salton Sea sediments and water where prey items occur represent a potential threat to nesting and foraging waterbirds. Monitoring efforts have been implemented in the past and will likely continue.

In accordance with the CCP, Refuge staff will continue to coordinate with the Service's Environmental Contaminants Program. Staff will also work with the Contaminants Program and other partners to seek funding for developing and implementing a water quality monitoring program for the managed wetlands located to the south of Bruchard Bay, as well as the restored open water habitat in Red Hill Bay; monitor selenium levels within restored habitat areas; and should monitoring indicate a need, work with these and other partners to develop measures that can be implemented to reduce selenium levels.

Volunteers, Partners, and Public Outreach

The Refuge has a small, but active volunteer program. Volunteers staff the visitor center contact station on Fridays, Saturdays, Sundays, and Mondays from October through April. They have been paid a small stipend and are allowed to live on the Refuge at a designated RV pad during the period in which they provide volunteer services. These and other volunteers go through a volunteer training program conducted by Refuge staff that enables the volunteers to orient visitors and answer questions related to birding. The Refuge also received assistance from members of the Anza-Borrego Foundation.

The Refuge also has a variety of Federal, State, and local partners that assist in conducting environmental education programs, managing the hunting program, and managing Refuge resources. These partners include CDFW, State Resources Agency, IID, Imperial County Regional Occupational Program, Desert Protective Council, Friends of Wister, Anza Borrego Natural History Association, Imperial County Farm Bureau, Coachella Valley Association of Governments, Center for Natural Lands Management, Imperial County Airport, and the Brawley Chamber of Commerce.

Over the years, Refuge staff have been active in both on-Refuge and off-Refuge events and activities that help increase the visibility of the Refuge within the surrounding communities. Such activities include participation in the Imperial County Fair, the Brawley Cattle Call Parade, Calipatria Christmas Parade, Westmorland Honey Festival, Riverside County Fair, and the Salton Sea Bird Festival.

Staff prepares for a public outreach event (USFWS)

Per available staffing, a Refuge public outreach program will be developed to identify and recruit surrounding residents interested in volunteering once or twice a month a range of refuge enhancement projects, as well as assisting staff with environmental education programs, conducting bird walks, and implementing programs related to connecting children with nature.

Partnerships related to restoration of wetlands in areas where the Salton Sea has receded are also likely to expand. In 2013, the Refuge was actively working in partnership with IID, CDFW, the California Natural Resources Agency, and others to restore Red Hill Bay and implement a pilot project associated with the Salton Sea SCH project.

A regional partnership is also proposed that would involve various agencies, private landowners, and businesses in an effort to promote and interpret the resources of the Imperial Valley. This interpretative program would involve the development of an auto tour route in the area south of the Salton Sea. The route, which would utilize existing public roads, would guide visitors past a variety of uses and resources within the Valley. Pullout areas and interpretive signs would provide opportunities to interpret the history and importance of agriculture in the Valley, water history and the need for water management, geothermal and solar opportunities, historical and cultural events, the history and future of the Salton Sea, and the importance of the area to birds and other wildlife.

3.5 Management of the Coachella Valley NWR

3.5.1 Refuge Management Overview

Following Refuge establishment in 1985, Refuge staff implemented actions in partnership with other entities to protect the newly acquired lands from disturbance. BLM provided important law enforcement support, significantly reducing illegal off-road vehicle activity on the dunes. Efforts were also undertaken to address sand loss from the site, including the installation of sand fences. Refuge and other Service staff also coordinated with other entities over a number of years to develop various habitat planning and habitat management documents for the preserved lands within the Coachella Valley. Table 3-3 identifies important events related to the management of the Coachella Valley NWR. Additional details regarding Refuge history is provided in Chapter 1.

Table 3-3
Timetable of Past Events Associated with the Coachella Valley NWR

Event	Date	Additional Details
Refuge established	1985	Defined lands managed by Service as a NWR
Federal Fish and Wildlife Permit issued to local counties	1986	Allowed incidental take of the Coachella Valley fringe-toed lizard outside of Preserve areas
Coachella Valley Preserve Public Equestrian/Hiking Trail System approved	1990	Provides for an equestrian trail on the northern and western edge of the Refuge
Sand corridor emerges as resource needing protection	1990s	Blowing sand replenishes sand dune habitat for the Coachella Valley fringe-toed lizard
Memorandum of Understanding for planning of the Coachella Valley MSHCP	1996	Initiates the planning effort for the Coachella Valley MSHCP that will address current and potential future Federal and State Endangered Species issues
Agencies continue to acquire land for the Coachella Valley Preserve	1997	To protect habitat for Coachella Valley fringe-toed lizard and multiple species habitat values

Table 3-3 Timetable of Past Events Associated with the Coachella Valley NWR		
Event	**Date**	**Additional Details**
Corps of Engineers initiates public scoping process for future flood control	1999	Flood control project proposed near Refuge that could impact habitat values (as of 2012, the project has not proceeded beyond the scoping process)
Final Recirculated Coachella Valley MSHCP completed	2007	The Plan "…will balance the demands of the growth of western Riverside County over the next decades with the need to preserve open space and protect species of plants and animals that are threatened with extinction."
Interim Management Agreement Memorandum of Understanding	2007	Provides guidance related to Reserve Management Unit Plans for the immediate future to ensure conservation of covered species and natural communities
Coachella Valley MSHCP Implementing Agreement	2008	Provides legal agreement among all responsible parties for plan implementation
Reserve Management Unit Plan for Reserve Management Unit 1 (Valley Floor Reserve Management Unit) approved	2012	Provides a framework for facilitating collaborative management to provide effective and efficient use of available combined management resources

3.5.2 Previous Management Documents

Prior to the completion of this CCP, management on the Coachella Valley NWR was guided by the goals and objectives of various management plans including the 1986 Management Plan for the Coachella Valley Preserve System, which was superseded by the 1995 Management Plan for the Coachella Valley Preserve System. In 2008, the Coachella Valley MSHCP superseded all previous planning documents for the Preserve System, although the overall management objectives remain generally the same. In 2012, the Reserve Management Unit Plan for the Valley Floor Reserve Management Unit was approved, which provides more detailed direction for addressing the threats, stressors, and other management issues affecting the habitats within the Refuge and other preserved areas within the Coachella Valley floor.

3.5.3 Past Management Actions

Past Conservation Planning Actions

In 1986, the Service, BLM, CDFW, and The Nature Conservancy signed an Implementing Agreement (IA) for Management of the Coachella Valley Preserve. This IA defined the goals and responsibilities of the four principal landowners within the Coachella Valley Preserve, as well as two associated satellite preserves (Willow Hole/Edam Hill and Indian Avenue). The area covered by the IA was referred to as the Coachella Valley Preserve System. The overriding goal of the IA is to conserve the fringe-toed lizard and implement the HCP through maintenance of unimpeded sand sources, protection of all suitable fringe-toed lizard habitat, and rehabilitate of impacted fringe-toed lizard habitat. Other goals of the IA include promoting and approving research projects on the Preserve System;

Sand fields on the valley floor (USFWS)

monitoring the fringe-toed lizard and other sensitive species populations; promoting public awareness of the resource values within the Preserve through on and off-site interpretation; enforcement of rules and regulations; and regulations of activities occurring within the Preserve System. As part of the provision of the IA, the Service agreed among other things to develop and coordinate research needs within the Preserve System, review and update the status of the fringe-toed lizard and research results annually, and provide increased patrols of the Refuge during high use periods. The IA was amended in January 1991 (now a Memorandum of Understanding) to include the California Department of Parks and Recreation as a major landowner.

The first management plan for the Preserve System was also prepared in 1986 by The Nature Conservancy. The goals of 1986 Coachella Valley Preserve Management Plan were consistent with the IA, addressing issues such as maintenance and enhancement of natural conditions, vehicle access restrictions; control of exotic plants and animals, restrictions on the use of firearms, establishment of a hiking and equestrian trail system, public outreach, monitoring listed and sensitive species, and encouraging research.

In 1989, the BLM prepared an EA to evaluated the potential effects of a system of public equestrian and hiking trails in the southern portion of the Coachella Valley Preserve that were proposed by the Ivey Ranch Equestrian Center and the Coachella Valley Association of Governments (CVAG) (BLM 1989). Several trail alternatives were evaluated that crossed lands included within the Coachella Valley NWR. In 1990, the Service issued a biological opinion indicating the implementation of BLM's preferred alternative was not likely to jeopardize the continued existence of the Coachella Valley fringe-toed lizard provided that the following reasonable and prudent measures were implemented: trail users limited their activities to the designated trail; no pets are permitted on the trails; and monitoring is implemented to identify potential adverse effects to the fringe-toed lizard or its habitat and to implement corrective measures, if required.

The Coachella Valley Preserve System Management Plan, prepared in 1986, was superseded in 1995 when the management plan was updated to address new issues related to recreation, trails, and the introduction of the desert pupfish on a portion of the Preserve Area located outside of the Refuge boundary. The overall goal for the Coachella Valley Preserve System remained essentially the same: maintain in perpetuity, a self-sustaining ecosystem, of which the Coachella Valley fringe-toed lizard is an integral part, through enhancement and maintenance of the lizard's habitat and protection of sand sources and sand transport corridors (BLM 1995).

While the 1995 Management Plan was being prepared, a scoping study was conducted by the Coachella Valley Mountains Conservancy for CVAG that recommended the preparation of a Multiple Species Habitat Conservation Plan for the entire Coachella Valley and surrounding mountains to address current and potential future state and federal Endangered Species Act issues. This recommendation ultimately resulted in the signing of a Memorandum of Understanding ("Planning Agreement") in 1995 and 1996 by numerous Federal, State, and local agencies to govern the preparation of the MSHCP . The Planning Agreement was later amended to indicate that the MSHCP would meet the intent of the Natural Community Conservation Planning (NCCP) Act as well as the California Endangered Species Act (CESA) and the Federal ESA. The Coachella Valley MSHCP, completed in 2008, continues to provide a regional vision for balanced growth to meet the requirements of Federal and State endangered species laws, while promoting enhanced opportunities for recreation, tourism and

job growth. The intent of the plan is to protect 27 plant and animal species. The Coachella Valley NWR is just one component of the much larger MSHCP conservation planning area.

When the Coachella Valley MSHCP was approved, the Coachella Valley Preserve System (Coachella Valley, Whitewater Floodplain, and Willow Hole/Edom Hill) were subsumed into the MSHCP Reserve System to be managed in accordance with the MSHCP. The Refuge, which was included within the Coachella Valley Preserve, became part of the Thousand Palms Conservation Area and management of the Refuge is intended to be consistent with the Conservation Goals and Conservation Objectives of the MSHCP.

The establishment of the MSHCP Reserve System combined with the MSHCP's Monitoring and Management Programs are designed to achieve the following conservation goals:

- Represent native ecosystem types or natural communities across their natural range of variation in a system of conserved areas;
- Maintain or restore self-sustaining populations or metapopulations of the species included in the MSHCP to ensure permanent conservation;
- Sustain ecological and evolutionary processes necessary to maintain the functionality of the conserved natural communities and habitats for MSHCP-covered species;
- Maximize connectivity among populations and avoid habitat fragmentation within conservation areas to conserve biological diversity, ecological balance, and connected populations of covered species;
- Minimize adverse impacts from off-highway vehicle use, illegal dumping, edge effects, exotic species, and other disturbances per the Management and Monitoring Programs; and
- Manage the conservation areas adaptively to be responsive to short-term and long-term environmental change and new science (CVAG 2007a).

The Thousand Palms Conservation Area, which contains approximately 25,900 acres, constitutes the largest unfragmented habitat area on the Coachella Valley floor. For management purposes, it is part of the Valley Floor Reserve Management Unit. In accordance with the Coachella Valley MSHCP, Reserve Management Plans are to be prepared for each Reserve Management Unit and coordination of management within the Reserve Management Unit is the responsibility of the Reserve Management Unit Committee. The Reserve Management Unit Plan for the Valley Floor Reserve Management Unit was approved in 2012. This plan includes a variety of recommended management actions related to invasive species, hydrological processes, climate change, habitat fragmentation, fire management, off-highway vehicle trespass, and public use and access.

The Refuge staff participated in the development of the MSHCP and continues to actively participant in this larger planning effort.

Past Management Actions

Since the Refuge was established, management has focused on habitat protection with minimal manipulation. Protection has been achieved by preventing or discouraging vehicle travel on the Refuge through signage, public contact, and perimeter fencing. Partners in the protection of the public lands within the larger Thousand Palms Conservation Area include BLM and CDFW.

Since the establishment of the Refuge, the monitoring of listed species on the Refuge has been conducted primarily by the Carlsbad Fish and Wildlife Office and/or contractors. For more than ten years, fringe-toed lizard monitoring has been conducted annually by Dr. Cameron Barrows from the University of California Riverside (UCR), who has used a passive monitoring method that involves track surveys. The Service's Ecological Services (ES) Program using an active monitoring program was also collecting data to assist in the development of monitoring protocols for this species. ES field data indicated that the track survey data collected by Dr. Barrows provided a good index of actual population. In 2012, monitoring protocols for this species were presented along with protocols for monitoring habitat and several other MSHCP-covered species in the Coachella Valley Multiple Species Habitat Conservation & Natural Community Conservation Plan Aeolian Sand Communities and Species Monitoring Protocols (CVCC 2012a).

In 2009 and 2010, the Coachella Valley Conservation Commission (CVCC) funded baseline surveys of plant and animal species including the flat-tailed horned lizard, Coachella Valley milk-vetch, and other blowsand-associated species. Coachella Valley milk-vetch counts have also been conducted by UCR staff within the Refuge's active sand dune habitat in association with their fringe-toed lizard surveys. A summary report of the results of these surveys is provided annually to the CVCC. Plant densities are low enough that total number of plants can be counted and converted to densities per 0.1 hectare for comparison with other habitats.

Habitat manipulation within the fragile dune habitat has been limited to the occasional removal of invasive plants to maintain quality habitat for the fringe-toed lizard. Invasive plant control has involved hand pulling of invasive annual weeds and the mechanical and chemical control of salt cedar (*Tamarix* sp.) that has colonized portions of the sand dunes. This work typically occurs once a year for a period of about one week.

An important aspect of protecting the sensitive species on the Refuge has been the protection and preservation of the "aeolian" (wind-blown) sand communities. At the landscape level, efforts are underway to preserve open space and sand sources upwind of the Refuge. At the Refuge level, managers are focused on maintaining the biological integrity provided by the aeolian communities.

In 2013, the Refuge, through the Service's student temporary employment program, hired a local college student as a part time employee for the purpose of overseeing conditions on the Refuge, documenting and reporting management issues, maintaining signs and fencing, and assisting University of California, Riverside (UCR) researchers with species monitoring.

Sahara mustard, a persistent invasive species, has in recent years blanketed the Refuge along with much of the low southwestern deserts. This plant has the potential to stabilize sand dunes, thereby reducing the shifting sand environment that the Coachella Valley fringe-toed lizard depends on. Furthermore, it may compete with endangered or threatened plants present on the Refuge. Sahara mustard also provides the fine fuels that may carry wildfire throughout an area where little fine fuels historically existed. Limited control of this species in the form of hand removal has been implemented in the past few years on the Refuge.

3.5.4 Ongoing and Future Refuge Management Actions and Programs

Of the management alternatives addressed in the draft CCP/EA for the Coachella Valley NWR, we selected Alternative B as the alternative that would most effectively achieve the Refuge purposes, goals, and objectives. The details of the selected plan are illustrated in Figure 3-12 and described here.

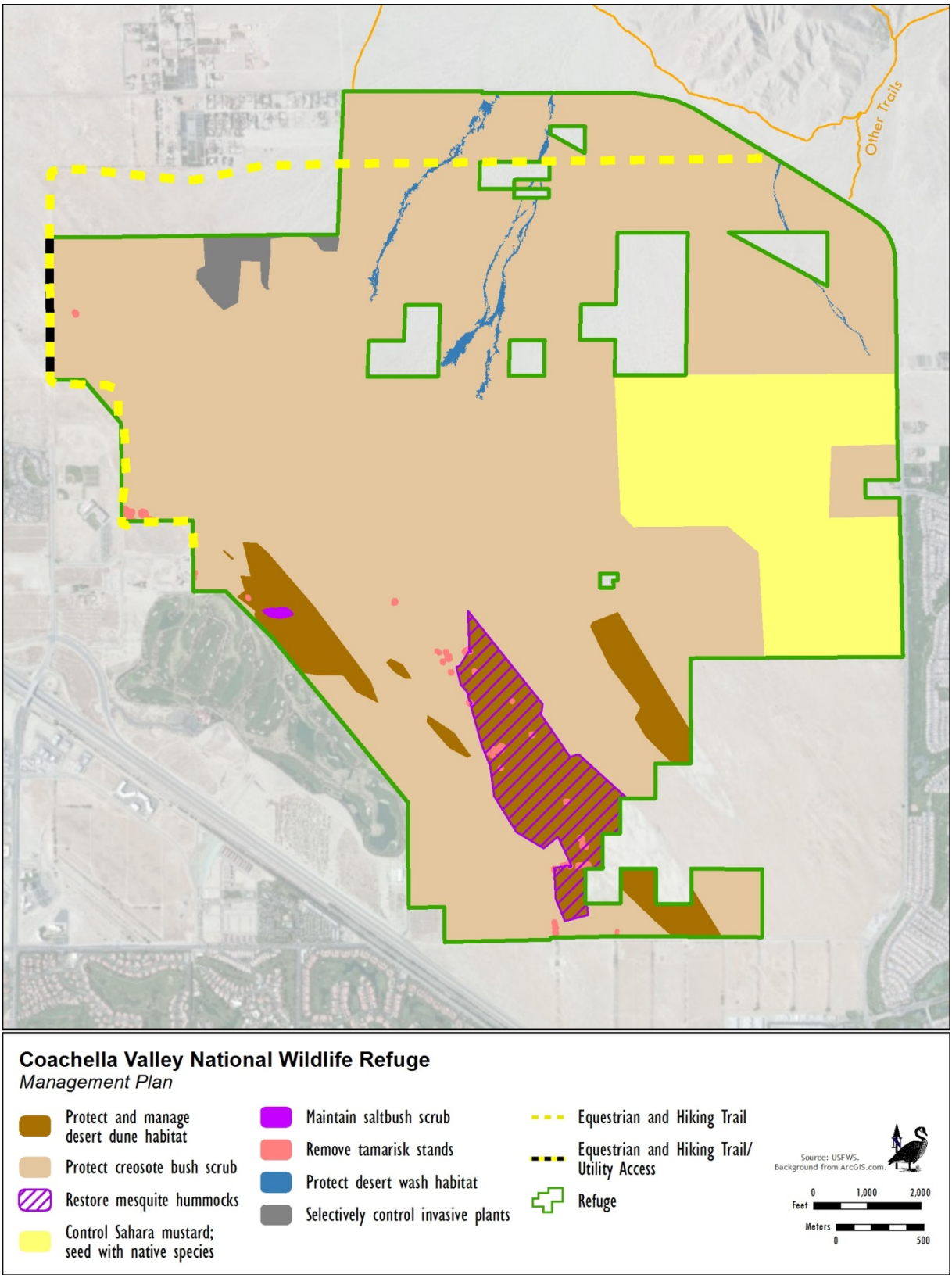


Figure 3-12. Management Plan for the Coachella Valley NWR

3.5.4.1 Wildlife and Habitat Management

The primary focus of the management on the Coachella Valley NWR will continue to be the protection, management, and monitoring of the Refuge's naturally occurring aeolian sand communities (e.g., active dunes, stabilized dunes (also referred to as mesquite hummocks), ephemeral sand fields, and stabilized sand fields) that support the federally listed Coachella Valley fringe-toed lizard and Coachella Valley milk-vetch, as well as a number of other species covered under the Coachella Valley MSHCP. Associated actions include surveillance and enforcement of Refuge regulations intended to avoid impacts to aeolian sand communities from unauthorized human and vehicular access; species and habitat monitoring; addressing sand transport issues both locally and regionally in partnership with other agencies and land managers; and controlling invasive weedy plants, particularly Sahara mustard, per available funding and staffing.

With some exceptions, the actions carried out on the Coachella Valley NWR have been conducted by Refuge personnel stationed at the Sonny Bono Salton Sea NWR, located about 80 miles from the Coachella Valley NWR. The Refuge does receive management support from Center for Natural Lands Management staff and volunteers who work out of the Thousand Palms Oasis Preserve site, and monitoring is coordinated through the CVCC. The CCP proposes the addition of a dual function refuge manager/Federal wildlife officer to the Refuge Complex organization chart. Filling this position would allow a permanent full-time staff member, with management and enforcement capabilities, to be assigned to this Refuge.

Habitat Protection

In contrast to the intensely managed habitats within Sonny Bono Salton Sea NWR, management of the Coachella Valley NWR focuses on the protection of the Refuge's native aeolian sand communities, an action critical to achieving Refuge purposes. Surveillance, which is conducted in partnership with other agencies, is and will continue to be conducted to deter unauthorized access onto sensitive habitat areas and fencing and signs are maintained to deter off-highway vehicle activity.

Illegal vehicle activity damages sensitive plants, spreads weed seeds, and kills reptiles and other wildlife (USFWS)

Sand fences have been installed on the Refuge by CVAG over the years to help keep sand on the Refuge and enhance active dune formation to support the Coachella Valley fringe-toed lizard, Coachella Valley milk-vetch, and other endemic dune species. These fences generally do not require maintenance; those that are working as intended simply become covered by sand to form new dune habitat and slow the loss of sand from the Refuge.

The County of Riverside Transportation Department (County DOT) has historically assisted in sand management by disposing of accumulated sand from the Preserve on the Refuge. Specially, when sand accumulated on Washington Street and 38th Avenue, County DOT through an informal agreement with the Refuge would remove the sand from roadways adjacent to the Refuge and deposit it back onto the north end of the Refuge. It is unclear if this practice will continue beyond 2013.

Invasive Plant Control

The control of invasive plants on the Refuge is an important component of habitat protection. Invasive plant control will be implemented in accordance with the Integrated Pest Management (IPM) Plan (Appendix G) prepared for the Sonny Bono Salton Sea NWRC in association with the CCP. Invasive plant species, particularly annual weeds, represent a threat to listed and sensitive species on the Refuge because of the impact they can have on habitat quality and individual native plants. Invasive plants can cause impacts through the physical alteration of the environment, as well as through completion with native plants for water, space, and sunlight. The invasive species of particular concern on the Refuge is Sahara mustard, although other nonnative species including cranesbill (*Erodium circutarium*) and various nonnative annual grasses are also present and could impact the productivity of the Refuge's native plant species. The nonnative shrub, salt cedar, is also an invasive species of concern within the Refuge's dune habitat.

Until recently, sporadic, local control of Sahara mustard was conducted by hand removal of plants within the dune habitat. Elsewhere on the Refuge, mechanical and chemical control of salt cedar has been implemented over the years. In 2011, a research investigation into the use of glyphosate to control Sahara mustard was conducted on the Refuge. Based on the results of the investigation, which indicated that proper timing of the use of herbicides could help control invasive plants while avoiding impacts to sensitive native species, a combination of hand removal and chemical control of invasive weeds in dune habitat began in 2010.

The implementation of the IPM Plan prepared for the Refuge Complex will assist in addressing the goal in the Valley Floor Reserve Management Unit Plan (CVCC 2012b) related to preventing new invasive species infestations within the larger Reserve and reducing or controlling current infestations. A general summary of the IPM Plan for the Refuge Complex has been provided previously in the Sonny Bono Salton Sea NWR discussion. Those aspects of the IPM Plan that specifically relate to the Coachella Valley NWR are presented here.

Tackling the Sahara mustard infestation on the Refuge requires a long-term approach to control that will require a combination of both physical/mechanical control and chemical control. Physical/mechanical control will involve primarily the hand pulling of weeds, although the use of hand tools and the occasional use of power tools may also occur when deemed appropriate by the Refuge wildlife biologist.

Hand pulling of Sahara mustard plants will continue, but this practice will be supplemented with the localized use of herbicide. Initially, the Refuge proposes to use glyphosate to provide local control of Sahara mustard in areas most vulnerable to impacts from infestation. Using backpack sprayers, the herbicide will be applied to the leaves and stems of the mustard plants prior to flowering. Because Sahara mustard germinates earlier than the Refuge's native annuals, herbicide application would occur in late winter or early spring depending upon the particular year's rain pattern. Depending upon the rainfall pattern in the spring, additional treatment may be necessary if new mustard plants are found to be germinating.

Outside of the dune habitat, efforts to hand hoe large stands of mustard when the plants are in the rosette or early stages of flowering may be attempted in an effort to reduce the plant's seed bank on the Refuge (Graham et al. no date). Weed whipping and mowing in areas that do not support sensitive habitat would only be considered if it could be implemented in association with the application of an herbicide immediately following mechanical control. Mechanical control would remove flowers before fruit could be produced on the plants, but without chemical control, the mustard plants would continue to grow producing new flowers and fruit

stalks. In some cases, this form of mechanical control has been shown to stimulate vigorous regrowth in Sahara mustard. Following control of a particular area, an appropriate native annual seed mix would be distributed over the site.

Research on the most effective control techniques for Sahara mustard without impacting the native plants that occur in the same areas is being conducted by various universities in California, Nevada, and Arizona, as well as by USGS. Appropriate research will be supported on the Refuge and the results of the various research efforts in the region will be considered in developing a long-term control plan of this invasive plant on the Refuge.

Herbicides proposed for use on the Refuge will be evaluated by the IPM Regional Coordinator for potential effects to Refuge biological resources and environmental quality. The results of this evaluation are documented in "Chemical Profiles." Chemical profiles have already been completed for the herbicides approved for use on the Coachella Valley NWR through the PUP process and are available for review in Attachment B of Appendix G.

Current research indicates that the herbicides glyphosate and triclopyr have varying degrees of effectiveness on the control of Sahara mustard (Graham et al. no date). Additional research may identify new, more effective herbicides in the future. Herbicides are also an effective tool for controlling individual salt cedar shrubs present in sensitive habitat areas. Whenever herbicides are considered for use on the Refuge, only those herbicides likely to result in minor, temporary, and/or localized effects to species and environmental quality based upon non-exceedance of threshold values in Chemical Profiles will be approved for use on the Refuge. In addition, BMPs will be implemented during the handling and application of all pesticides. For some herbicides, non-exceedance of threshold values may be achieved through the implementation of herbicide specific BMPs that further define how, when, where, and to what extent a specific pesticide may be applied. Table 3-4 lists those herbicides that currently have the potential for use on the Refuge. As stated here, additional herbicides may be proposed in the future that would be evaluated through the procedures described in the IPM Plan (Appendix G).

Table 3-4
Pesticides that May be Proposed for Use on the Coachella Valley NWR

Active Ingredient	Common Product Name(s)	Target Pests	Habitat Type	Application Method(s)	Application Equipment(s)
Glyphosate	Roundup, Roundup Pro	Sahara mustard, cranesbill	sand dune, sand field	foliar	backpack sprayer
Imazapyr	Stalker	salt cedar	sand dune, sand field	foliar cut stump	backpack sprayer hand-held sprayer
Triclopyr	Garlon 3A, Remedy	Sahara mustard	sand dune, sand field	foliar	backpack sprayer

Another form of invasive plant control to be implemented on the Refuge involves surveillance and prevention. Early identification and control of new invaders can prevent the establishment of nonnative species within the Refuge. New invaders identified during surveillance should be removed well before they flower and produce seed. To reduce the potential for invasion, soil disturbance by vehicles, equipment, or other activities will be minimized, and movement of vehicles, people, and soil between infested and uninfested areas will be avoided.

Habitat Enhancement

Approximately 400 acres of disturbed habitat are located in the eastern portion of the Refuge. This site, referred to as the old vineyard site, was under cultivation prior to Refuge establishment. In 2013, the site supported primarily Sahara mustard and other weedy vegetation. The Sahara mustard infestation limits the habitat quality of the area for most native species, including the flat-tailed horned lizard. In an effort to restore habitat value in this area, the CCP proposes the phased control of the invasive plants in this area (refer to Figure 3-12), per available funding and staffing. This enhancement project will be implemented using a combination of mechanical and chemical control. Following control of an area, native seeds would be distributed to promote the establishment of native creosote bush scrub habitat. Individual creosote and mesquite bushes in the area would be protected in place. The specifics of this phased habitat enhancement project would be more fully defined in a step-down Habitat Management Plan (HMP) for the Refuge. Implementation of this action would improve habitat quality on the Refuge for the flat-tailed horned lizard, while also reducing the Sahara mustard seed bank present on the Refuge.

Species Monitoring

Species monitoring on the Coachella Valley NWR is conducted in accordance with the Coachella Valley Multiple Species Habitat Conservation & Natural Community Conservation Plan Aeolian Sand Communities and Species Monitoring Protocols (CVCC 2012a). These monitoring protocols cover active sand dune, ephemeral sand field, stabilized sand field, stabilized sand dune (Mesquite hummock) communities, as well as the following species: Coachella Valley fringe-toed lizard, flat-tailed horned lizard, giant sand-treader cricket, Coachella Valley milk-vetch, round-tailed ground squirrel, and Coachella Valley Jerusalem cricket.

Species monitoring and data collection are critical to effective management (USFWS)

As described in detail in the Coachella Valley Multiple Species Habitat Conservation Plan & Natural Community Conservation Plan Biological Monitoring Program Draft 2012-2013 Year-End Report (CVCC 2013), this monitoring framework was designed to inform the CVCC, wildlife agencies, and resource managers of the status of the Coachella Valley MSHCP's covered species and communities. Its purpose is to assess the success the Coachella Valley MSHCP has in meeting its biological conservation goals, and to quantify the risk and urgency for any management actions that may be needed to support the continued sustainability of covered species and communities.

The biological monitoring program involves several fundamentally different types of monitoring, representing a variety of different spatial, temporal, and functional scales (CVCC 2013). Species monitoring provides an assessment of covered species' abundances and/or occurrences as well as a determination of whether changes in those metrics constitute a need for new management actions. Community monitoring creates a context for understanding observed species dynamics as well as provides a measure of the condition of the covered communities. While community monitoring addresses the condition of habitat patches, landscape monitoring considers size, location, and distribution of these patches along with connecting corridors, and their dynamics over time in response to variation in natural and anthropogenic stressors (CVCC 2013).

The CCP advocates increased participation by Refuge staff in monitoring activities on the Refuge. Therefore, the Refuge will, per available funding and staffing, take a more active role in annual aeolian sand communities and species monitoring on the Refuge per established protocols, through a cooperative effort with other Coachella Valley MSHCP partners.

Sand Transport

Refuge staff will work with other agencies and research partners to develop and jointly implement a long-term sand transport monitoring plan for the Thousand Palms Conservation Area. In addition, the effectiveness of existing sand fences on the Refuge will be evaluated and those fences that were installed some years ago that continue to remain exposed will be considered for removal and possible relocation within the Refuge.

The reestablishment of mesquite hummocks on the Refuge is also proposed as a potential means for trapping sand on the site. Mesquite hummocks, which were historically supported on the Refuge, can reduce the rate at which blowsands are carried off the Refuge. A combination of factors are likely responsible for the loss of mesquite vegetation on the Refuge, including the significant lowering of the groundwater table over the past 50 years due to groundwater pumping to support development and agriculture in the region and drought.

The development of a mesquite restoration plan was initiated for the Coachella Valley in 2011 by the CVCC and as of 2013, plan development was ongoing. This plan is expected to include a constraints analysis detailing site conditions where stands of mesquite (defined by leaf area and fruit production) are currently doing well or are declining or absent. This constraints analysis will form the basis of a draft restoration plan, which will be submitted to the CVCC and other agencies for comments.

Should restoration of mesquite be initiated on the Refuge, it will likely require some form of irrigation (e.g., extension of water lines, use of a water truck) or an alternative source of water such as DRiWATER or similar time-release water product. The successful reestablishment of honey mesquite on the Refuge would be expected to promote the creation of mesquite hummocks, slow sand loss from the site, and assist in preserving habitat to support the Refuge's listed and MSHCP covered species.

Monitoring the Effects of Climate Change

Refuge staff will continue to work in partnership with other land managers and researchers to identify funding for developing and implementing expanded monitoring programs that focus on the effects to habitats and species of changing climatic conditions. Monitoring programs will be designed to address key questions about how management actions can be adapted to facilitate species sustainability in the Coachella Valley (CVCC 2013), as well as provide important data related to species population trends and habitat conditions within the Coachella Valley MSHCP planning area.

Coachella Valley MSHCP Reserve Management Unit Plan

In January 2012, a Reserve Management Unit Plan was approved for Reserve Management Unit 1 (Valley Floor) (CVCC 2012b). The Thousand Palms Conservation Area, of which the Refuge is a part, is included within this Management Unit. The purpose of the Reserve Management Unit Plan is to provide a framework for facilitating collaborative management by all of the involved management entities (i.e., Federal, State, local, non-profit organizations) within the Management Unit. This collaborative effort will provide for effective, efficient, and cooperative use of available resources. The management goals presented in the Reserve Management Plan include:

- Prevent the establishment of new infestations of invasive plants and animals and reduce or control current infestations;
- Maintain essential hydrological processes to support the species and natural communities addressed by the Coachella Valley MSHCP, with the primary targets of maintaining adequate ground water levels and sand source/transport mechanisms;
- Ensure that species have the ability to shift their range in response to the effects of climate change on habitat and the distribution of natural communities;
- Avoid or minimize the potential for and effect of habitat fragmentation from causes including infrastructure and other development in the Conservation Areas, and edge effects from adjacent development;
- Prevent damaging wildfires that reduce the ability of the Reserve Management Unit to support the species and natural communities addressed by the Coachella Valley MSHCP and evaluate and use prescribed fire in specified areas if determined appropriate;
- Minimize the impacts of existing and potential new power and gas lines in the Reserve Management Unit;
- Identify, restore, enhance, and protect key sand transport locations and processes;
- Identify, implement, and maintain appropriate habitat enhancement and restoration projects;
- Provide for public access and use of Reserve System lands consistent with the conservation goals and objectives of the Coachella Valley MSHCP and ensuring public safety; and
- Maintain the Reserve Area free of dumping and hazardous materials through prevention and quick cleanup of materials that are dumped on Reserve Lands.

Some of these goals can be addressed at the local preserve level, but several require the implementation of actions at the larger landscape level.

3.5.4.2 Public Use

Public access onto the Refuge is and will continue to be limited to occasional guide tours which are regulated through the Refuge Special Use Permit process, as well as equestrian and hiking trail use on a designated trail route established in 1990 (refer to Figure 3-12). The guide tours, which are generally conducted by Center for Natural Lands Management staff, facilitate wildlife observation, photography, and interpretation. Some informal interpretation of the resources protected on the Refuge also occurs at the Center for Natural Lands Management's Thousand Palms Oasis Preserve site.

Equestrians and hikers are also provided with opportunities for wildlife observation and photography from the designated trail corridor that extends through the upper portion of the Refuge. To avoid adverse effects to listed species, trail users are required to stay on the designated trail at all times and dogs and other pets are prohibited on the trail and throughout the Refuge.

A few outside research projects and resource surveys have been conducted on the Refuge, most related to listed species. Research projects and surveys conducted on the Refuge by outside individuals, organizations, or agencies that are not directly related to Refuge management may only be conducted after a Special Use Permit (SUP) has been issued by the Refuge Manager. The SUP documents the purposes of the work to be conducted and includes specific conditions intended to protect trust resources and ensure adherence to applicable Refuge regulations and policies.

The Refuge will continue to develop research partnerships with academic institutions, and other public (e.g., USGS), private, and non-profit researchers, particularly for research that can benefit Refuge management and/or Refuge resources. Potential research topics include but are not limited to the effects of climate change on the Refuge's listed and sensitive species; the effects of invasive species on the Refuge's listed species populations; and the effects of herbicide use on annual plant production in blowsand habitats.

Public outreach and interpretation related to Refuge's purposes and Refuge resources will be expanded to include the design and development of off-refuge interpretative elements. Per available funding, a permanent display will be created for installation at an offsite facility such as the Coachella Valley Preserve Visitor Center and a traveling display will be designed and fabricated for temporary display at schools, libraries, and other public facilities in the area.

3.5.4.3 Refuge Operations

To achieve the goals and objectives of the CCP and implement the associated strategies, the CCP proposes to expand the staff of the Sonny Bono Salton Sea NWR Complex to include a dual function refuge manager/Federal wildlife officer, who would dedicate a minimum of 25 percent of the time to law enforcement activities on both the Coachella Valley and Sonny Bono Salton Sea NWRs. The remaining time would be dedicated to management activities on the Coachella Valley NWR, including habitat and species management, species surveys and monitoring, general site maintenance and protection, managing and expanding current partnerships, and coordinating with the Valley Floor Resource Management Committee and CVCC.

The equipment needed to support this Refuge is maintained at the Sonny Bono Salton Sea NWR or at facilities maintained by Center for Natural Lands Management. No buildings, utilities, or parking areas are present on the Refuge. The only structures present on the Refuge are perimeter fences, sand fences, signs, and the existing equestrian and hiking trail. Sand fences were most recently installed in 2006 by CVAG.

Law Enforcement

As of 2013, the Sonny Bono Salton Sea NWR Complex did not have a Federal wildlife officer on staff; instead, law enforcement throughout the Complex is conducted by the Service's Southern California Zone Officer, as well as BLM, California State Parks, and local law enforcement staff under an interagency agreement established through Coachella Valley MSHCP. Creating and filling a dual function refuge manager/Federal wildlife officer position would enhance Refuge management capabilities.

Fire Management Plan

The Coachella Valley NWR does not currently have a fire management plan. In 2003, the Service exempted the Refuge from developing a Fire Management Plan due to lack of burnable vegetation, lack of ignition sources, no established fire management program, and no reason or plans to conduct prescribed burning.

Mosquito Management

No mosquito management is conducted on the Refuge.

Cultural Resource Management

As described previously, a Cultural Resources Review was conducted to provide the Refuge Manager with pertinent information about the cultural resources within the Refuge Complex,

including the Coachella Valley NWR. Because there is the potential for undiscovered cultural resources to be present within the Refuge, any ground disturbing activities proposed within the Refuge boundary are reviewed by the Service's Cultural Resources Program for compliance with Section 106 of the Historic Preservation Act. The review process involves the preparation of a Request for Cultural Resources Compliance, which is submitted, to the Regional Cultural Resources Office for review. Those projects that would result in only minor impacts to subsurface materials could fall under the Service's programmatic agreement with SHPO, while other projects requiring greater ground disturbance would require SHPO review and concurrence. The Sonny Bono Salton Sea NWR Complex will also work with the Regional Archaeologist to development procedures (that would be formalized through a Memorandum of Understanding with the appropriate tribal representatives) to be implemented in the event of a NAGPRA-related discovery during the implementation of a Refuge-related project.

Environmental Contaminants Coordination

The Service's Environmental Contaminants (EC) Program is available to assist the Refuge Manager in issues related to contaminants, as well as to conduct studies related to the effects of contamination on Refuge trust resources. The EC Program also assists the Refuge on pre-acquisition environmental contaminants surveys. Refuge staff will continue to coordinate with the EC Program on environmental contaminant issues as they arise.

Volunteers, Partners, and Public Outreach

Partnerships play an important role in the management of this Refuge. Over the years, Federal, State, local, and non-profit organizations have assisted in the management and operation of the Refuge. This assistance has ranged from law enforcement assistance from BLM to sand fence installation by CVAG. Staff and volunteers from the Center for Natural Lands Management, and before that from The Nature Conservancy, have assisted with weed control, interpretation, and public outreach. The Refuge will continue to work with existing partners and volunteers, in an effort to address Refuge specific and region-wide issues and needs. When staff is available, a public outreach program will be developed to identify surrounding residents interested in volunteering for activities related to weed control and habitat enhancement. Additionally, volunteers will be sought to assist the Refuge in disseminating information at various off-refuge locations that addresses the importance of the Refuge in preserving the area's diminishing native aeolian sand habitats and the specialized species present within these habitats.

4. Refuge Resources

4.1 Introduction

Each of the two Refuges within the Sonny Bono Salton Sea NWRC protects very different habitats and species; therefore, this Chapter presents on overview of the regional setting, followed by separate descriptions of the various physical, biological, cultural, social, and economic resources within the Sonny Bono Salton Sea NWR and Coachella Valley NWR.

4.2 Regional Setting

The Refuges of the Sonny Bono Salton Sea NWRC are located within the 8,360-square-mile Salton Basin (also referred to as the Salton Trough), a large natural depression that extends for almost 200 miles through the Colorado Desert (a portion of the larger Sonoran Desert) from a narrow point at the base of the San Gorgonio Pass in Riverside County trending southeast to the Gulf of California in Mexico (refer to Figure 1-1). The basin, which is the result of a deep, down-dropped fault block, occurs along the San Andres Fault at a point where two major tectonic plates, the North American Plate and the Pacific Plate, move past one another.

The Salton Basin is flanked on the northeast by the San Bernardino Mountains and is within the rain shadow of the Peninsular Range, which borders the basin to the southwest. Most of the Colorado Desert lies at a relatively low elevation, below 1,000 feet, with the lowest point of the desert floor at approximately 275 feet below MSL. The summer daytime temperatures within the Colorado Desert are greater than the higher-elevation areas of the Sonoran Desert region and the occurrence of frost is extremely rare (CDFG 2007). Unlike the Mojave Desert to the north, which receives precipitation primarily during the winter months, the Colorado Desert, particularly the southern portion of the desert, generally experiences two rainy seasons per year, one in winter and another in late summer (CDFG 2007).

The Salton Basin is included within the Colorado Desert region of California's Wildlife Action Plan (Action Plan) (CDFG 2007). According to the Action Plan, the major stressors affecting wildlife and habitat within this region include water management conflicts and water transfer impacts; inappropriate off-road vehicle use; loss and degradation of dune habitats; disruption of sand transport processes; invasive plant species; and loss of habitat associated with growth and development. The Salton Sea and the Colorado River are identified by the Action Plan as the region's two most significant aquatic systems. A few of the conservation actions proposed by the Action Plan to restore and conserve wildlife in this region include: 1) maintaining and restoring the Salton Sea ecosystem in a form that provides vitally important aquatic habitats; 2) protecting and restoring biologically significant habitats in the Coachella Valley through cooperative actions involving Federal, State, and local agencies and nongovernmental conservation organizations; and 3) securing resources, including funding for research, monitoring, and integrated pest management, from Federal, State, and local agencies to eradicate or control and limit introductions of invasive species in the region (CDFG 2007).

The Salton Basin is also included within the boundaries of the Desert Landscape Conservation Cooperative (LCC), which encompasses portions of five U.S. states (i.e., Arizona, California, Nevada, New Mexico, Texas) and ten states in northern Mexico (i.e., Baja California, Sonora, Chihuahua, Sinaloa, Durango, Coahuila, Nuevo Leon, Zacatecas, Nayarit, San Luis Potosí, Aguascalientes). The U.S. Bureau of Reclamation and the Service are partnering to develop the Desert LCC, which represents a broad vision of conservation that includes working with partners

across landscapes to ensure that the necessary science capacity is in place to successfully address current and future conservation challenges (e.g., effects of long-term drought on the composition, abundance, and distribution of species; effect of reduced water availability on vegetation, wildlife, and human populations; changes in ecosystem productivity, structure, and composition resulting in changes in the rate of carbon sequestration and amount of carbon stored as biomass; changes in fire frequencies and intensities, due in part to the invasion of non-native grasses into native habitat areas). The Desert LCC will inform managers about potential impacts of climate change, develop adaptation strategies to assist in addressing these impacts, and provide a forum for on-going dialog between sciences and land managers.

4.3 Refuge Setting

4.3.1 Sonny Bono Salton Sea NWR

Environmental Setting

The Sonny Bono Salton Sea NWR is located in the southern portion of the Colorado Desert at the south end of the Salton Sea in Imperial County, California. As of 2010, the Refuge boundary encompasses approximately 32,410 acres of submerged land within the southern half of the Salton Sea and an additional 5,250 acres of upland and adjacent Salton Sea shoreline at the southeastern edge of the Sea (refer to Figure 1-2). Since 1995, the Salton Sea has been receding, resulting in approximately 700 acres of exposed playa on the Refuge. The Sonny Bono Salton Sea NWR is the only Refuge in the NWRS that is located entirely below sea level.

The manageable portions of the Refuge consist of two areas, Unit 1, located near the southwestern end of the Salton Sea, and Unit 2, which includes the Refuge Complex headquarters, Union Tract, and Hazard Tract (Figure 4-1). Unit 2 is located approximately 18 miles to the northeast of Unit 1, at the southeastern end of the Salton Sea. The lands that abut the Refuge generally support agricultural uses; however, several properties in the general vicinity of the Refuge that previously supported agricultural uses are now geothermal production sites.

Flyway Setting

The Salton Sea is considered one of the most important habitats for birds in North America, supporting some of the highest levels of avian biodiversity in the southwestern U.S. (Shuford et al. 2002, Patten et al. 2003). The results of a yearlong study of the birds utilizing the Salton Sea (Shuford et al. 2002) documented the importance of the Salton Sea within the Pacific Flyway for wintering, migratory, and breeding waterbirds. Various other studies indicate the Salton Sea is of regional or national importance to pelicans and cormorants, wading birds, waterfowl, shorebirds, and gulls and terns.

A California brown pelican and brown booby squabble over roosting rights (Mark Stewart/USFWS)

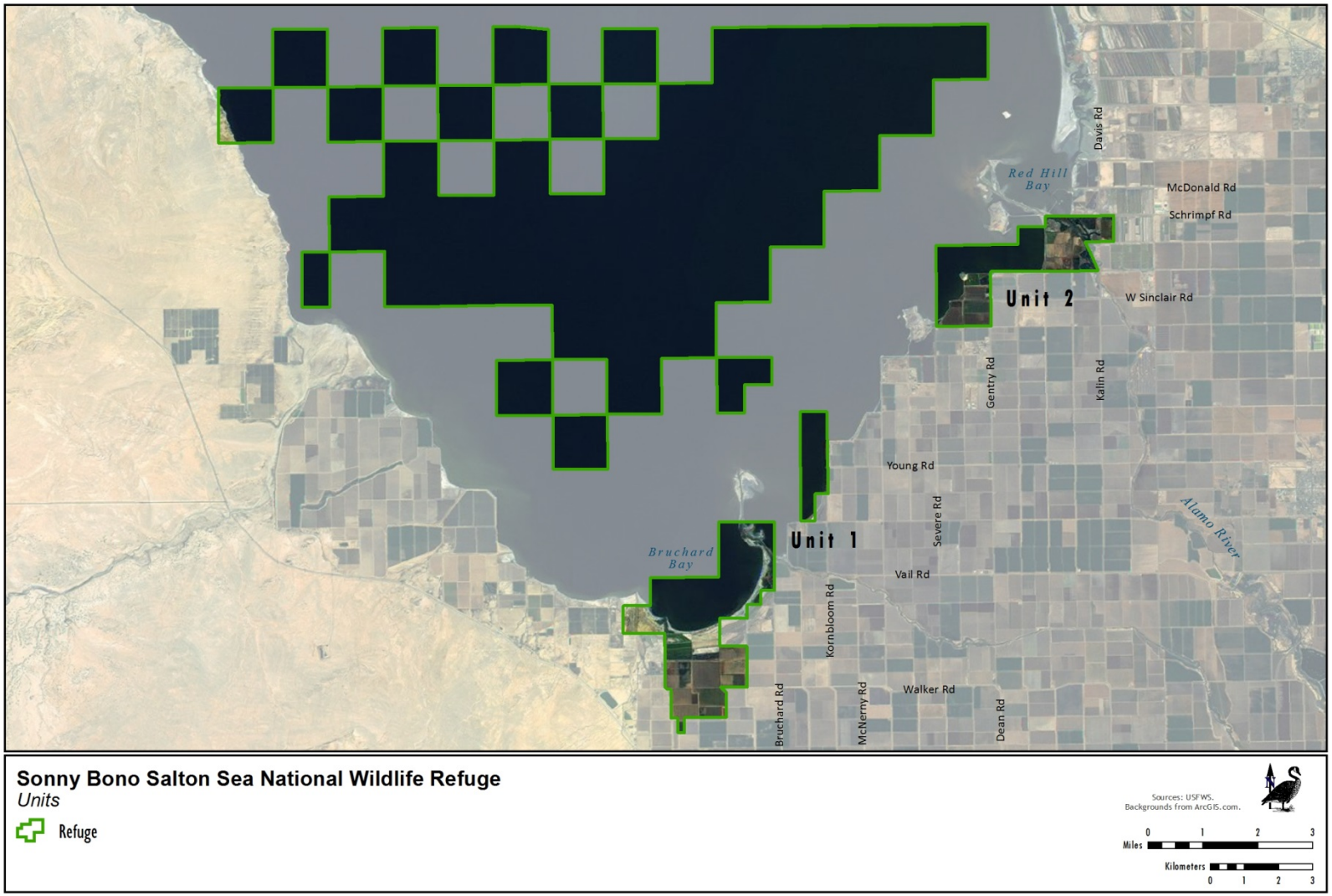


Figure 4-1. Units of the Sonny Bono Salton Sea NWR

According to Shuford et al. (2002), in terms of overall shorebird numbers, the Salton Sea is the most important area in the Intermountain and Desert region of the West in spring and the second most important, after Great Salt Lake, in fall. Further, anecdotal evidence suggests there is a strong shorebird migrant connection with the west coast of Mexico, the Gulf of California, and the Pacific Coast of the U.S., particularly in spring. The Salton Sea is also strongly linked to the Gulf of California by northward post-breeding dispersal of species such as the brown pelican, wood stork (*Mycteria americana*), laughing gull (*Larus atricilla*), and yellow-footed gull (*Larus livens*).

Historical Setting

A combination of upland and wetland habitats occurred within the original boundary of the Refuge when it was established, but by 1941, the elevation of the Salton Sea was -242 feet MSL and rising, with the vast majority of the original Refuge submerged beneath the Sea. In 1945, an agreement was reached with IID to allow the Refuge to reclaim and improve lands within the area that today is referred to as Unit 1. Little of this area had been farmed and what portion was farmed had been fallow since 1924. As a result, major land alteration (e.g., land leveling, ditch and canal construction) was required before the land could be used to support forage crops for wintering waterfowl. By 1947, all of the original Refuge lands had been inundated and today this area is located under the southern end of the Salton Sea. To support waterfowl management and other uses, the IID in 1947 made available for leasing approximately 24,000 acres of upland that was situated between the southern edge of the Salton Sea and private farmlands. A portion of this area was leased by the Service for the Refuge. A number of the parcels located within the area of the Refuge referred today as Unit 2 were acquired through lease or purchase in the late 1940s and early 1950s. The lands within Unit 2 were already productive when the Service initiated its management activities; therefore, no major land alteration was necessary.

By 1963, the elevation of the Salton Sea had risen to 231.65 feet below MSL, inundating all but about 4,415 acres of Units 1 and 2, and of that acreage, only 1,640 acres were suitable for uses that supported waterfowl and other waterbirds. Even the suitability of these lands was limited due to soil depletion and subbing (water movement in the soils) from the Salton Sea. Because of the lack of adequate farmland to raise cereal grain and green forage foods for waterfowl, impoundments were created in 1962 to produce alkali bulrush to supplement foraging opportunities for waterfowl. The ongoing management of these refuge lands is described further in Chapter 3.

4.3.2 Coachella Valley NWR

Environmental Setting

The 3,709-acre Coachella Valley NWR is located near the center of the Coachella Valley, to the northeast of Palm Desert, in an unincorporated portion of west-central Riverside County, California (Figure 4-2). Riverside County covers over 4.7 million acres (7,310 square miles), making it California's fourth largest county (CVAG 2007b). The Coachella Valley is a broad, low elevation, northwest to southeast trending valley that extends from the Santa Rosa and San Jacinto Mountains in the northwest to the Salton Sea in the southeast. The Refuge includes extensive sand dune and sand field habitat that once characterized much of the lower Coachella Valley. The Refuge's sand dunes and sand fields are identified as core habitat areas for a variety of species conserved by the Coachella Valley MSHCP.

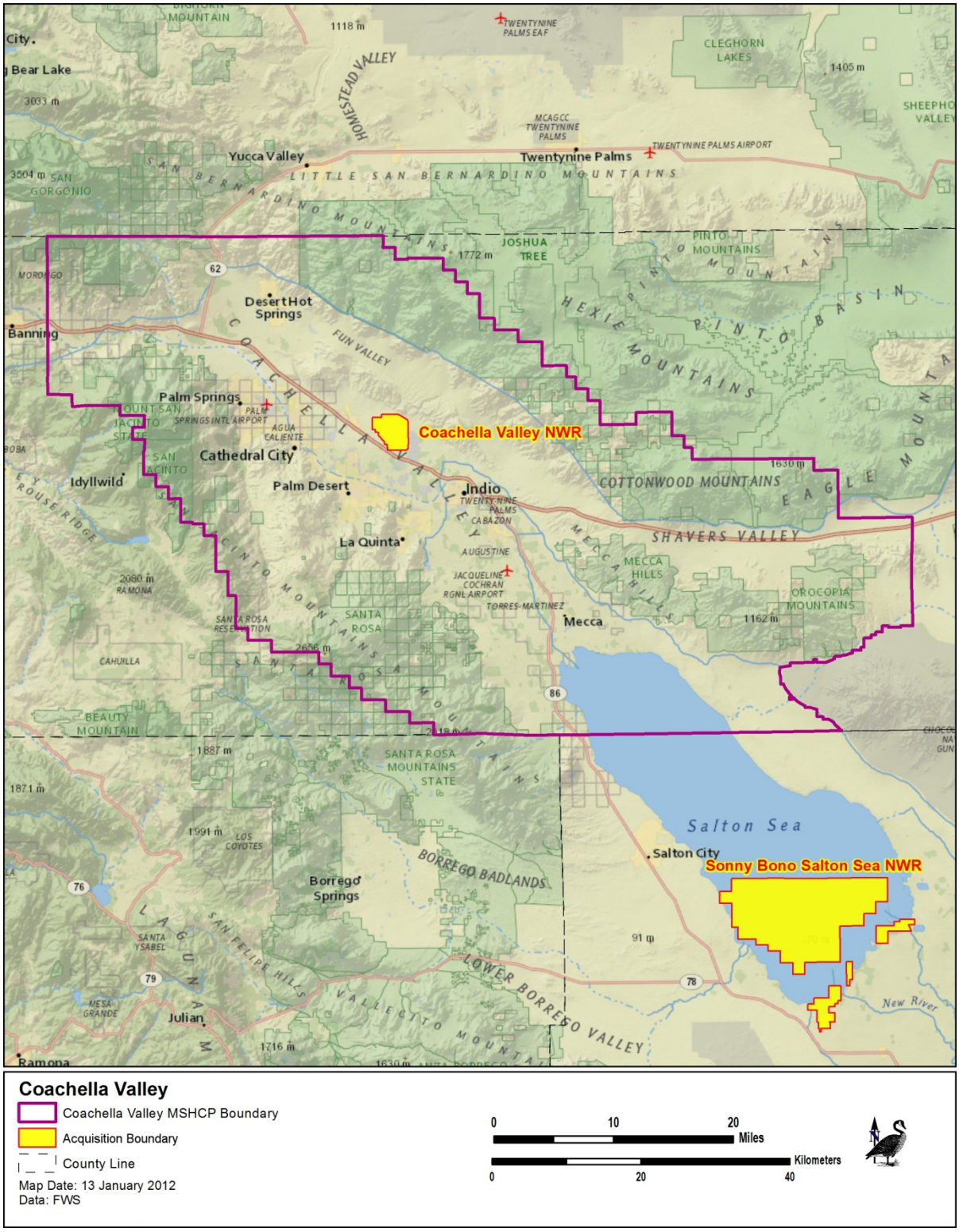


Figure 4-2. Regional Setting - Coachella Valley NWR

The Refuge, which is located within the Thousand Palms Conservation Area of the Coachella Valley MSHCP, is bounded to the south by 38th Avenue, to the east by Washington Street, and to the north by Ramon Road (Figure 4-3). Interstate 10 (I-10) is located approximately 0.5 mile southwest of the Refuge boundary. The area to the east of Washington Street includes a planned residential community, with a few larger residential lots located to the northeast. A small agricultural parcel (about 10 acres in size) is located to the northeast and to the south, southwest, and northwest are low-density residential developments. A golf course is located to the southwest of the Refuge and immediately to the southeast are conserved lands owned and managed by CDFW.

The Thousand Palms Conservation Area, established for the protection of desert sand dune habitat critical to the survival and continued viability of a variety of endemic species, contains more than 25,000 acres. The Refuge and adjacent CDFW land, as well as considerable acreage to the north and northeast of the Refuge are included within this preserve system. By 1996, approximately 16,810 acres of the Thousand Palms Preserve had been conserved, including approximately 3,620 acres of Refuge land (CVAG 2007c). Additional property has been acquired within the Refuge boundary since that time.

Historical Setting

The lands within the Coachella Valley NWR are part of the Coachella Valley's historical natural dune system. The Refuge is one of the last remaining strongholds for this once widespread, and unique "wind-blown sand" habitat. Although large areas of the Refuge may have at one time been impacted by unauthorized off-road activity, it appears that only the northeastern and northwestern portions of the refuge lands have experienced any significant alteration. Evidence of ground alteration associated with past agricultural activity on the Refuge is still visible on aerial photographs. These areas include approximately 400 acres along the northeastern edge of the Refuge and another 60 acres in the northwestern portion of the Refuge. The northern portion of the Refuge also includes remnants of old dirt roads. No buildings or paved roads are present on the Refuge.

4.4 Physical Environment

Elements of the physical environment include topography, visual quality, geology/soils, paleontology, agricultural resources, mineral and geothermal resources, hydrology/water quality, climate/climate change, air quality, greenhouse gas emissions, contaminants, and noise. No activities are proposed in proximity to sensitive noise receptors (e.g., housing, hospitals, libraries), therefore, there is no potential for significant adverse noise impacts as a result of implementing any of the potential management alternatives. As a result, no further noise analysis is required.

4.4.1 Topography/Visual Quality

4.4.1.1 Sonny Bono Salton Sea NWR

The lands within the Sonny Bono Salton Sea NWR are generally flat, situated between about -230 and -225 feet MSL, and with some exceptions, there is little visible variation in elevation either on the Refuge or on the majority of the adjacent lands. The most prominent features in the area are the Salton Buttes, five small rhyolite domes, present at the southeastern end of the Salton Sea. These include Obsidian Butte, located just to the west of Unit 2; Red Island, with two small domes that are located just to the north of Unit 2; Mullet Island, located to the north of Red Island; and Rock Hill, which is located on the Refuge to the northwest of the Refuge Complex headquarters.

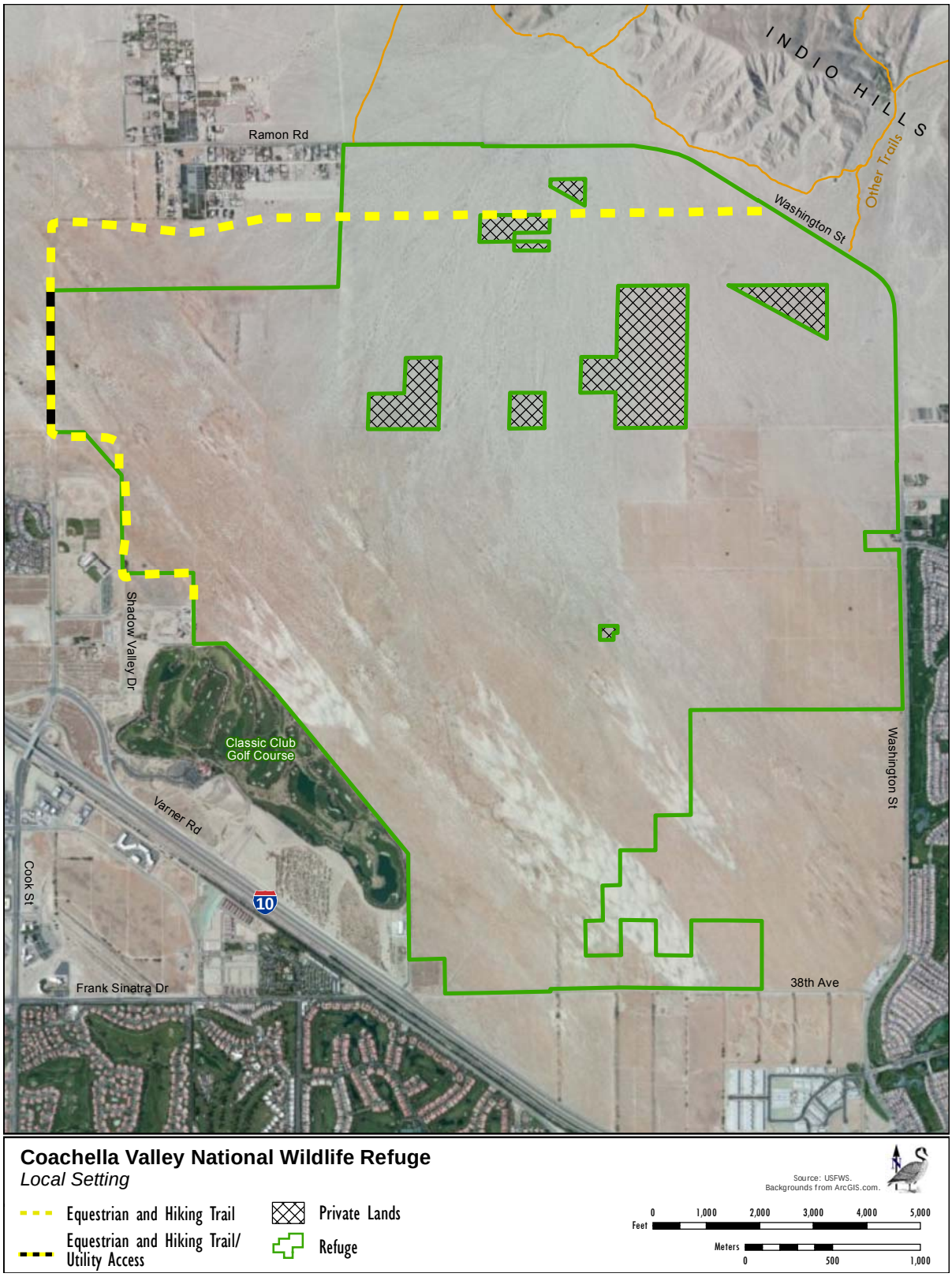


Figure 4-3. Local Setting - Coachella Valley NWR

The peak of Rock Hill ascends 92 feet above the adjacent Refuge lands, with an elevation at its peak of -138 feet MSL (Niland 7.5´ USGS quadrangle map).

Minor changes in the topographic character occur along the drainages and levees of the New and Alamo rivers, and along the major drains that have been constructed to direct agricultural runoff from upstream agricultural fields into the Salton Sea.

4.4.1.2 Coachella Valley NWR

The topographic character of the Coachella Valley is defined by three distinct topographic features, the valley flatlands, alluvial fans and washes, and mountains. Elevations on the valley floor range from 1,600 feet above MSL at the north end of the valley to 250 feet below MSL at the south end of the valley near Mecca, California. The major mountain ranges surrounding and defining Coachella Valley include the San Bernardino (north), Little San Bernardino (east), San Jacinto and Santa Rosa Mountains (west), and the Orocopia and Chocolate Mountains (southeast), with peaks ranging in elevation from approximately 9,600 feet to 11,502 feet MSL. Elevated terrain elsewhere includes the Indio Hills and the Mecca Hills. These contrasting viewsheds result in an exceptional display of open space and mountain scenery that enhances the aesthetic quality of the area (Conservation Biology Institute 2009, CVAG 2007b).

Within the boundary of the Refuge, the topographic relief is less varied, with the elevation gradually descending from north to south (Figure 4-4). The northern portion of the Refuge is situated at about 300 feet MSL, with the area of highest elevation, approximately 320 feet MSL, occurring at the northeast corner of the Refuge. The southern portion of the Refuge ranges from about 140 feet MSL at the southwest end to about 107 feet MSL at the southeast corner of the site.

The most notable visual features on the Refuge and adjacent Coachella Valley Preserve are the ever-shifting blowsand dunes and associated sand fields. Dunes and sand fields are archetypal desert visual resources with high visual value. In many areas, they are enhanced by the presence of mesquite hummocks that provide a vivid contrast of green against the light color of expanses of sand. In the spring, annual plants often provide added color to these areas.

Coachella Valley sand dunes and sand fields (USFWS)

The Refuge can be viewed from I-10, as well as from the distant Indio Hills to the northeast. Although Caltrans considers this segment of the I-10 to be eligible for designation as a State scenic highway, the County of Riverside has not taken action to officially designate it as such.

The immediate Refuge landscape and larger Coachella Valley basin and surrounding mountains can also be viewed from Refuge and Preserve trails. Currently, a 24-foot-wide corridor designed for public hiking, scenic viewing, and equestrian use occurs along the west Refuge boundary, and through the northern portion of the Refuge. The only structures present on the Refuge are a shed and pump house, constructed around 1975 prior to acquisition of the property by the Service.

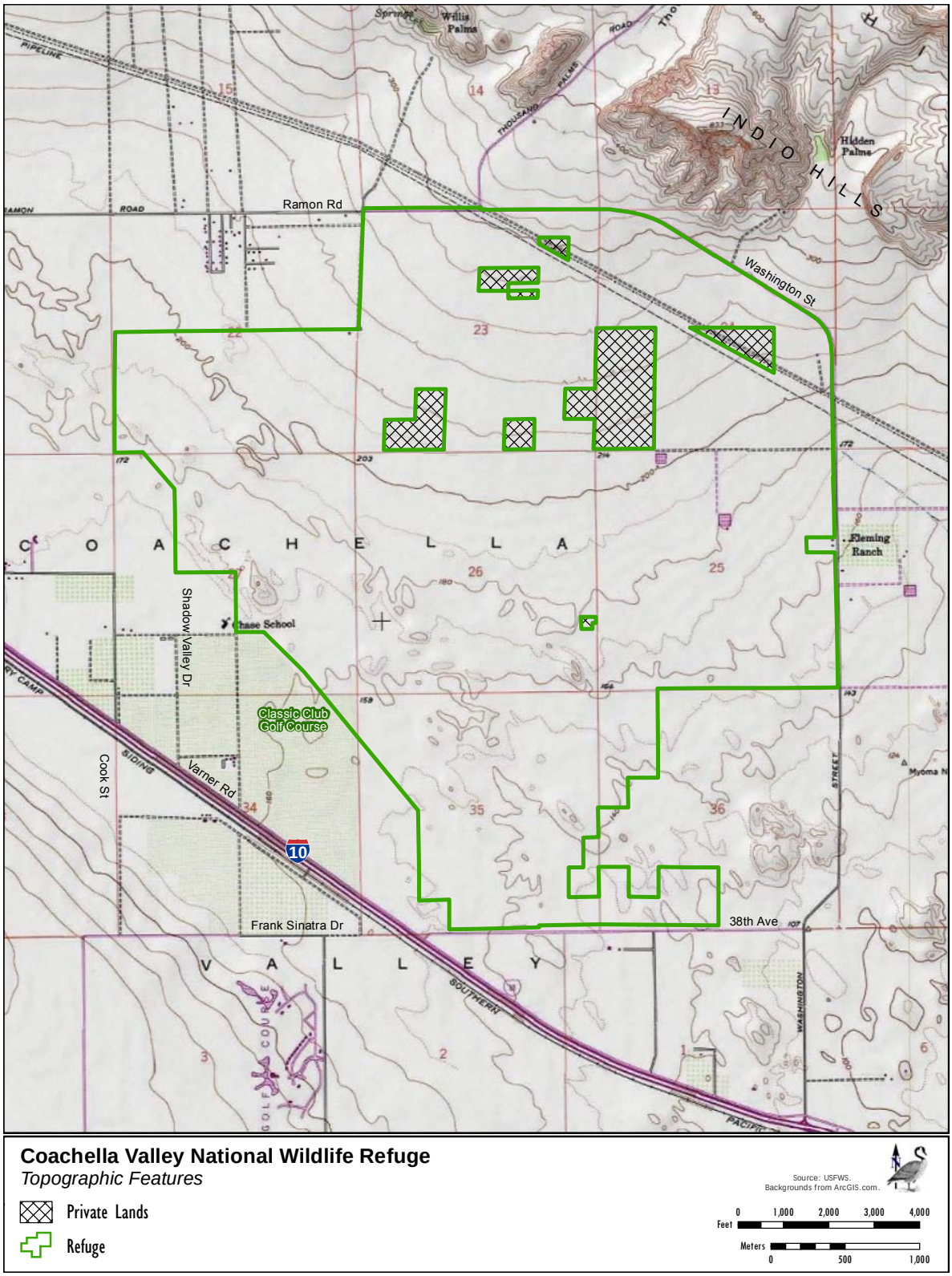


Figure 4-4. Topographic Features of the Coachella Valley NWR

4.4.2 Geology, Soils, and Geological Hazards

4.4.2.1 Sonny Bono Salton Sea NWR

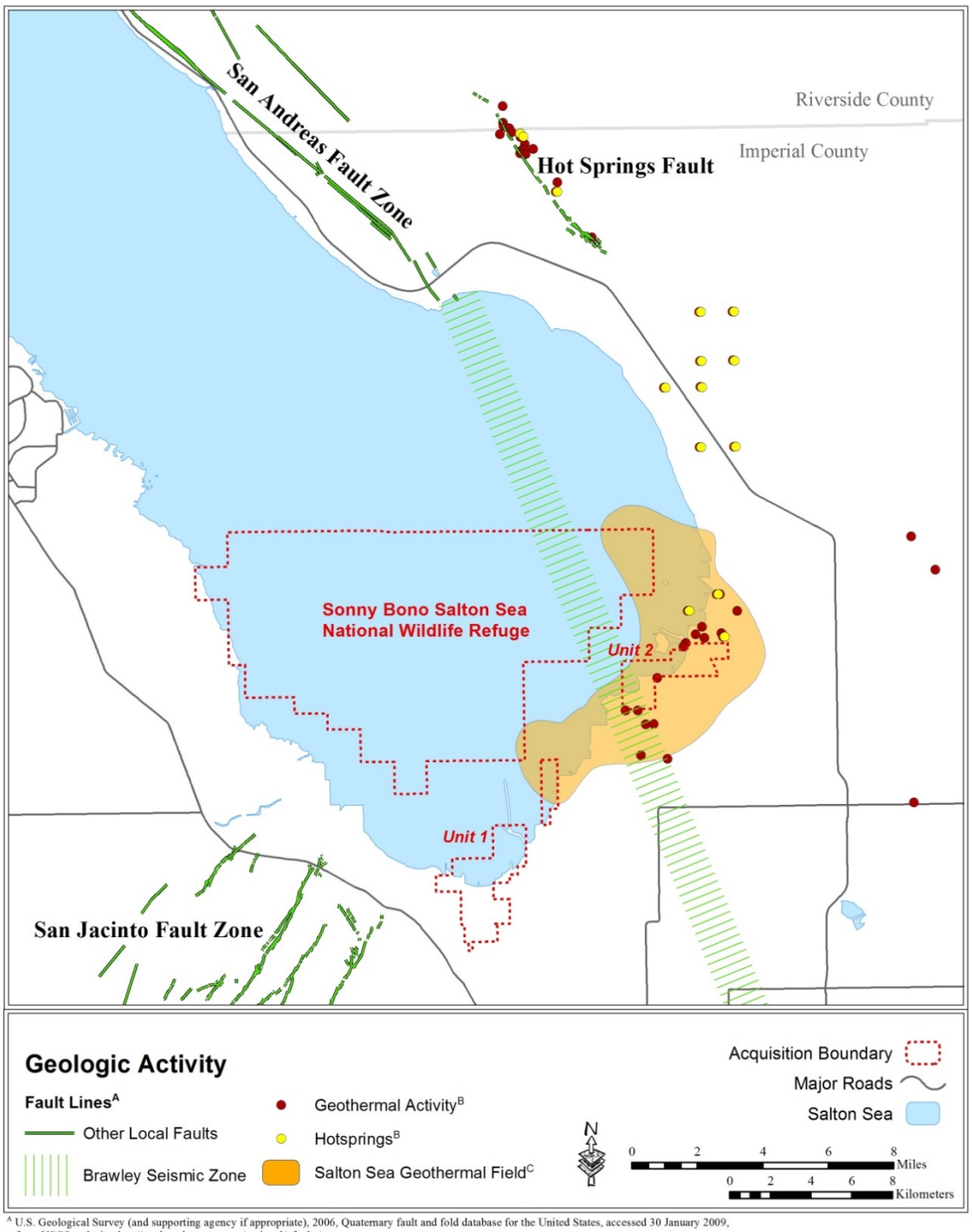
Geology. The Colorado Desert geologic province is bounded on the north by the Western Mojave Desert Province, to the east by the Basin and Range Province, and to the west by the Peninsular Range Batholith (Norris and Webb 1990). The Salton Basin is the province's dominant feature, extending 180 miles south from Palm Springs to the head of the Gulf of California.

Ancient tectonic plate movement created the geological formations and fault zones that today make up the Salton Basin, the area draining directly into the Salton Sea. Characteristics associated with the Salton Basin are high seismicity, extensional tectonics, crustal thinning, geothermal activity, and rapid sedimentation (URS 2004). Major strike-slip faults run in a northwest direction through the region as part of the San Andreas Fault Zone system: the Banning branch fault to the north and east, Imperial Fault to the south, San Jacinto Fault to the west, and Mission Creek Fault to the east. Within and near the Sea, the Brawley Seismic Zone and several smaller faults underlie the Refuge.

Frequent seismic activity reflects the southern part of the region's location as the spreading center between the North American and Pacific tectonic plates. As a result, the Basin is considered a "pull-apart basin" floored by thin, stretched continental crust (Norris and Webb 1990, URS 2004). The Salton Sea's surrounding mountains are generally made up of Precambrian sedimentary and volcanic rocks and Pre-Cenozoic metamorphic rocks, intruded by granitic rocks chiefly of Mesozoic age. In the lower elevations, younger deposits of Quaternary non-marine, marine, and alluvial sediments are found. Millions of years of deposits from the Colorado River delta have blocked the southern portion of the Basin from being inundated by the marine waters of the Gulf of California (Norris and Webb 1990).

Underlain by very thick land-laid deposits from the Cenozoic, the basin's floor has sunk due to the accumulated great weight and is presently hundreds of feet below sea level. Most recent deposits are associated with the ancient Lake Cahuilla when it occupied the basin during the late Pleistocene and possibly the early Holocene. This deposition layer ranges from six to 300 feet thick. The old Lake Cahuilla beds are soft, weakly consolidated siltstones and clays, which are easily cut into when sufficient runoff occurs. The lake's ancient shorelines, with an average elevation of 30 to 50 feet above MSL, are indicated today as darker rocks or pebble patterns on the landscape. Cause of the lake's multiple fillings over recent millennia was most likely the Colorado River changing course across its delta. Evaporation continually reduced the lake level and left a salty crust on the central area of the basin floor. Lake Cahuilla's most recent filling of the Salton Sink was probably between A.D. 900 and 1400. The Refuge lies on top of these Quaternary lake deposits (Norris and Webb 1990).

Geological Hazards. At the southeastern end of the Salton Sea, some low volcanic hills were formed probably during the Quaternary age. Between Obsidian Butte and Mullet Island (and near Unit 2 of the Refuge), these rhyolitic domes of pumice and obsidian continue to produce warm gases of steam, carbon dioxide, and hydrogen sulfide. Mud volcanoes, mud pots, and boiling springs are found in this area. Carbon dioxide wells were built in the 1920s but abandoned when the Salton Sea's level rose in the 1950s (Norris and Webb 1990). Due to the presence of multiple geothermal fields in the Salton Basin with reservoir temperatures greater than 150°C, geothermal power plants have been built and are in production in the Imperial Valley. Several wells are located south and east of the Refuge. The location of local geologic features in and surrounding the Sonny Bono Salton Sea NWR are presented in Figure 4-5.



[A] U.S. Geological Survey (and supporting agency if appropriate), 2006, Quaternary fault and fold database for the United States, accessed 30 January 2009, from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/.
[B] Redlands Institute, University of Redlands (2002).
[C] Hulen et al. (2002).

Figure 4-5. Local Geologic Features – Sonny Bono Salton Sea NWR

As one of the most seismically active regions in California, the Salton Basin produces a significant number of earthquakes of varying magnitude. The number of moderate to small earthquakes in the Imperial Valley area is greater than in any other section along the San Andreas Fault system (Hill et al. 1975). Plots of epicenters with a magnitude greater than 2 show a concentrated pattern along the San Jacinto and Imperial faults to the west and south of the Salton Sea (Figure 4-6).

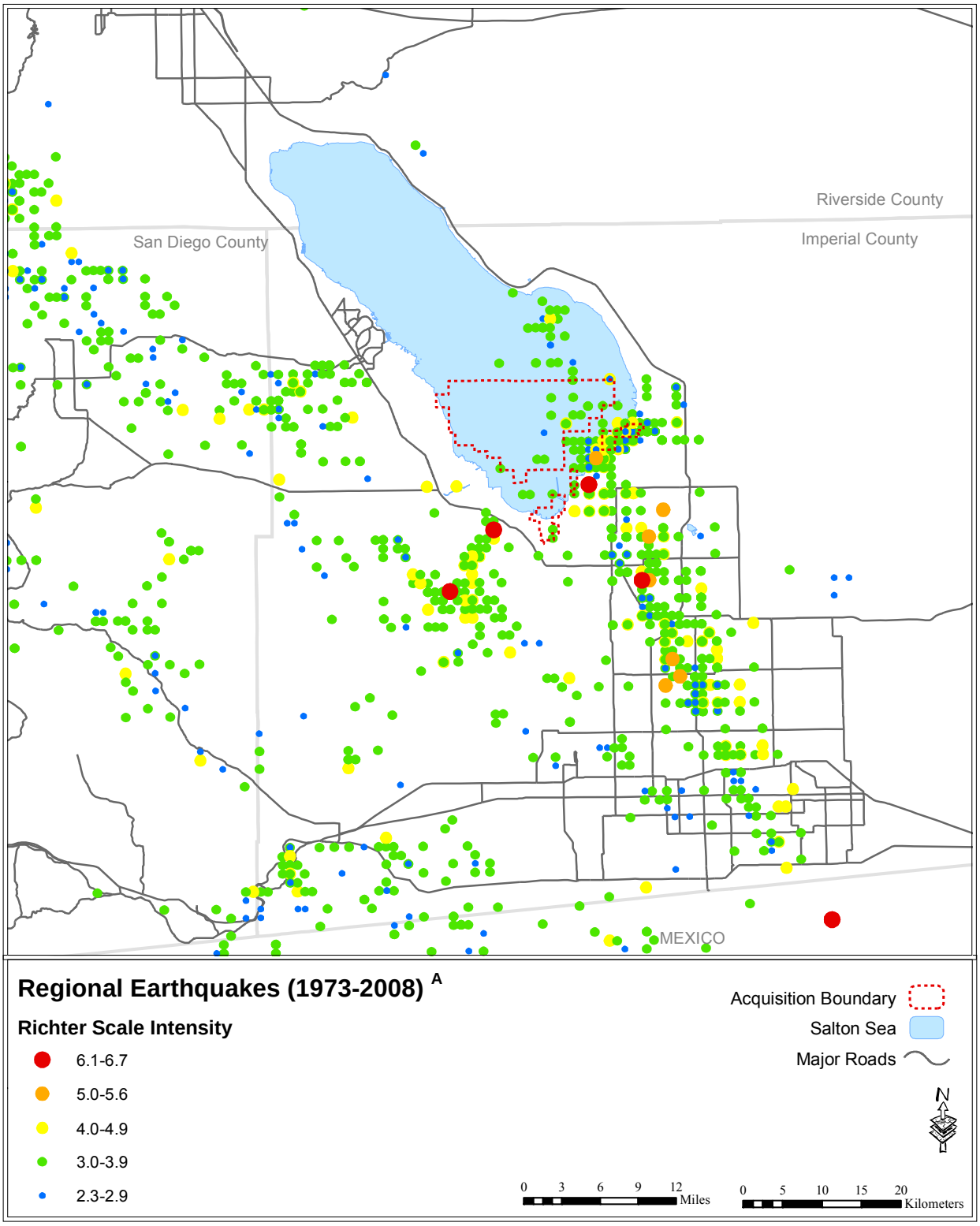
Much of the seismicity in the area occurs within the Brawley Seismic Zone, which extends from the northern end of the Imperial Fault northwest into the Salton Sea (Larsen and Reilinger 1991). The Sonny Bono Salton Sea NWR, particularly Unit 2, lies within this Brawley Seismic Zone. Swarms of small to medium earthquakes and "microearthquakes" (less than 1) are common in the area, all measured by a seismographic network (Hill et al. 1975, USGS 2008). The length of local faults and their rate of movement indicate a potential for larger earthquakes in the region (URS 2004), especially since the Brawley Seismic Zone and the Imperial Valley are "undergoing rapidly changing tectonics" (Larsen and Reilinger 1991).

Recent research indicates that over a 1,000-year period, the Salton Sea region experienced five earthquakes on the southern end of the San Andreas that appear to have been larger than magnitude 7. These large earthquakes occurred about every 180 years. It has been about 300 years since the last of these major earthquakes on the San Andreas has occurred. However, as shown in Table 4-1, over the past 30 years, at least five large earthquakes with a magnitude greater than 6 have occurred near the Sea. These events were sufficiently large to cause significant property damage due to the main shock and aftershocks. Surface ruptures included both lateral and vertical ground displacement along certain sections of the faults.

Table 4-1
Recent Large (>6.0) Earthquakes in the Salton Sea Region

Date	Location	Fault(s)	Magnitude
10/15/1979	Imperial Valley	Imperial	6.5
4/26/1981	Westmorland	Brawley seismic zone	6.3
7/8/1986	North Palm Springs	San Andreas	5.6-6.1
11/24/1987	Imperial Valley	Superstition Hills	6.5-6.7
4/23/1992	Joshua Tree	West Deception Canyon	6.1
4/04/2010	Baja California, Mexico	Laguna Salada (possible southern continuation of the Elsinore fault zone)	7.2

Source: (USGS 2008, 2009; CDWR and CDFG 2006)



A Earthquake data from the USGS Earthquakes Hazards Program (January 2009)

Figure 4-6. Past Earthquakes in the Vicinity of the Salton Sea

Historic and current records reveal several very large earthquakes measuring greater than magnitude 7 have occurred along other faults within the region including: a 7.1 in 1940 on the Imperial Fault; two of 7.1 in the Mexicali Valley (in 1915 and 1934) on the Cierro Prieto Fault, located to the south of the Imperial Fault (Hill et al. 1975). In April 2010, a 7.2 magnitude quake occurred about 30 miles southeast of Mexicali along the Laguna Salada fault system in the Mexican state of Baja, California. According to USGS, it was the largest quake to strike this area since 1892. This fault is believed to be a southern continuation of the Elsinore fault zone in Southern California, and is related to the San Andreas Fault zone complex.

A recent geotechnical study evaluated sediments in the Salton Sea's bed (URS 2004). It found that most of the sediments were high plasticity clays, which tend to have a low potential for liquefaction. However, due to extensive liquefaction of granular deposits in the 1979 Imperial Valley earthquake and the high seismicity of the area, the report cautioned that recent granular deposits below the Sea would have a high liquefaction potential.

Another hazard in the region is the potential for a seiche, which refers to oscillations of enclosed and semi-enclosed bodies of water, such as bays, lakes, reservoirs, or the Salton Sea, due to strong ground motion from seismic events, wind stress, volcanic eruptions, and local basin reflections of tsunami. Seiches can result in the creation of long-period waves that can cause water to overtop containment features or cause seiche run-up on adjacent landmasses, similar to tsunami run-up. Although unlikely, if a seiche were to occur, it could result in localized flooding or damage to low lying areas adjacent to the Salton Sea. A seiche has not been recorded at the Salton Sea.

As described previously, evidence of volcanic activity is also present in the Imperial Valley. Evidence of past and current volcanic activity includes rhyolite domes, geothermal fields, mud pots, and hot springs. Mud pots are present in the vicinity of the Refuge's Unit 2 properties and the liquids present at these sites can be quite hot.

Soils. Soil resources in the Salton Basin reflect the area's geologic history and climate as well as the importation of sediment-laden water from the Colorado River. The granitic rock intrusions erode to sand, but the arid environment slows the erosion rate of parent rock material. Ancient Lake Cahuilla's beds are composed of soft, weakly consolidated siltstones and clays. River alluvial deposits can be of sand and loam. As indicated in Table 4-2, the soil types found in Imperial County show this variation of sandy loam, clay loam, silty clay, sand, and loam soils (USDA NRCS 2008). The spatial distribution of these soils on Refuge lands is illustrated in Figure 4-7.

Mud pot located near Unit 2 of the Refuge (V. Touchstone/USFWS)

Table 4-2 Soil Types and Acreages within the Sonny Bono Salton Sea NWR		
Soil Type	**Acres Mapped in Imperial County**	**Acres within Refuge Boundaries (Percent In Refuge)**
Meloland very fine sandy loam, wet	41,734	818 (2.0)
Imperial silty clay, wet	123,401	538 (0.4)
Imperial-Glenbar silty clay loams, wet, 0 to 2 percent slope	203,659	481 (0.2)
Fluvaquents, saline	12,262	254 (2.1)
Holtville silty clay, wet	70,574	246 (0.3)
Vint and Indio very fine sandy loams, wet	15,462	218 (1.4)
Vint loamy very fine sand, wet	31,545	206 (0.7)
Meloland and Holtville loams, wet	11,483	115 (1.0)
Indio loam, wet	13,625	106 (0.8)
Torriorthents-Rock Outcrop Complex, 5 to 60 percent slope	462	11 (2.4)
Rositas fine sand, wet, 0 to 2 percent slope	22,626	7 (less than 0.1)
Indio-Vint Complex	29,643	1 (less than 0.1)

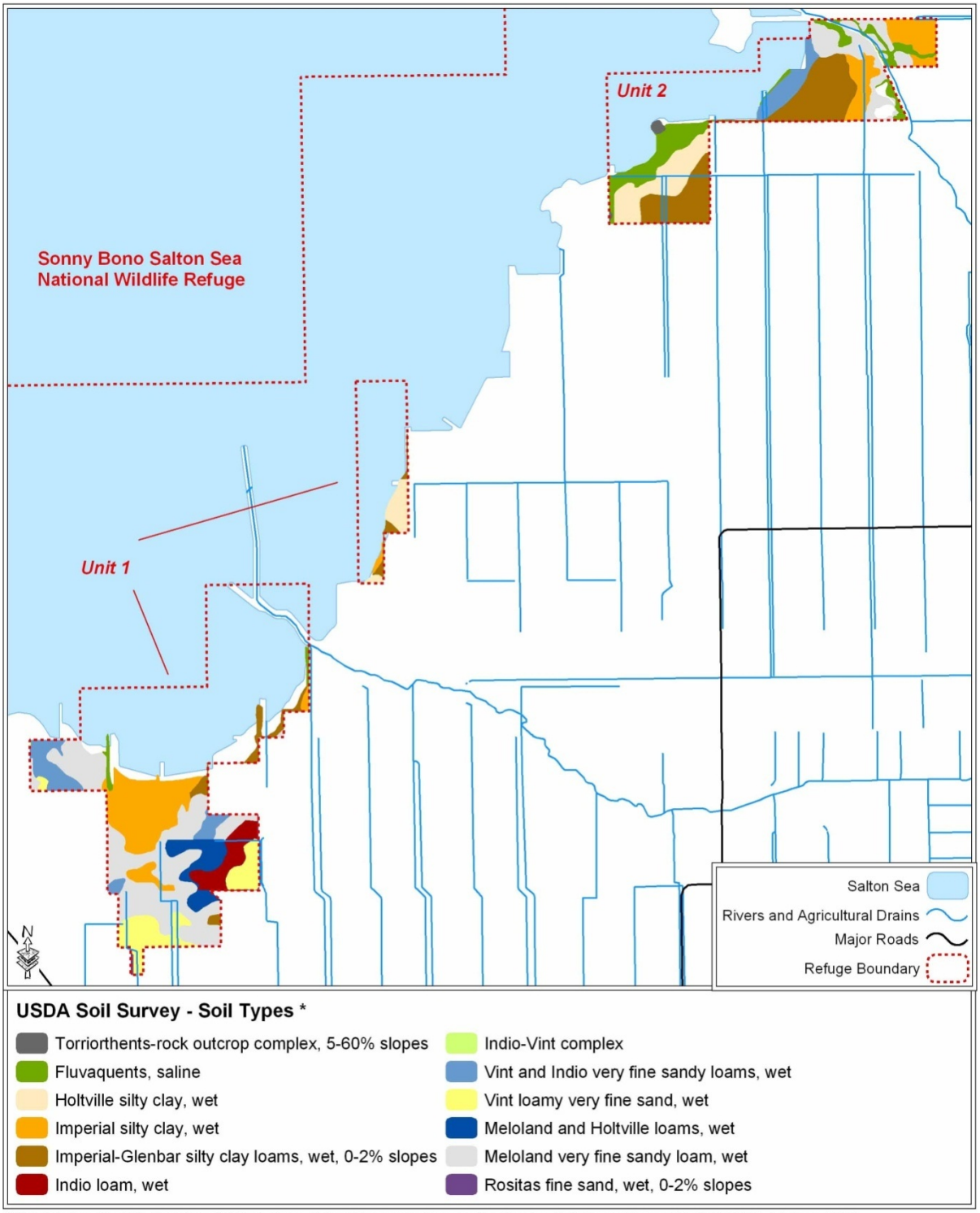
Source: (USDA NRCS 2008)

When the Refuge was established, the Salton Sea was much lower and the largest block of Refuge land was above the waterline. Today, a much smaller portion of the Refuge is on dry land. Wet soil types predominate the areas along the edge of the Sea. Those areas of the Refuge most frequently inundated by the Sea are overlain with saline soils. The Rock Hill area is covered by the Torriorthents-Rock Outcrop Complex. Loams provide good soils for farming. With Unit 1 located at the mouth of the New River and Unit 2 situated just to the south of the terminus of the Alamo River, these onshore and offshore areas are overlain by upland soils carried downstream.

4.4.2.2 Coachella Valley NWR

Geology. The Coachella Valley NWR is also located within the Salton Basin and has been subject to geologic processes similar to those experienced at the south end of the Salton Sea. The geology and geomorphology of the Coachella Valley is captured within the geologic development of the Sonoran Desert. This is a dynamic and diverse geological landscape formed over millions of years as a result of geological activity related to active plate tectonics processes and associated earthquake faults, mixed with intermittent flooding and continuous wind and water erosion. The result is a mosaic of mountains, washes, valleys, badlands, dunes, dry lakebeds, and delta plains.

Various sedimentary layers, or formations, are exposed throughout the Coachella Valley, particularly in the Indio and Mecca Hills and near Whitewater Canyon. The oldest sedimentary formation, known as Coachella Fanglomerate, is composed of debris-flow and stream-laid deposits of gneiss, granite, and volcanic rock. The Imperial Formation, which is probably of early Pleistocene age, was deposited when the Gulf of California extended into the northern reaches of the Coachella Valley and contains marine fossils in its sandstone layer. Ocotillo Formation, which is extensively exposed in the Indio and Mecca Hills, is largely composed of cobble, gravel, and sand containing granite and metamorphic units.



* Soil data from the U.S. Department of Agriculture, Natural Resources Conservation Service, Soil Survey Geographic (SSURGO) database, 2008.

Figure 4-7. Soils Overlaying the Sonny Bono Salton Sea NWR

The most recently laid sediments in the region are alluvial (stream-deposited) and aeolian (wind-deposited) sediments, referred to as Quaternary Alluvium. These sediments, which were deposited during the later Pleistocene or more recently, during the Holocene, typically consist of gravel, sand, and clay deposited by mountain streams and found within alluvial fans and the lower reaches of mountains canyons. They originate from basement rock, the oldest formations within surrounding mountains, and sedimentary rock from base rock erosion, which may be buried in deep layers or actively moving due to heavy winds in the valley (CVAG 2007b). Within the Refuge boundary, the geology is characterized as alluvium fan and streamwater deposits generally along the eastern half of the Refuge; alluvial plain and sand deposits generally within western half of the Refuge; and areas of dune sand deposits within the southern portion of the site (CDWR 1964).

Geological Hazards. In the Coachella Valley, the North American and Pacific tectonic plates slide past one another along the San Andreas, San Jacinto, and other related faults (Figure 4-8). Scientists predict that the southern section of the San Andreas Fault, from the Coachella Valley to the Mojave Desert, will rupture in the next 30 years, producing an earthquake with an estimated magnitude of 7.2 to 8.1.

The lowlands of the Coachella Valley include alluvial fans or cones, which originate at the mouth of major drainages and have created extensive and frequently intersecting deposition areas. These features are essential to the fluvial erosion and sorting process that generates the wide range of sands and gravels located on the valley floor. On the lower portions of the valley floor and following the northwest/southeast gradient of the valley, sand dunes and sand fields have formed. Deposits in these areas are shifted and moved over time by prevailing winds (Figure 4-9).

Wind erosion is initiated by wind forces exerted against the ground and results in the transport and re-deposition of dry, sandy, finely granulated soils exposed to the wind regime. This sand erosion and transport system has been a primary force in shaping unique and shifting habitats for specialized sand-adapted plant and wildlife species (CVAG 2007a, www.peaklist.org/USlists/USP5000.html).

Soils. The soils that overlay the Coachella Valley originate from two main sources: sediment deposits from ancient Lake Cauhilla and weathered rock from the surrounding mountains. These sediments are deposited by wind and water, which creates a complex distribution of distinctive soil types. With the exception of the northeastern corner, the Refuge is overlain almost exclusively by Myoma fine sand. A small area of Coachella fine sandy loam is present near the center of the site and the northeastern portion of the site is overlain with Carsitas cobbly sand, 2-9 percent slope, which transitions to Carsitas gravelly sand, 2-9 percent slope (Figure 4-10).

4.4.3 Paleontological Resources

Paleontological resources (fossils), defined as the remains, imprints, and/or traces of prehistoric plant and animal life exclusive of human remains or artifacts, represent a limited, non-renewable, sensitive scientific and educational resource. Fossil remains such as animal bones and teeth, shells, and wood are found in the geologic deposits (rock formations) in which they were originally buried and provide scientists with the opportunity to explore the history of life on earth.

The potential for fossil remains at a location can be predicted through previous correlations that have been established between the fossil occurrence and the geologic formations within which they are buried. For this reason, knowledge of the geology of a particular area and the paleontological resource sensitivity of particular rock formations, make it possible to predict where there is a high or low potential for fossils to be present in a given area. There are however some formations in which the potential for fossils to be present is harder to predict.

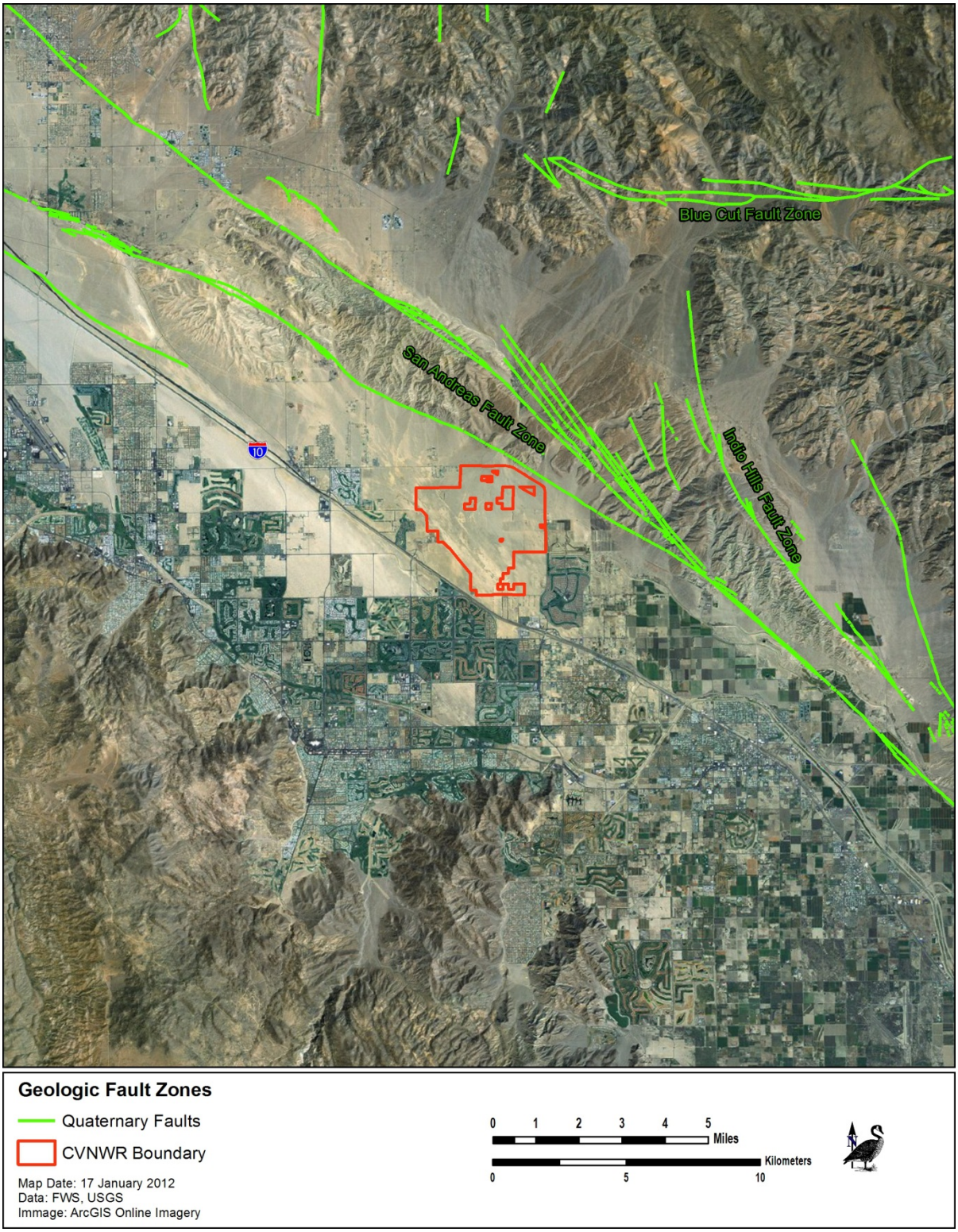


Figure 4-8. Faults in the Vicinity of the Coachella Valley NWR

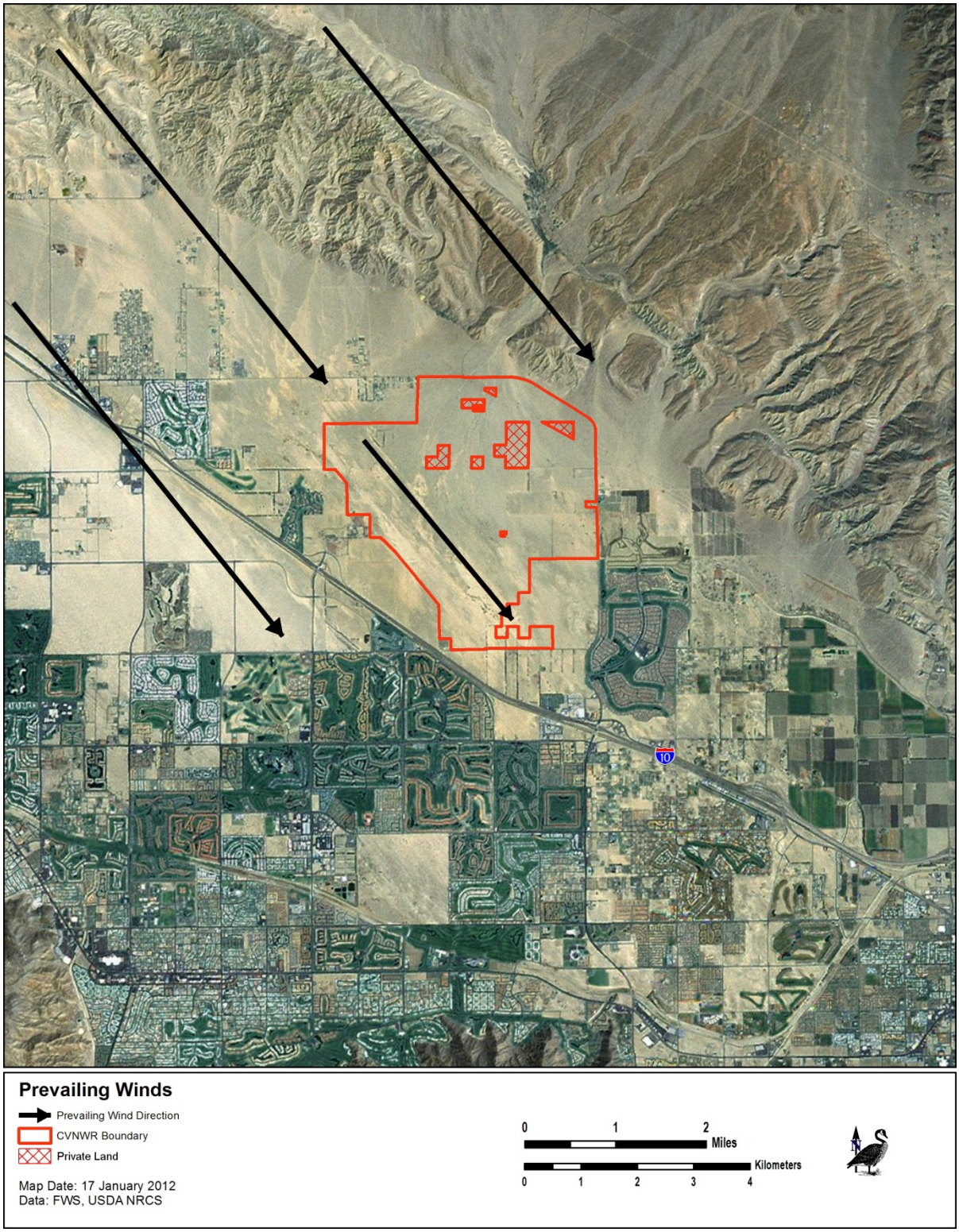


Figure 4-9. Prevailing Wind Pattern in the Coachella Valley

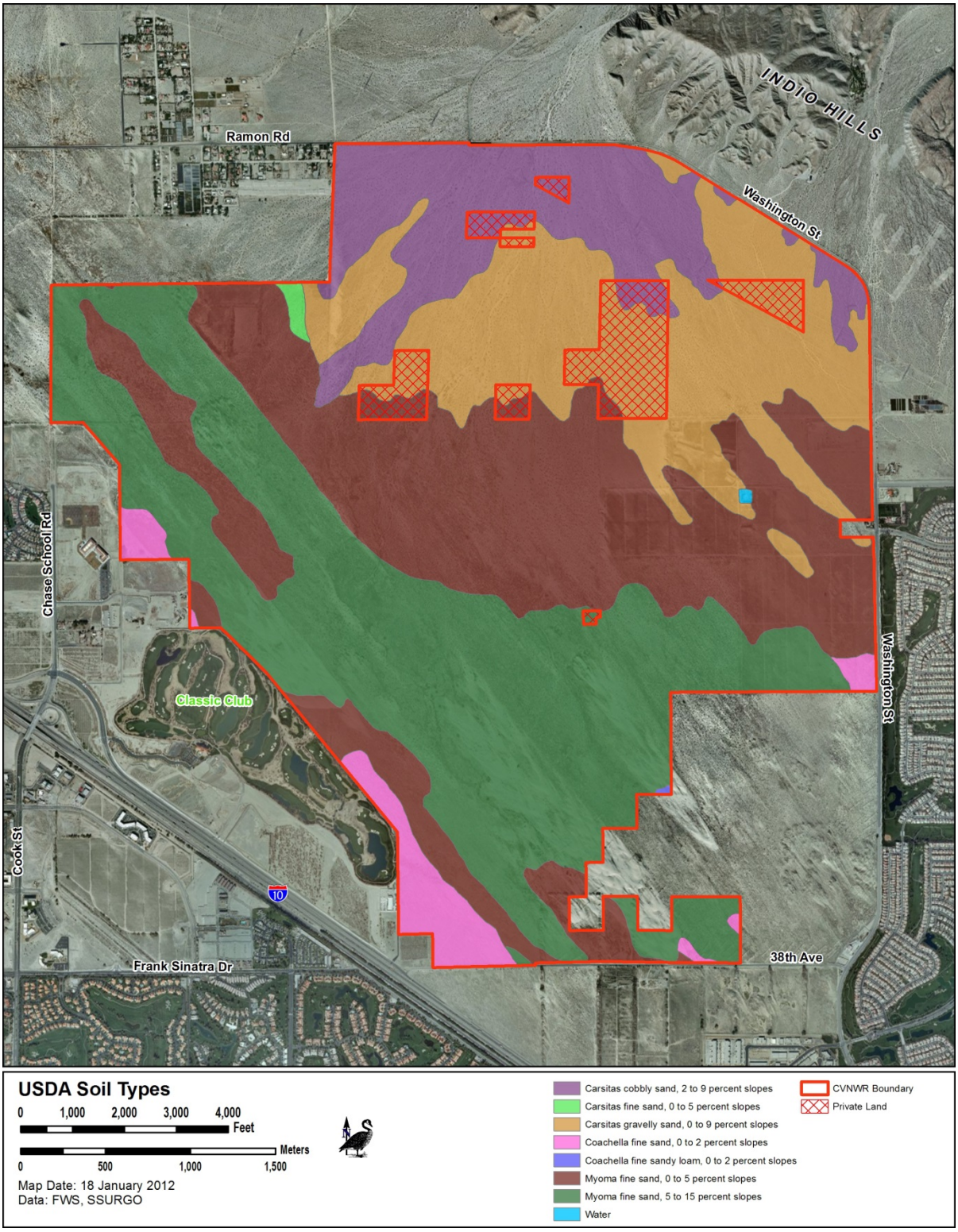


Figure 4-10. Soils Overlaying the Coachella Valley NWR

4.4.3.1 Federal Regulatory Requirements and Other Standard Guidelines

The Antiquities Act of 1906, as amended (P.L. 59-209; 34 Stat. 225; 16 U.S.C 431-433), was the first law enacted to protect historic or prehistoric ruins or monuments, or any objects of antiquity, situated on lands owned or controlled by the Federal government. This act does not refer to paleontological resources specially; however, the protection of "objects of antiquity" has been interpreted to include paleontological resources.

In 2000, the Secretary of the Interior submitted a report to Congress entitled *Assessment of Fossil Management on Federal and Indian Lands*. This report was prepared with the assistance from a variety of Federal agencies, including the Service and the Smithsonian Institution. The report concluded that administrative and congressional actions with respect to fossils should be governed by seven basic principles:

- Fossils on Federal land are a part of America's heritage;
- Most vertebrate fossils are rare;
- Some invertebrate and plant fossils are rare;
- Penalties for fossil theft should be strengthened;
- Effective stewardship requires accurate information;
- Federal fossil collections should be preserved and available for research and public education; and
- Federal fossil management should emphasize opportunities for public involvement.

As part of the Omnibus Public Land Management Act of 2009, (P.L. 111-011), the Paleontological Resources Preservation Act was enacted. This act requires the management and protection of paleontological resources on Federal lands using scientific principals and expertise. It also requires Federal agencies to develop plans for the inventory, monitoring, and scientific and educational use of paleontological resources; addresses the collection and curation of resources; identifies prohibited acts, and establishes criminal and civil penalties.

In addition to Federal requirements for the protection of paleontological resources, the Society of Vertebrate Paleontology (SVP) has established standard guidelines (SVP 1995) that outline professional protocols and practices for conducting paleontological resource assessments and surveys, monitoring and mitigation, data and fossil recovery, sampling procedures, and specimen preparation, identification, analysis, and curation (SVP 1991, SVP 1996). Most practicing professional vertebrate paleontologists adhere closely to the SVP's assessment, mitigation, and monitoring requirements included in the guidelines. Regulatory agencies often accept and utilize the professional standards set forth by the SVP.

The SVP (1995) has established three categories (high, low, and undetermined) to assign the paleontological sensitivity of an area or the potential for a stratigraphic or bed unit to yield significant paleontological resources. Each of these categories affects the degree to which paleontological mitigation is required.

A high potential for paleontological resources is assigned to those stratigraphic units from which vertebrate or significant invertebrate fossils or suites of plant fossils have been previously recovered. Such units include, but are not limited to, sedimentary formations and some volcanic formations that contain significant nonrenewable paleontological resources anywhere within their geographical extent and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small, vertebrate, invertebrate, or botanical, and (b) the importance of recovered evidence for new and significant

taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas that contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas that may contain new vertebrate deposits, traces, or trackways are also considered to have high sensitivity.

Reports in the paleontological literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potential for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections. Finally, areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potential.

In general terms, for geologic units with high potential, full-time monitoring for paleontological resources is typically recommended during any action that requires ground disturbance. For geologic units with low potential, protection or salvage efforts typically are not required. For geologic units with undetermined potential, field surveys by a qualified paleontologist are usually recommended to specifically determine the potential for paleontological resources in the rock unit present within the project area (USACOE and California Natural Resources Agency 2011).

4.4.3.2 Sonny Bono Salton Sea NWR

The potential for paleontological resources on the Sonny Bono Salton Sea NWR is directly related to the geologic, hydrologic, climatic, and biological processes occurring in the region. In the past, the natural northward diversions of the Colorado River into the Salton Trough resulted in the periodic formation of Lake Cahuilla. At least six Late Pleistocene infillings of Lake Cahuilla have left relic maximum shorelines at elevations between 170 and 101 feet above MSL. The latest and lowest shoreline is tentatively radiocarbon dated at 26,000 B.P. (Laylander and Garnsey 2007).

Lake Cahuilla may have continued to form and then recede throughout the middle Holocene. However, the Late Holocene stands of Lake Cahuilla are somewhat better documented. The lake is known to have been present at times but not continuously during the millennium prior to A.D. 1000 (Love and Dahdul 2002, Waters 1983, Wilke 1978). Radiocarbon, stratigraphic, and historical evidence indicates that the lake underwent at least three cycles of filling and recession between ca. A.D. 1200 and 1700 (Laylander 1997).

Lake Cahuilla covered the entire area of the Sonny Bono Salton Sea NWR, including the current upland areas. The areas at the south end of the Salton Sea where actions associated with the implementation of the CCP would occur are underlain by the Holocene Lake Cahuilla Beds and the Pleistocene Brawley Formation. The Holocene Lake Cahuilla Beds consist of flat-lying lacustrine sediments including sandy deltaic and beach deposits, silt, and clay associated with ancient Lake Cahuilla. Cahuilla Lake Bed deposits form a relatively thin sedimentary deposit over the older Brawley Formation, which consists of tectonically deformed cemented lacustrine sediments, including silts and clays (California Energy Commission 2003). The Cahuilla Lake Beds and the Brawley Formation tend to be highly fossiliferous and often preserve late Pleistocene and Holocene invertebrates (e.g., diatoms, pollen, foraminifera, ostracods, freshwater clams, snails); small vertebrates (e.g., fish, amphibians, reptiles, birds, small to medium-sized mammals); and larger mammal fossils, some of which are large extinct mammals (USACOE and California Natural Resources Agency 2011).

A review of museum collections records from the Vertebrate Paleontology Section of the Natural History Museum of Los Angeles County, Vertebrate Collections at the University of California Museum of Paleontology, the Paleontology Section of the San Diego Natural History Museum, and the San Bernardino County Museum was performed in 2002 and 2009 in association with a

proposed geothermal plant (Salton Sea Unit 6 Geothermal Power Project) to be located just to the south of the Refuge's Unit 2 and to the northeast of Obsidian Butte. The purpose of this review was to determine whether there were any known fossil localities in or near the proposed site for the geothermal plant (SWCA Environmental Consultants 2009). The review found that no fossil localities have been previously recorded on the project site or within a one-mile radius of the project site; however, at least four scientifically significant vertebrate fossil localities were identified in the general area. These sites, which occurred within the same geologic sediments underlying the Refuge, yielded significant remains of freshwater fish and terrestrial vertebrates and microvertebrates, including reptiles, birds, and mammals. Three of the sites also yielded non-vertebrate fossils, including diatoms, land plants, clams, snails, and crustaceans (SWCA Environmental Consultants 2009).

A paleontological records and literature search was also conducted for the Salton Sea SCH project, which depending upon the alternative selected for implementation could occur within a portion of the Sonny Bono Salton Sea NWR. This search indicated that no previously known paleontological resource localities have been recorded within one mile of the proposed project sites. However, the restoration sites have not been surveyed for surficial paleontological resources (USACOE and California Natural Resources Agency 2011).

The literature search did reveal that three fossil mollusk sites were identified within Lake Cahuilla beds in the banks of irrigation ditches and the New River drainage during a paleontological resource field survey conducted for the proposed Salton Sea Unit 6 Geothermal Power Project (USACOE and California Natural Resources Agency 2011). Because scientifically significant fossils have been recorded from both the Holocene Lake Cahuilla Beds and the Pleistocene Brawley Formation, and because depositional conditions appear to be favorable for the preservation of fossils, these formations are considered to have high sensitivity for paleontological resources.

4.4.3.3 Coachella Valley NWR

The Coachella Valley NWR is underlain with Quaternary Alluvium; these sediments were deposited during the later Pleistocene or more recently, during the Holocene. The alluvium deposits in the south end of the Coachella Valley, including the lands within the boundary of the Coachella Valley NWR, have sensitivity for paleontological resources that ranges from undetermined to high.

4.4.4 Mineral and Alternative Energy Resources

4.4.4.1 Mineral Resources

Sonny Bono Salton Sea NWR

Minerals known to occur in Imperial County include gold, gypsum, sand, gravel, lime, clay, and stone (Imperial County 1993). A number of industrial materials are also extracted for commercial sale including kyanite, mineral fillers (e.g., clay, limestone, sericite, mica, tuff), salt, potash, calcium chloride, manganese, and sand. There are a number of mining operations in Imperial County, but none are located near the Refuge (Imperial County 1993), nor are any significant deposits of these minerals or industrial materials known to occur within the Refuge boundaries. With respect to sand and gravel, the Imperial County General Plan (1993) indicates that there are limited suitable sand and gravel deposits within the County and none of the deposits are considered to be of exceptional quality or suitability.

Another potential source of minerals is brine, a byproduct of geothermal activities. Minerals have been extracted from brine when it is cost effective to do so. The brine extracted during geothermal operations near the Refuge contains high levels of sodium, arsenic, antimony, mercury, selenium, potassium, iron, tin, manganese, chlorine, boron, bromine, potash, and zinc. Precious metals, such as silver, gold, and platinum, are also present in trace concentrations. Studies of brine in the Salton Sea area have shown substantial differences in the trace element compositions even from relatively closely spaced wells, and the total dissolved solids and mineral concentrations in the brine can change with the well flow rate (Imperial County 2006). At one time, CalEnergy Operating Corporation operated a zinc extraction plant near the Salton Sea (USACOE and California Natural Resources Agency 2011), but that plant has since been closed. Simbol Materials is processing lithium, manganese, and zinc (materials used in the production of high performance batteries) from the byproducts of geothermal power production in the Imperial Valley.

Coachella Valley NWR

Mineral resources in the Coachella Valley consist mainly of construction aggregate (e.g., sand, gravel, crushed stone). Construction aggregate is important in a variety of construction materials, including Portland cement concrete, asphaltic concrete, stucco, road base, railroad ballast, specialty sands, and fill. Construction aggregate is a high bulk weight commodity, meaning that for the most part the major cost to the consumer for having this product delivered to a site is the cost of transportation. Thus, locally available, high quality construction aggregate deposits are vitally important to the construction industry.
In the case of the Coachella Valley, important deposits of aggregate materials, particularly deposits containing Portland cement concrete-grade (PCC) aggregate, occur within the region and are actively being developed. As of 2006, 11 mines were producing PCC-grade aggregate in the Palm Springs Production-Consumption Region, which includes the Coachella Valley. In addition to PCC-grade aggregate, these mines also produce a full range of lower aggregate grades for such products as asphaltic concrete and base (California Geological Survey 2007). Sand and gravel operations presently occur on private lands and on some Federal lands managed by BLM.

The California Department of Conservation, Division of Mines and Geology, now known as the California Geological Survey (CGS), has assigned Mineral Resource Zone (MRZ) classifications (that describe the potential for significant PCC-grade aggregate deposits in an area) to all lands within the Palm Springs Production-Consumption Region (CGS 2007). These classifications include:

MRZ-1: Areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence. These areas include the Quaternary alluvial deposits of the central upper Coachella Valley.

MRZ-2: Areas where adequate information indicates that significant mineral deposits are present, or where it is judged that a high likelihood for their presence exists.

MRZ-3: Areas containing mineral deposits, the significance of which cannot be evaluated from available data.

The Refuge lands are classified as MRZ-3, and there are no known aggregate resources on the Refuge. In the past, lands purchased for the sole purpose of protecting wildlife habitat and other conservation values have not been designated by the State as significant mineral deposit areas.

Other mineral deposits occurring in the region include limited and/or small deposits of copper, limestone, gold and tungsten within the Mecca Hills, Little San Bernardino Mountains and the Santa Rosa Mountains surrounding the Coachella Valley. Decorative stone is mined on public land in the Painted Hills area west of Desert Hot Springs. Clay deposits exist at the base of the Mecca Hills on public and private land east of Thermal. Some of these deposits have been permitted for mining and may be used to provide impermeable linings for landfills and ponds (CVAG 2007b). These resources are not known to occur on the Refuge.

4.4.4.2 Alternative Energy Resources

Traditional energy resources include both production and transmission of petroleum products, natural gas, and electricity from their points of production to those of use. The alternative sources particularly relevant to these Refuges include wind, geothermal, and solar.

Sonny Bono Salton Sea NWR

Geothermal. The presence of geothermal activity in the form of "mud pots" was noted by some of the earliest inhabitants of the Imperial Valley (LeConte 1855). Surficial evidence of geothermal activity deep below the surface includes not only the existing mud pots at the southeast end of the Salton Sea, but also the prominent rhyolite domes, including Obsidian Butte and Rock Hill, that are present in the general vicinity of the Refuge. Records from the 1920s indicate an early interest in developing these resources (Clear Creek Associates 2011), however, it was not until the 1970s and 80s that efforts began in earnest to develop geothermal plants in the Imperial Valley.

Hulen et al. (2002) provides detailed information regarding the Salton Sea geothermal field, which extends along the southeastern shore of the Salton Sea from about three miles south of Obsidian Butte to about six miles northeast of Obsidian Butte (refer to Figure 4-5). The Salton Sea geothermal field is among the world's largest and hottest active magma-hydrothermal system. The energy production has occurred within this area for more than 30 years, and recent investigations suggest that the field can likely be sustained for decades, if not longer. To date, production has occurred within the onshore portion of this thermal anomaly. It is likely that the offshore portion of the thermal anomaly will be underlain by geothermal resources similar to those currently being exploited along the shoreline. If the entire resource is developed, it may provide enough electricity to serve 2.33 million households (Hulen et al. 2002).

In 2011, a Geothermal Resource Assessment was conducted of the lands in the Imperial Valley that are controlled by the IID (The Aerospace Corporation and Clear Creek Associates 2011). The results of the assessment confirmed the observations made by Hulen et al. (2002) that the potential for significant geothermal resources in most of this area is high.

As of 2013, CalEnergy owned and operated ten geothermal electrical generating plants within the Salton Sea geothermal field. These facilities provide 342 megawatts of electrical power. CalEnergy has plans to develop an additional 470 megawatts of generating facilities at the Salton Sea.

Solar. The Imperial Valley's year-round sunny climate also makes this area attractive to solar energy producers. In June 2012, a 23-megawatt solar facility constructed in Niland, located to the northeast of the Refuge, began distributing power to the surrounding community and another facility is expected to be constructed in 2012 by the same company in an area north of Niland. Three solar farms are also proposed for areas to the east of the Refuge, approximately 2.5 miles north of the City of Calipatria along the Highway 111 corridor. These facilities,

which will collectively support 2.2 million solar panels across 1,738 acres, are expected to generate 275 megawatts.

The Sonny Bono Salton Sea NWRC has also taken advantage of the area's sunny climate. In 2010, with funding provided through the American Recovery and Reinvestment Act of 2009, nine photovoltaic arrays (eight 6.4-kilowatt arrays and one 6.8-kilowatt array) were installed on five refuge building rooftops. Since the project's completion, the Refuge has reduced its overall annual energy consumption by about 22,300 kilowatt-hours.

Coachella Valley NWR

Southern California Edison and IID provide electric power services to the Coachella Valley, using a combination of wind, hydroelectric, thermal, diesel, and geothermal power sources, most of which are located outside the valley. Viable wind resource areas occur in the western Coachella Valley and as far to the east as Edom Hill, where strong, sustained winds emanate from the San Gorgonio Pass and cross the valley in a southeasterly direction. Large areas within and immediately east of the San Gorgonio Pass under the jurisdiction of Riverside County, Desert Hot Springs, or Palm Springs, are already developed with Wind Energy Conversion Systems wind farms or designated for future energy-related industrial development. There were 19 different wind energy projects in the San Gorgonio Pass area as of January 2002, with a combined installed power capacity of 421.1 megawatts. Many turbines can be viewed within the I-10 Corridor. Both the approved BLM California Desert Conservation Area Plan (BLM 2002) and the Coachella Valley MSHCP (CVAG 2007a) allow for construction of windfarms that are developed in an environmentally sound manner on non-Conservation Area lands within the planning area. The Service has provided the Secretary of the Interior with a set of final recommendations on how to minimize the impacts of land-based wind farms on wildlife and its habitat. No wind turbine development is proposed in the immediate vicinity of the Refuge.

Solar thermal systems are widely used in the Coachella Valley for heating domestic water and swimming pools. However, such uses are largely limited to private lands. Geothermal resources are plentiful in the northwestern portion of the Coachella Valley. In Desert Hot Springs, geothermal energy is used primarily for commercial spas and therapeutic pools. This resource is not currently being developed for energy production in the vicinity of the Refuge.

4.4.5 Agricultural Resources

4.4.5.1 Introduction

Agriculture in the Imperial and Coachella Valleys is renowned for its high productivity due to abundant imported water, warm weather, and long growing season. An impressive variety of crops and a large number of livestock are produced in the region. In 2009, Imperial County was ranked 10th among California's counties for the value of its agricultural production (CDFA 2007). Within the Colorado River Region, about 750,000 acres support irrigated crops (CDWR 1998). Both refuges within the Sonny Bono Salton Sea NWRC include lands that have been classified as "farmland." For information about past and current agricultural uses on these Refuges, refer to Chapter 1.

As an action implemented by a Federal agency, the management of refuge lands is subject to the requirements of the Farmland Protection Policy Act (FPPA) (7 U.S.C. §4201 et seq.). The purpose of FPPA is to minimize the extent to which Federal programs contribute to the unnecessary conversion of farmland to nonagricultural uses. "Farmland" is defined by FPPA as land that

meets the definition of Prime Farmland, Unique Farmland, Farmland of Statewide, or Farmland of Local Importance. Farmland protected under FPPA can include land that is not currently being cultivated (e.g., lands supporting native vegetation, grazing lands), but does not include land already in or committed to urban development or water storage.

The California Department of Conservation, as part of the Farmland Mapping and Monitoring Program (FMMP) (http://www.conservation.ca.gov/dlrp/fmmp/), develops maps and statistical data used to analyze potential impacts to the important farmlands in the State. The maps, produced using data from the Department of Agriculture's Natural Resource Conservation Service (NRCS), are referred to as Important Farmland Maps. The maps define various categories of lands including, but not limited to, Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance. The definitions for these agricultural land categories were developed by the NRCS as part of the nationwide Land Inventory and Monitoring criteria and have been modified for use in California (i.e., in California only irrigated lands are classified as Prime Farmland and Farmland of Statewide Importance). Farmland classifications relevant to the Sonny Bono Salton Sea NWRC are defined here.

Prime Farmland. Prime Farmland is land that has the best combination of physical and chemical characteristics for the production of crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yield crops when treated and managed, including water management, according to current farming methods. Prime Farmland must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. These lands are best suited for producing food, feed, forage, fiber and oilseed crops and have minimal management problems. Prime Farmland does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Farmland of Statewide Importance. Farmland of Statewide Importance is similar to Prime Farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for production of irrigated crops at some time during the two update cycles prior to the mapping date. Lands within this category may have associated management problems such as increased alkalinity or salinity, and have a moderate erosion hazard. Farmland of Statewide Importance does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Unique Farmland. Unique Farmland is land of lesser quality soils currently and specifically used for the production of the State's leading agricultural crops (as listed in *California Agriculture,* California Department of Food and Agriculture). It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality or high yields of a specific crop when treated and managed according to current farming methods. Unique Farmland is usually irrigated, but may include non-irrigated orchards or vineyards found in some climatic zones in California. Some Unique Farmland crops include oranges, olives, avocados, rice, grapes, and cut flowers. Unique Farmland does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Farmland of Local Importance. Farmland of importance to the local agricultural economy is determined by the County Board of Supervisors and a local advisory committee. These farmlands include agricultural areas with soils that would be classified as "Prime" or "Statewide Important" but lack available irrigation water, as well as lands producing major (but not unique) crops or supporting dairies. Also included are lands identified by City or County ordinance as agricultural zones.

4.4.5.2 Sonny Bono Salton Sea NWR

The Imperial Irrigation District (IID) delivers water to the Refuge and other farmland in the vicinity. The number of farm accounts, crops acreages, and water provided within the area served by IID as of 2011 are presented in Table 4-3. The total acreages of land farmed and the types of crops in cultivation vary from year to year, depending on crop prices, fallowed land, and other factors. However, the total farmable area has remained relatively stable, with only a slight decrease between 2003 and 2011.

The largest acreage of farmland receiving water from IID is devoted to growing field crops (e.g., alfalfa, wheat, Sudan grass, Bermuda grass, sugar beets, ryegrass, field corn) (2012 Crop Rank and Acreage, http://www.iid.com/Modules/ShowDocument.aspx?documentid=7808). Also important are garden crops, which can include over 60 different types of products (e.g., lettuce, carrots, broccoli, onions, sweet corn, melons). Permanent crops include citrus (e.g., lemons, grapefruit, tangerines, oranges), asparagus, dates, mangos, and pasture land. Duck ponds, managed habitats on the Refuge, and fish farms are also included considered permanent crops.

Table 4-3
Annual Inventory of Areas Receiving Water from the Imperial Irrigation District (Years 2003, 2009, 2011)

Category	Acres in 2011	Acres in 2009	Acres in 2003
Number of Farm Accounts			
Owner-Operated	2,344 (39.6%)	2,491 (40.2%)	2,398 (38.6%)
Tenant-Operated	3,568 (60.4%)	3,710 (59.8%)	3,807 (61.4%)
Total	*5,912*	*6,201*	*6,205*
Average Acreage/Farm	80.21	76.42	76.68
Crop Survey (ac)			
Garden Crops	94,075	94,679	87,663
Field Crops	376,895	380,913	427,867
Permanent Crops	21,851	19,758	20,743
Total	*495,821*	*495,350*	*536,273*
Total Area Farmable (ac)			
Total Net Acres in Crops (multiple cropping)	440,564	432,027	450,556
Net Area Irrigated (+ areas being reclaimed)	440,650	432,158	450,571
IID Fallowing program	11,224	15,317	n/a
Fallowed land	22,332	26,428	25,251
Total	*474,206*	*473,903*	*475,822*
Total Area Receiving Water (ac)			
Area of Farms in other use	16,088	16,723	16,821
Area in Municipal use	30,013	29,836	28,114
Grand Total	*520,307*	*520,462*	*520,757*

Source: (IID 2012, http://www.iid.com/Modules/ShowDocument.aspx?documentid=7809)

Within the Sonny Bono Salton Sea NWR, croplands are intensively managed to provide valuable forage for some 30,000 wintering geese and other migratory birds and wildlife. Managed agricultural fields account for about 850 acres within the Refuge, and require approximately 3,000 acre-feet of irrigation annually. An additional 7,000 acre-feet is needed annually to support wetland habitat management on about 760 acres within the Refuge. In the past, local farmers cooperatively farm many of the Refuge fields, requiring additional irrigation to support year-round field production. In 2013, the primary crop cultivated on the Refuge for waterfowl forage was rye grass; however, over the last 20 to 30 years alfalfa, wheat, milo, and millet have also been produced.

Besides being surrounded by a large area of valuable Imperial Valley farmland, the Refuge boundary also includes farmland designated as Prime Farmland, Farmland of Statewide Importance, and Unique Farmland by the California Department of Conservation (CDOC 2007). Illustrated in Figure 4-11 and itemized in Table 4-4 is the distribution of Prime Farmland, Farmland of Statewide Importance, and Unique Farmland within Units 1 and 2 of the Refuge.

Table 4-4
Farmland Designations and Acreages of Valuable Farmland in 2008
In Imperial County and within the Sonny Bono Salton Sea NWR

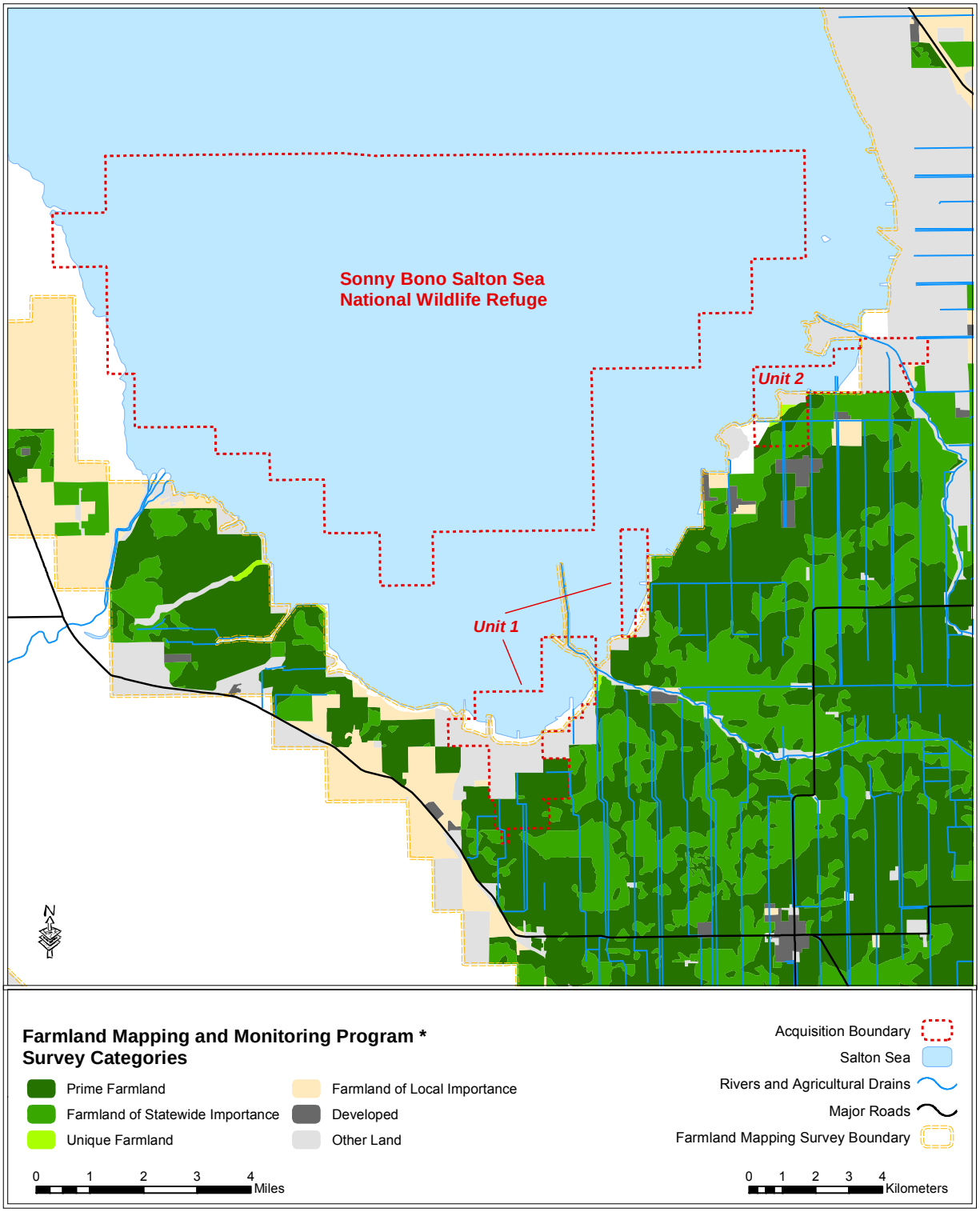
Category	Acres in Imperial County	Acres on the Refuge (percent in Refuge)
Other	457,510	1,558 (0.3)
Prime Farmland	195,589	901 (0.5)
Farmland of Statewide Importance	311,048	194 (0.1)
Unique Farmland	2,196	37 (1.6)
Farmland of Local Importance	32,109	1 (0)
Urban and Developed	27,709	0

Source: (CDOC 2007)

4.4.5.3 Coachella Valley NWR

Deposited by wind and water, the sediments derived from parent materials in the nearby mountains combine to create a large variety and complex distribution of distinctive soil types throughout the Coachella Valley. In general, soils at lower elevations of the Coachella Valley floor are composed of fine textured sedimentary materials that are classified as silts and silty loams. Much of the Coachella Valley's crops are grown on these fine textured soils. They have greater water holding capacities than the coarser sands, gravels, and rocks found at higher elevations near the surrounding mountains and on alluvial fans. Compaction and stratification (layering) of different soil types are often seen in the finer textured soils. Both of these soil characteristics can reduce rates of water penetration, nutrient availability, root growth, and other components of healthy plant development. Most of the soils in the Valley are moderately to severely alkaline with pH levels up to 8.4. These high pH levels result in reduced crop production.

Early development in the Coachella Valley was associated with agriculture uses. Initially, farming occurred in the eastern portion of the Valley where there was easy access to groundwater. The eastern Valley is still noted for its prime agricultural lands, which generally extend from Washington Street southeast to the Salton Sea. Today, the primary agricultural areas are centered in the Indio and Coachella areas, although into the mid-20th Century large-scale date and citrus cultivation extended as far northwest as present-day Cathedral City and Rancho Mirage.



* Farmland data from the California Department of Conservation, Division of Land Resrouce Protection, Farmland Mapping and Monitoring Program, 2007.

Figure 4-11. Farmland Mapping - Sonny Bono Salton Sea NWR

With a large aquifer of high quality groundwater easily accessible in the eastern portions of the Valley, extensive land conversion and crop production was underway well before outside sources of water were imported into the Valley. Early crops included dates, citrus, and cotton. Today, the Coachella Valley is a major producer of table grapes, dates, citrus, and truck crops. In recent years, rising water costs and land values have resulted in the conversion of agricultural lands to urban uses. In 2000, 150,984 acres were classified as Prime Farmland in Riverside County, while in 2010 Prime Farmland was reduced to 119,635 acres. The loss of Farmland of Statewide Importance and Unique Farmland between 2000 and 2010 was 3,136 acres and 5,559 acres, respectively (CDOC 2010).

Aerial photographs of the lands within the Coachella Valley NWR indicate evidence of past agricultural activity on approximately 400 acres along the northeastern edge of the Refuge and on another 60 acres in the northwestern portion of the Refuge. As indicated in Figure 4-12, portions of the larger area, which at one time supported a vineyard, continue to be classified as Farmland of Local Importance. Another small area of land classified as Farmland of Local Importance also occurs along the southwestern edge of the Refuge. Table 4-5 provides information regarding the total acreage of valuable farmland in Riverside County in 2010, along with the total acres of designated farmland within the boundaries of the Coachella Valley NWR.

Table 4-5
Farmland Designations and Acreages of Valuable Farmland in 2010
In Riverside County and within Coachella Valley NWR

Category	Acres in Riverside County	Acres on the Refuge (percent in Refuge)
Other	1,020,717	3,465 (0.3)
Prime Farmland	119,635	0 (0)
Farmland of Statewide Importance	44,086	0 (0)
Unique Farmland	35,391	0 (0)
Farmland of Local Importance	229,877	244 (0.1)
Urban, Developed, Water Areas	383,914	0 (0)

Source: (CDOC 2010)

Although there has been no agricultural activity on the Refuge since well before 1996, the most recent map from the California Department of Conservation (2008) identifies portions of the Coachella Valley NWR as Farmland of Local Importance. Farmland of Local Importance is defined by each county's local advisory committee and adopted by its Board of Supervisors. In Riverside County, areas defined as Farmland of Local Importance are generally areas in active production; however, this classification may be applied to areas where soils are present that would be classified as Prime Farmland and Farmland of Statewide Importance but lack available irrigation water. The areas of the Coachella Valley NWR that are classified as Farmland of Local Importance are overlain by such soils, although their value for agriculture is limited due to high soil blowing hazards.

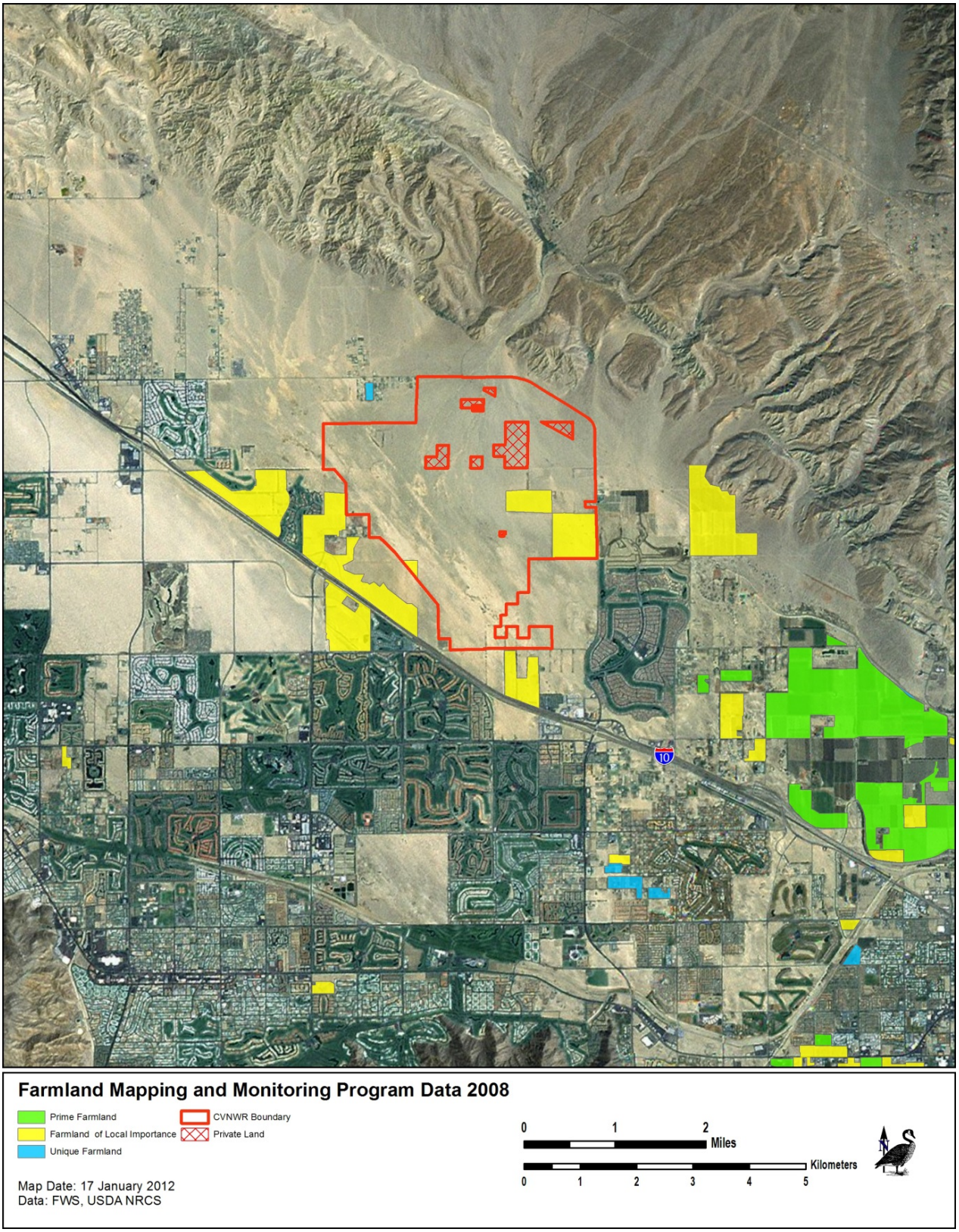


Figure 4-12. Important Farmland in and around the Coachella Valley NWR

4.4.6 Hydrology/Water Quality

4.4.6.1 Introduction

This section addresses the hydrology and water quality of the surface water bodies (e.g., Salton Sea, New River, Alamo River, irrigation drainage channels) and groundwater underlying the Salton Sea Basin. With no outflow, the Salton Sea lies within its own closed hydrologic basin (Figure 4-13). Its natural drainage area is 8,360 square miles of varied terrain and encompasses portions of four counties and northern Mexico (Hely et al. 1966, CDWR 2008).

The Salton Sea is also connected hydrologically to the much larger Colorado River Basin since over 90 percent of its incoming water is artificially diverted from the Colorado River through a canal system to the Imperial and Coachella Valleys. Originating in the Rocky Mountains, this river drains 17 percent of the continental United States and has much of its immense runoff stored behind multiple dams for water supply, flood control, and hydroelectric purposes.

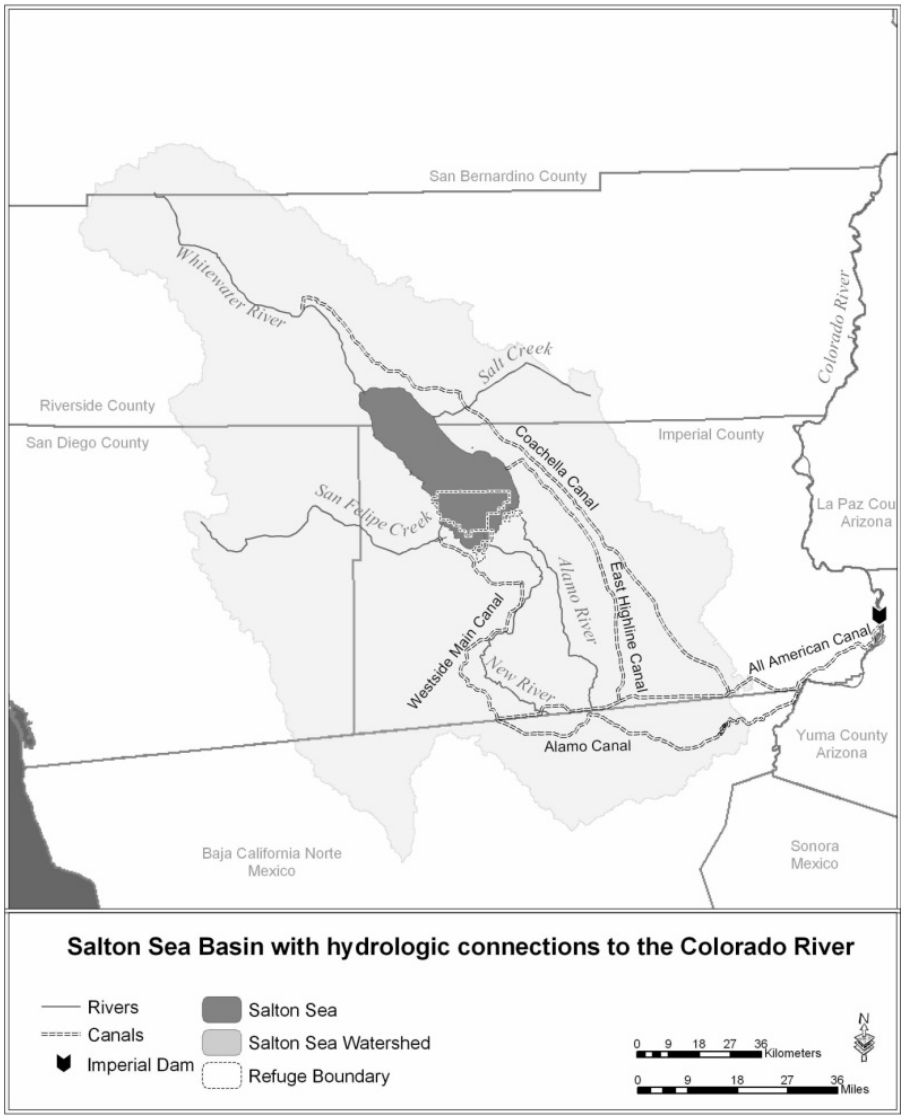


Figure 4-13. Salton Sea Watershed

4.4.6.2 Hydrology

Sonny Bono Salton Sea NWR

Surface Water. By 1902, at least 400 miles of canals and ditches were used to convey Colorado River water to Imperial Valley for irrigation (Norris and Webb 1990). The present day Salton Sea was formed in 1904-07 when heavy Colorado River floodwaters broke through a temporary diversion structure and repeatedly flooded the valley (Hely et al. 1966). When the breach was finally sealed, the level of the newly formed Salton Sea was at 198 feet below MSL and was about 80 feet deep. Its deepest point is -278 feet MSL.

Today, the Sea is the largest body of water entirely within California. With a surface area in 2003 of about 360 square miles, the Sea measured approximately 35 miles from north to south and 9 to 15 miles from east to west, with 105 miles of shoreline (CRWB 2003). The Sea's storage volume was estimated at 7.2 million acre-feet (CDWR and CDFG 2006). The Salton Sea's level has fluctuated considerably over the past 100 years (IID 2006). Due to significant evaporation and low inflow, the level was reduced to 250 feet below MSL by 1920.

Total inflow to the Sea until recently averaged about 1.3 million acre-feet per year (CDWR and CDFG 2006). Up to 90 percent of the total freshwater input to the Sea is currently from agricultural return flows derived from imported Colorado River water (CRWB 2003). These flows, which are conveyed to the Salton Sea via canals and two rivers (the New and Alamo rivers), have contributed to the fluctuation in water levels in the Sea over the years. The Whitewater River drains the agricultural lands of the Coachella Valley to the north and contributes about seven percent of the inflow. Minor tributaries are San Felipe Creek on the west and Salt Creek to the northeast.

Figure 4-14 illustrates the historical approximate proportion of the various water inflow sources to the Sea (SSA 2008). As of 2010, natural sources contribute less than 10 percent of the inflow.

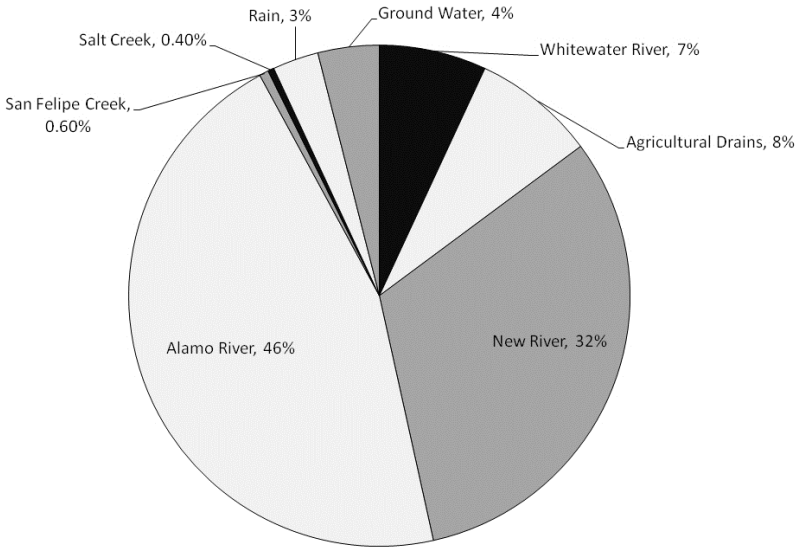


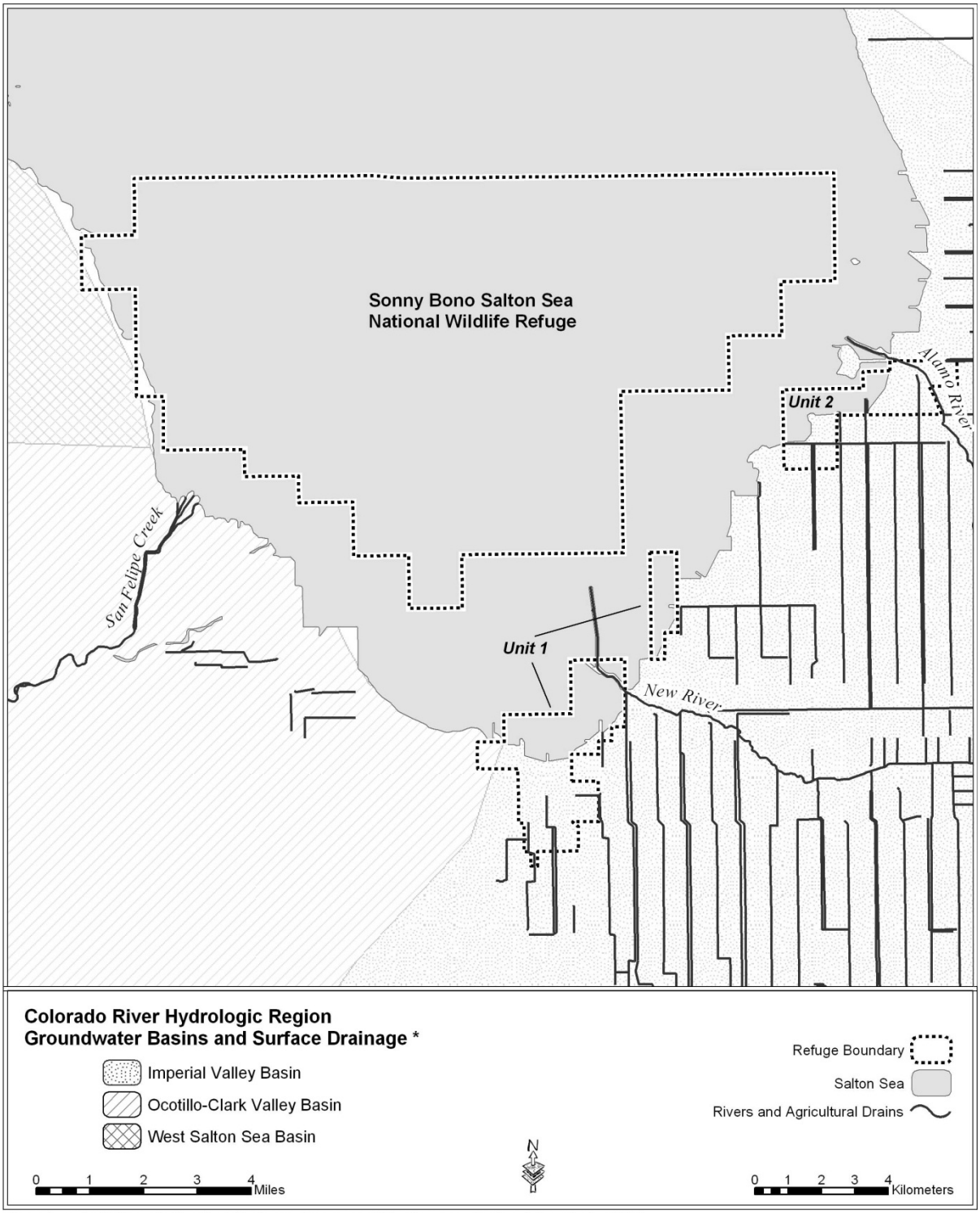
Figure 4-14. Historical Water Inflow Sources for the Salton Sea

The flooding that created the Salton Sea also transformed the New and Alamo rivers from small gullies to their current deeper and wider forms. Following their transformation, these rivers became valuable drainage channels for agricultural drainage water (Norris and Webb 1990). Originating in Mexico, New River flows 20 miles through Mexicali Valley and the city of Mexicali before crossing into the United States at Calexico. The river then flows another 60 miles through Imperial County before emptying into the Salton Sea. River flow at the international border is between 181 and 362 cubic feet per second (cfs), carrying urban runoff, partially treated and untreated municipal and industrial waste, and agricultural runoff from Mexico. While passing through the Imperial Valley, the New River receives inputs from urban, agricultural, treated industrial and wastewater, and domestic sources. Historically, by the time the New River reached the Sea, flow had increased to a range of 553 to 705 cfs. The Alamo River begins about two miles into Mexico and is dominated by agricultural return flows (with some treated wastewater) from the Imperial Valley by the time is finishes its 50 mile journey from the border. The river's flow at the border is quite low (about 2 to 4 cfs), but historically by the time the river reached its delta with the Salton Sea, the flows increased to range of from 680 to 902 cfs (CRWB 2003).

Water is delivered from the Colorado River by the All-American Canal to the Imperial Valley and its agricultural drain system, which itself is approximately 1,450 miles long. The Imperial Valley Agricultural Drain system discharges into the Alamo and New rivers as well as directly into the Salton Sea. Runoff into the Sea historically included about 44 to 48 percent tailwater (excess surface flow associated with agricultural irrigation), 13 percent seepage from canals, drainage channels, and other sources, 27 to 31percent tilewater (subsurface drainage), and 12 percent operational spill (CRWB 2003). The amount of runoff from each of these sources has likely changed since the early 2000s due to the implementation of water conservation measures and the current field fallowing program being conducted by IID. The input of agricultural runoff into the Salton Sea has occurred in accordance with its Federal and State designated purpose as a repository for receiving and storing agricultural, surface, and subsurface drainage waters (specifically as a result of Secretarial Orders issued in 1909, 1920, and 1930, and action by the State of California in 1968).

The Sonny Bono Salton Sea NWR exists both at the edge and under the water at the south end of the Salton Sea. The New River flows north through Unit 1 of the Refuge while the Alamo River flows through the northeast side of Unit 2, after which they each empty into the Sea (Figure 4-15). Changing water levels through time as well as land acquisitions through lease from the Imperial Valley IID have changed the proportion of the Refuge that exists on dry versus inundated land.

Groundwater. Underlying the Salton Sea are thick deposits of alluvium, with silt and clay layers interspersed with sand and gravel deposits where the groundwater occurs (CDWR and CDFG 2006). To the north, this alluvium is permeable as evidenced by the yields of artesian and water table wells in the Coachella Valley. However, the Imperial Valley area is quite impermeable and wells have extremely low yields south of the Sea. In the 1960s, groundwater inflow to the Salton Sea was estimated at about 50,000 acre-feet per year, of which 30,000 acre-feet came from the Coachella Valley and an estimated 10,000 acre-feet flowed in the Sea through the alluvium bordering San Felipe Creek, while inflow through the alluvium of the Imperial Valley was less than 2,000 acre-feet (Hely et al. 1966). Hely et al. does not account for the remaining 8,000 acre-feet of groundwater, but stated that of the seepage from the Coachella Canal, about 8,000 acre-feet entered the Sea from surface channels.



* Groundwater basin information from the California State Department of Water Resources. Drainage information from ESRI.

Figure 4-15. Groundwater Basins and Surface Drainage in and around the Sonny Bono Salton Sea NWR

The California Department of Water Resources (CDWR) has identified three groundwater basins near the Refuge at the south end of the Sea (refer to Figure 4-15). The Imperial Valley Groundwater Basin underlies most of Units 1 and 2 and has a surface area of 1,870 square miles (CDWR 2003). The New and Alamo rivers flow over this basin. The basin has two major aquifers: an upper one with an average thickness of 200 feet, separated by a semi-permeable clay layer (aquitard) from a lower one with an average thickness of 380 feet. Poor hydraulic connection exists between the two aquifers. Recharge of the upper aquifer is primarily from agricultural irrigation, but also from rainfall percolation, underflow into the basin, and seepage from unlined canals. Water levels within the basin vary, but in the recent past, were generally stable because of constant recharge. Conservation measures, which began in earnest in the 1990s and continued into the early 2010s, have contributed to a decrease in the amount of recharge from seepage.

Extremely deep (several thousand feet) groundwater is being pumped from beneath the southern Salton Sea shoreline to support geothermal energy plants (CDWR and CDFG 2006). Total storage capacity of this basin is estimated to be 14 million acre-feet, but the amount of groundwater in storage is not known (CDWR 2003).

The Ocotillo-Clark Valley Groundwater Basin underlies a much smaller portion of the Refuge on the westernmost portions of Unit 1, while the West Salton Sea Groundwater Basin is present below the portion of the Refuge that is almost entirely submerged below the Salton Sea. A small area of dry land is however included along the Refuge's western edge. These basins are recharged by runoff percolation (CDWR 2003). Flows in the lower reaches of San Felipe Creek are supplemented by several hot springs (Salton Sea Authority 1999 in CDWR and CDFG 2006).

Water Importation History. The Salton Sea and its environs are almost entirely dependent on the importation of Colorado River water. However, this dependence on water from the Colorado River extends far beyond the areas around the Salton Sea. In all, seven Colorado Basin states and Mexico receive defined apportionments of water from the Colorado River. California's normal year apportionment is 4.4 million acre-feet (maf), although with some exceptions the State has also had access to one-half of any surplus water appropriated to the lower basin states.

Since the early 1900s, a long and complex history of laws, treaties, contracts, and court rulings, collectively known as the "Law of the River," have led to the current allocations of Colorado River water (CDWR 1998, McClurg 2001). The Colorado River Compact of 1922 is considered the cornerstone of the Law of the River (USBOR 2008). Negotiated by the seven Colorado River Basin states and the Federal government, this compact defined the relationship between the upper basin states, where most of the Colorado River supply originates, and the lower basin states, where most of the demand for water was occurring.

The Boulder Canyon Project Act of 1928 ratified the 1922 Compact; authorized the construction of the Hoover Dam and related irrigation facilities in the lower basin; and apportioned water to the lower basin states. This Act also authorized and directed the Secretary of the Interior to function as the sole contracting authority for Colorado River water use in the lower basin. As such, the Secretary was given final authority over allocating water supplies under the Law of the River. The U.S. Bureau of Reclamation (USBOR), which represents the Secretary on these matters, has authority over contracts with all users of Colorado River water and manages the water storage facilities.

Despite the actions and apportionments set forth in the Boulder Canyon Project Act, conflicts over water priorities continued. The California Seven Party Agreement of 1931, an agreement between Palo Verde Irrigation District, Imperial Irrigation District (IID), Coachella Valley County Water District, Metropolitan Water District of Southern California (MWS), City of Los Angeles, City of San Diego, and County of San Diego, helped resolve in part a long-standing conflict between California's agricultural and municipal interests over Colorado River water priorities (USBOR 2008).

In 1963, the Supreme Court issued a decision settling a 25-year dispute between Arizona and California over the allocation of Colorado River water. In its 1964 decree, the Court enjoined the Secretary of the Interior from delivering water outside the framework of apportionments defined by the law, including water rights that pre-dated the 1928 Boulder Canyon Project Act. The Court also mandated the preparation of annual reports documenting the uses of water in the three lower basin states (California, Arizona, and Nevada). In 1979, the Court issued a Supplemental Decree that addressed present perfected rights referred to in the Colorado River Compact and in the Boulder Canyon Project Act. These rights, essentially entitlements established under state law, have priority over later contract entitlements.

Despite the approval of the California Seven Party Agreement in 1931, public agencies in California continued to dispute their respective allocations of Colorado River water, reasonable use of the water, entitlements, and responsibilities for conservation projects (Lewis-Roberts 2013). Actions related to these disputes finally lead to a Quantification Settlement Agreement (QSA) for the allocation of Colorado River water. The QSA, which was completed in October 2003, has been described as a historic agreement that provides California with the means to implement water transfer programs that will allow California to live within its 4.4 million acre-foot basic annual apportionment of Colorado River water. To do that, the water signatories have agreed to carry out water conservation measures, initiate agricultural to urban transfers, and develop groundwater banking and conjunctive use programs.

Changing Water Use in the Imperial Valley. A number of factors have influenced how water is used and distributed in the Imperial Valley, among them are water laws and agreements (discussed above), water conservation measures, changes in agricultural practices, and rainfall. Over the past 20 to 25 years, a variety of water conservation measures have been implemented in the Imperial Valley to reduce water use including improvements to the water distribution system and changing farming practices to optimize water use in agricultural fields.

In 1988, IID and MWD executed an agreement for the funding and implementation of water conservation measures within IID's service area. Following the completion of several conservation projects in 1997, the parties agreed that the program was conserving an average of 105,000 acre-feet per year (afy), which could then be transferred for use by the junior priority water rights holders under the California Seven Party Agreement of 1931, including CVWD, which would receive up to 20,000 afy, and MWD, which would receive the balance.

In 1998, the IID and the San Diego County Water Authority (SDCWA) approved an Agreement for Transfer of Conserved Water. Pursuant to the original terms of the transfer, the IID agreed to make available to SDCWA a minimum annual quantity of 130,000 acre-feet and a maximum annual quantity of 200,000 acre-feet ramped up over a 10-year schedule. All water was to be provided by efficiency conservation projects (www.iid.com/index.aspx?page=121, accessed on 11/27/13).

In October 2003, IID executed the QSA and related agreements. The QSA is a consensual reallocation of Colorado River water based on a series of agreements related to water conservation, transfer, and exchange projects among IID, CVWD, MWD, the State of California, and the Department of the Interior. The QSA included the 1988 and 1998 conservation and transfer agreements, with modifications, for a period of up to 75 years. In addition to the 105,000 acre-feet of water being conserved under the 1988 IID/MWD Conservation Program, these more recent agreements define an additional 303,000 acre-feet per year to be conserved by IID from on-farm and distribution system conservation projects for transfer to SDCWA, CVWD, and MWD (www.iid.com/index.aspx?page=121, accessed on 11/27/13).

Other examples include the lining of the All-American Canal and the Coachella Canal. These projects, which were funded in 2003, collectively reduce seepage losses from these delivery canals by 98,550 afy. IID has also developed high efficiencies for its on-farm and distribution system; farmers have been lining farm head ditches, installing tile drains, leveling farm fields; IID has built regulating reservoirs, implemented canal seepage recovery programs, and other non-structural measures. A fallowing program has also been initiated by IID in which willing landowners and/or lessees contract with IID to fallow fields; each year a price is set and payment is made for the conserved water (IID 2008).

Water use in the Imperial Valley and to a lesser degree in the Coachella Valley is "inextricably tied to the Salton Sea" because agricultural drainage water flows from the higher elevations of these valleys down to the Salton Sea, the lowest point in the region (IID 2011). For this reason, water conservation plays a role in the overall water availability to the Salton Basin.

There are various predictions for how the changes in water availability within the Imperial Valley could affect the Salton Sea. The California Department of Water Resources in its draft Salton Sea Species Conservation Habitat Project Implementation Plan (2010) states: " The QSA imposes water conservation measures within the IID service area to allow transfer of this water elsewhere, which reduces the volume of agricultural runoff that constitutes the Sea's chief source of water." The Draft Environmental Impact Statement/Environmental Impact Report for the Salton Sea Species Conservation Habitat Project (USAOCE and California Natural Resources Agency 2011) states ". . . the Salton Sea is supported primarily by agricultural return flows. These return flows have decreased in recent time, largely because of water transfers from the Imperial Valley and the resulting water conservation measures. Recent Salton Sea elevations show the elevation peak around May 1995 and a decreasing trend to the end of the 2010 water year . . . Inflow to the Sea from the Imperial Valley is projected to continue to decline from the current annual average of 1,029,620 afy to 723,940 afy (with adjustment for the Quantification Settlement Agreement [QSA]) by 2020. . . As water use within IID decreases, the flow in the New and Alamo rivers would be expected to decrease by approximately 305,670 afy, which would result in a declining water surface elevation in the Sea and an increasing salinity because of the concentrating effect of evaporation. The Quantification Settlement Agreement (QSA) is one of the factors contributing to declining inflows."

McClurg (2001) in The California Plan and the Salton Sea states: "Every drop of water saved and transferred will help California reduce its overall Colorado River use. But every drop of water saved and transferred is one less drop than would normally flow in the Salton Sea…"

Drought conditions also reduce the availability of water within the Salton Basin. Between 2000 and 2005, runoff into Lake Powell ranged from 25 to 62 percent of average. This long drought was the seventh worst in the past 500 years for the Colorado River Basin (McClurg 2006). Sharing the shortage in available water is a sensitive and complicated issue, especially now that the Colorado River has reached full development by its water users. Climate change could also significantly reduce the water supply for longer periods.

Historically, 97 percent of the water delivered by IID was for agricultural purposes. The average annual water requirements per acre for the most valuable crops in the region are indicated in Table 4-6, and range from 2.0 acre-feet per acre for lettuce to 9.5 acre-feet for dates (CVWD 2008). The balance of water use within the District is for municipalities, community water systems, rural homes and businesses, and some industrial uses (IID 2008).

Table 4-6
Crop Average Annual Water Requirements per Acre

Crop*	Acre-feet
Table grapes	6.5
Dates	9.5
Peppers (bell, chili)	5.1
Lettuce	2.0
Watermelons	4.4
Carrots	3.4
Grapefruit	6.9
Oranges and tangerines	7.3
Broccoli	3.2
Green beans	3.2
Sweet corn	3.6
Tomatoes	4.7
Alfalfa hay	7.5
Nursery	9.1
Household (1.3 acre-feet a household)	6.1
Golf course	7.4

*Crops among largest gross value 2005

Source: (CVWD 2008)

The Imperial Water District delivers an average of 10,000 acre-feet of water to the Refuge each year; this water is purchased as needed by the Service (pers. comm. Chris Schoneman, Sonny Bono Salton Sea NWRC). All managed wetlands are flooded with "Class 1" irrigation water (free from fertilizers, pesticides, and salts common in agricultural drain water) supplied by the IID. Wetland plant growth in various stages is promoted through periodic flash flooding and draining of diked ponds during the spring and summer. This management practice provides a variety of wetland plant food and cover to support bird nesting and feeding.

Refuge fields are irrigated during the growing season to produce forage for migratory birds and wildlife. Although the Refuge has been receiving water from IID since about the 1930s, reliable water delivery in the future is uncertain and the cost of delivered water could increase

significantly. As of 2012, the Service did not have a contract with IID for Refuge water use and, as discussed above, limitations on water use by the District's customers are increasing (pers. comm. Chris Schoneman, Sonny Bono Salton Sea NWRC).

Coachella Valley NWR

Surface Water. The Coachella Valley NWR is located within the Coachella Valley Hydrologic Unit, which encompasses all of the areas that drain into the north end of the Salton Sea (CDWR 1964). The primary natural conduit of surface water flows through the Valley is the Whitewater River, which extends for about 70 miles and drains an area containing roughly 400 square miles of valley land and 1,550 square miles of surrounding mountains ranges. Originating in the San Bernardino Mountains to the north of the Coachella Valley, the Whitewater River enters the valley at the east end of San Gorgonio Pass, and flows to the southeast, emptying into the Salton Sea.

As the channel of the Whitewater River extends down into the valley, it broadens into a low-lying floodplain that measures more than a mile in width. At about Cathedral City, river flows are directed into a partially improved channel known as the Whitewater River Stormwater Channel, which protects urban development from potential flooding. East of Washington Street in La Quinta, the natural course of the Whitewater River has been completely channelized and is referred to as the Coachella Valley Stormwater Channel.

Periodic surface flows also occur within ephemeral streams that extend out of the surrounding mountains and onto the central plain of the Coachella Valley. One stream, which originates in the Indio Hills, extends onto the Refuge from Thousand Palms Canyon. Along with periodic water flows, the stream can carry sand and gravel eroded from the adjacent hills onto the valley floor.

Flooding. Due to the subtropical desert climate of the Coachella Valley, the annual rainfall is typically very low, averaging four to six inches. In some years, no measurable rainfall is reported. Precipitation generally occurs during winter months (November through March), although thunderstorms can occur from mid-summer through early fall. Such storms are capable of generating substantial quantities of rainfall in short periods of time. The resulting flash flooding can affect washes extending from canyons, floodways, and floodplains. Flooding on alluvial fans, such as those present on the Refuge, can be particularly damaging because floodwaters move at high velocities and spread across wide, unchannelized areas. The flood hazard present on the Refuge and in the surrounding areas is illustrated in Figure 4-16.

Major storm events have been documented in the Coachella Valley. On September 24, 1939, a storm centered over Indio generated 6.45 inches of rain in a 6-hour period. Hurricane Kathleen, which entered California as a tropical storm on September 9, 1976, generated heavy rainfall between September 9 and September 11 in Riverside, San Bernardino, and Imperial Counties. The mountains and hillsides of the Coachella Valley received as much as 14 inches of rainfall, which drained onto the valley floor and caused extensive flooding and property damage.

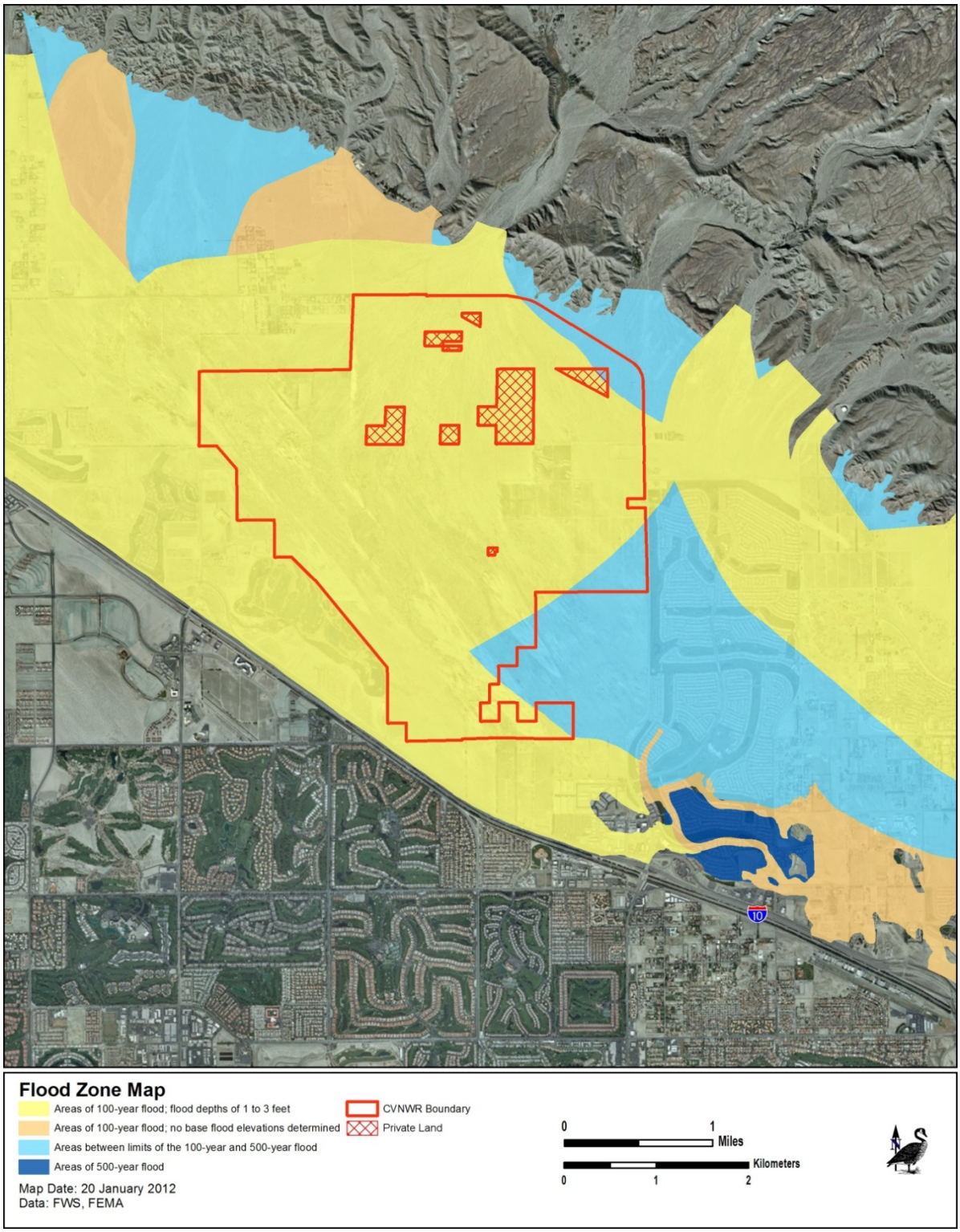


Figure 4-16. Flood Hazards on and surrounding the Coachella Valley NWR

The CVWD is responsible for flood control within the portion of the Coachella Valley in which the Refuge is located. The Whitewater River/Coachella Valley Stormwater Channel is CVWD's principal stormwater management facility. A wide range of regional flood control improvements, including dams, debris basins, and concrete-lined channels, have also been constructed throughout the Coachella Valley in an effort to protect life and property from flooding hazards. However, several areas within the Coachella Valley, including the Thousand Palms area, lack adequate flood control facilities and are vulnerable to alluvial and riverine flooding (Coachella Valley Regional Water Management Group 2010).

The USACOE and CVWD have been working on a design for the Thousand Palms Flood Control Project that proposes the construction of a system of levees that would extend east from Rio del Sol Road to Washington Street. This proposal could affect portions of the Refuge's southeastern boundary, but further information is required from CVWD before the potential effects of this project on the Refuge can be evaluated.

Groundwater. The Coachella Valley Hydrologic Unit includes three groundwater basins, topographic lows that are filled with alluvial debris. The largest of these basins is the Coachella Valley groundwater basin, which encompasses over 690 square miles and has an estimated maximum depth to consolidated rocks in excess of 12,000 feet. It extends from the west end of San Gorgonio Pass to the Salton Sea. The CVWD estimates that the Coachella Valley groundwater basin contains about 36.5 million acre-feet of groundwater within the first 1,000 feet below the ground surface. The two smaller basins (Morongo Valley and Shavers Valley) within the Coachella Valley Hydrologic Unit drain into the lower Coachella Valley basin, contributing to the supply of groundwater in the larger basin (CDWR 1964).

The Coachella Valley NWR is located with a portion of and hydraulically connected to the Whitewater River subbasin, the largest of the four subbasins within the upper Coachella Valley groundwater basin (Tyley 1974). This subbasin is recharged primarily by flows from the Whitewater River watershed with groundwater generally flowing from the recharge areas of the surrounding mountain fronts southeast through the center of the valley to the Salton Sea (Tyley 1974).

In 1936, groundwater usage in the upper Coachella Valley was approximately 15,500 acre-ft., but by 1999, usage had increased to 207,800 acre-ft. Uses for groundwater include crop irrigation, fish farms and duck clubs, golf courses, greenhouses, and industrial use (CVWD 2002). In 1999, all of the water needed to satisfy the agricultural demands in the upper valley and 89 percent of the water demand for golf courses in the upper valley was supplied by groundwater.

Groundwater well data for the upper Coachella Valley groundwater basin indicate that over the last two decades water levels in the aquifer below the lands being conserved as part of the Coachella Valley MSHCP, including the Coachella Valley NWR, have dropped considerably as a result of groundwater pumping to meet the needs of the surrounding areas (CVWD 2005). Records of the water levels in several wells located along the perimeter of the Coachella Valley NWR indicate a drop in water levels between the 1990s and 2012 of about 20 feet (My Desert.com 9/9/13).

Water Availability. Precipitation on the valley floor contributes very little useable water; therefore, agriculture is dependent on irrigation. The main natural source of water in the Valley is groundwater. Potable water is extracted from only two of the region's subbasins, the Whitewater River Subbasin being the primary source. This water is used for domestic and

agricultural purposes and golf course irrigation in the upper and lower Coachella Valley. Groundwater pumped for agricultural and domestic purposes is currently the largest component of outflow from the basin and represents 80 percent of all outflows. The demand for water to irrigate golf courses is reduced to some extent by the availability of reclaimed water from CVWD.

Although there are nearly 37 million acre-feet of groundwater in storage in the Coachella Valley, to meet the demand of the growing region, water needs require that more water be pumped out of the aquifer than can naturally percolate back in. The result is groundwater depletion, which can have adverse effects on the potable water supply, agricultural uses, and native habitat.

Groundwater depletion in the valley was evident as early as 1918. To address this issue, the CVWD was formed. As its first action in 1918, the CVWD began recharging the basin at the unimproved Whitewater Spreading Area using local water. Today, the most important source for recharge of the Coachella Valley aquifer is water from the Colorado River that is directed to the valley via man-made canals (CVWD 2003).

In recent years, a number of projects have been completed and water agreements reached to provide water to this area. The CVWD's Lower Whitewater River Subbasin Groundwater Replenishment Program was implemented to address the declining water table in the lower portion of the Whitewater River Subbasin.

4.4.6.3 Water Quality

Introduction

Issues related to water quality in the Salton Sea Basin are regulated by the Federal Clean Water Act (CWA) of 1972, as amended, (33 U.S.C. §1251 et seq.) and Division 7 of the 1969 California Water Code (also known as the Porter-Cologne Water Quality Control Act). Both the Federal and State law were enacted to protect the beneficial uses of water, although the Porter-Cologne Water Quality Control Act addresses both ground and surface waters, while the CWA addresses only surface waters.

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and regulating quality standards for surface waters. The U.S. Environmental Protection Agency (USEPA) has delegated responsibility for implementing portions of the CWA to the States. In California, the State Water Resources Control Board (State Water Board) and nine Regional Water Quality Control Boards (Regional Water Boards) are the agencies with the primary responsibility for implementing delegated CWA requirements. The Regional Water Boards are also responsible for the preparation, adoption, and implementation of water quality control plans, the issuance of waste discharge requirements, and the performance of other functions concerning water quality control within their respective regions. The Refuge Complex is located within Region 7, which is administered by the staff of the Colorado River Basin Regional Water Board.

California's Porter-Cologne Water Quality Control Act authorizes the Regional Water Boards to adopt, review, and revise policies for all waters of the State (including both surface and ground waters) and directs them to develop region-specific Basin Plans. The purpose of these Basin Plans is to designate beneficial uses of the region's surface and ground waters, designate water quality objectives for the reasonable protection of those uses, and establish an implementation plan to achieve the objectives.

The purpose of the water quality control plan, also referred to as the Basin Plan, is to develop water quality standards for ground and surface waters within the basin. These standards include designated beneficial uses of water bodies, criteria or water quality objectives that are protective of those beneficial uses, and policies to prevent or limit the degradation of water bodies. Per the requirements of the CWA, water quality standards are reviewed and, if necessary, updated every three years.

The Water Quality Control Plan for the Colorado River Basin - Region 7 (Basin Plan), most recently amended in June 2006, sets forth water quality objectives for constituents that could potentially cause an adverse effect on the beneficial uses of water. Periodic review of the Basin Plan is required by both Federal and State law.

The CWA has delegated responsibility for implementation of water quality control programs such as the National Pollutant Discharge Elimination System (NPDES) to the states. The NPDES permit system was established in Section 402 of the CWA to regulate point source discharges to surface waters of the U.S. NPDES permits are issued to ensure that the quality and quantity of discharges does not adversely affect surface water quality or beneficial uses.

Construction and industrial activities are typically regulated under statewide general permits that are issued by the State Water Board. The Regional Water Boards also issue Waste Discharge Requirements that serve as NPDES permits under the authority delegated to the Regional Water Boards under the CWA. In November 1990, under Phase I of the urban runoff management strategy, the EPA published NPDES permit application requirements for municipal, industrial, and construction stormwater discharges. With regard to municipalities, the permit application requirements were directed at jurisdictions owning or operating municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more, or contributing significant pollutants to waters of the U.S. Such municipalities were required to obtain coverage under a NPDES municipal stormwater permit as well as to develop and implement an urban runoff management program to reduce pollutants in urban runoff and stormwater discharges.

The California State Water Board recently approved a NPDES General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities that went into effect in July 2010. This General Permit authorizes discharges of stormwater associated with construction activity so long as the dischargers comply with all requirements, provisions, limitations and prohibitions in the permit. Covered under this General Permit are all discharges of pollutants in stormwater associated with construction activity (storm water discharges) to waters of the U.S. from construction sites that disturb one or more acres of land surface, or that are part of a common plan of development or sale that disturbs more than one acre of land surface. Coverage under this General Permit is obtained by filing a Notice of Intent, Storm Water Pollution Prevention Plan, and other appropriate documents with the State Water Board. In some cases, a General Permit may be determined by the Regional Water Board to be inappropriate for a specific construction project, requiring the discharger to obtain an Individual Permit or apply for coverage under a more specific General Permit. To make this finding, the Regional Water Board must determine that the General Permit does not provide adequate assurance that water quality would be protected, or that there is a site-specific reason for obtaining an individual permit.

Another section of the CWA pertinent to this discussion is Section 305(b), which requires States to prepare and submit to the USEPA a report on the status of the state's ambient water quality. This report includes regional water quality assessments for the various water bodies

within the State. The report lists the water bodies that are assessed, the pollutants of concern, and the potential pollutant sources. Water bodies identified in the 305(b) report as not supporting one or more beneficial uses are considered "impaired" and are then placed on the CWA Section 303(d) List of impaired water bodies. In accordance with CWA Section 303(d), each State must develop, update, and submit to the USEPA a list of those surface water body segments that are "impaired or threatened"- meaning not meeting, or not expected to meet, water quality standards. This impaired water bodies or segments must be addressed through the development of Total Maximum Daily Loads (TMDLs), alternative regulatory programs, or revisions in standards.

The requirement to develop TMDLs applies to "pollutants" as defined in the CWA. Pollutants include chemicals, sediment, and temperature. TMDLs are not required for impairment due to "pollution." Pollution includes factors such as flow alteration, hydromodification, and alterations in aquatic habitat that are not related to specific pollutants.

Section 303(d) of the CWA not only requires States to identify "water quality limited segments" but also to 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 CWA 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 California, the Section 303(d) List is prepared in accordance with the 2004 Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List ("Listing Policy"). The Listing Policy requires the nine Regional Water Boards to assess information and data, conduct public participation processes, and adopt recommendations to the State Water Board regarding the segments to be included in the statewide Section 303(d) List. Following additional participation, the State Water Board submits a statewide list to the USEPA. The USEPA may approve or disapprove specific listings, and may add other segments to the list.

In coordination with the Section 303(d) assessment, the State Water Board has historically prepared a statewide Section 305(b) report with information on the total miles of streams, acres of lakes, and areas of other surface water bodies that support or do not support beneficial uses. For the 2008 cycle, the Water Boards prepared their first Integrated Reports addressing both Section 303(d) and 305(b) of the CWA. The final 2008 Integrated Report was incorporated into the statewide 2010 Integrated Report that was approved by the State Water Board in August 4, 2010 and by the USEPA on October 11, 2011 (CDWR 2011).

Sonny Bono Salton Sea NWR

Surface Water. The Salton Sea and its contributing streams provide for many beneficial uses: water recreation (contact and non-contact), agricultural water supply, municipal water supply, industrial water supply, warm freshwater habitat, wildlife habitat, preservation of threatened or endangered species, freshwater replenishment, and aquaculture (CRWB 2003). Unfortunately, many of these uses are adversely affected by poor water quality conditions. Before 1923, the chemical composition of the Salton Sea's water was directly related to the solution of minerals in the seabed (Hely et al. 1966).

However, as a terminal lake, the only avenue for water to leave the Salton Sea is through evaporation, a process that leaves many salts behind (McClurg 2005). In addition, human uses of imported Colorado River water, which also carries a high load of sediments and minerals, significantly reduce water quality by the time it reaches the Sea. Urban uses have expanded rapidly around Mexicali, Mexico and also in the Coachella Valley. As a designated agricultural drainage, the Salton Sea reflects the input of agricultural runoff containing soluble pesticides and fertilizers as well as chemicals naturally occurring and leached from the watershed's soil. The Sea's high nutrient content classifies it as hyper-eutrophic (CRWB 2005a).

The Sonny Bono Salton Sea NWR receives pollutants from this same variety of sources. The Alamo and New rivers, which feed into the Sea from the south, each pass through Refuge property at their termini. The bulk of the flow in these rivers is agricultural drain water (a mix of tail and tile water along with a much smaller volume of operational discharges). Agricultural drains also empty directly into the Sea from Refuge Units 1 and 2. At times, drainage from the southern portion of Refuge Unit 1 contains water that was used to irrigate Refuge fields.

Legal mandates to protect water quality reside primarily with the California Regional Water Quality Control Board, Colorado River Basin Region (CRWB). The Regional Water Board has declared the Salton Sea Transboundary Watershed (USGS Hydrologic Unit 18100200) as its Priority Watershed for pollution control. This watershed encompasses one-third of the region and contains five of the Region's impaired surface water bodies: Salton Sea, New River, Alamo River, Imperial Valley Agricultural Drains, and Coachella Valley Stormwater Channel.

The CRWB Water Quality Control Plan (2006a) provides general surface water quality objectives for surface waters of the Colorado River Basin Region. These water quality objectives are compared in Table 4-7, by constituent of concern, to seasonal water quality data collected by the BOR in the Salton Sea and its tributaries between 2004 and 2010 (USACOE and California Natural Resources Agency 2011).

Table 4-7
Comparison of Water Quality Objectives with Mean Annual Conditions (2004 -2010)

		Mean Annual Conditions (2004 – 2010)		
Constituent	**Objective***	**Salton Sea**	**New River**	**Alamo River**
Suspended solids (mg/L)		39	217	261
Total dissolved solids (Salinity) (mg/L or ppt)	35 ppt (Salton Sea) 4 ppt (rivers)	51,829 mg/L 52 ppt in 2010	2,636 mg/L 2.6 ppt	1,987 mg/L 2.0 ppt
Nitrate and nitrites (µg/L)		209	4,142	5,862
Ammonia (µg/L)		1,157	1,750	1,347
Total phosphorus (µg/L)	35 (Salton Sea)	103	976	624
Orthophosphate (µg/L)		42	536	306
Selenium (µg/L)	5	1.34	3.18	5.39
Dissolved oxygen range (µg/L)	5	-	3.2-11.5	5.0-12.5

*Objectives from the Water Quality Control Plan for the Colorado River Basin (CRWB 2006a)
Source: USACOE and California Natural Resources Agency 2011

Section 303(c)(2)(B) of the Clean Water Act requires states to adopt numeric criteria for the priority toxic pollutants listed under section 307(a) if those pollutants could be reasonably expected to interfere with the designated uses of States' waters. These designated uses include fish and wildlife preservation and enhancement. On May 18, 2000, the EPA promulgated the California Toxics Rule, which provides numeric water quality criteria for priority toxic pollutants and other provisions for water quality standards to be applied to waters in the state of California. This rule resulted from the determination that the numeric criteria are necessary in California to protect human health and the environment. Among other things, the final rule promulgated ambient aquatic life criteria for 23 priority toxics. In all, 126 priority toxic pollutants are referenced in the Final Rule. A matrix of the applicable EPA aquatic life and/or human health criteria for priority toxic pollutants in California is presented in 40 CFR 131.38.

To remain consistent with the Federal CWA Section 303(d), the State has identified waters that do not meet appropriate water quality standards. The USEPA approved the most current 303(d) list of impaired water bodies for the Colorado River Basin Region on October 11, 2011. Table 4-8 indicates which pollutants are listed for each water body near the Refuge.

Table 4-8
303(d) Listed Water Quality Limited Segments and Pollutants of Concern near the Sonny Bono Salton Sea NWR

Water Body	Pollutant/Stressor	Potential Sources	TMDL Completion Proposed	
			Date	Actual*
Salton Sea				
	Arsenic	Unknown	2021	
	Chlorpyrifos	Unknown	2021	
	DDT	Unknown	2021	
	Enterococcus	Unknown	2021	
	Nutrients	Agriculture, industrial/out-of-state	2006 ongoing	
	Salinity	Agriculture, natural, out-of-state	2019	
	Selenium	Agricultural return flows	2019	
Alamo River				
	Chlordane	Unknown	2021	
	Chlorpyrifos	Insecticide	2019	
	Diazinon	Unknown	2021	
	DDT	Insecticide	2019	(2001)
	Dieldrin	Insecticide	2019	
	Endosulfan	Unknown	2021	
	Enterococcus	Unknown	2021	
	Escherichia coli (E. coli)	Unknown	2021	
	Mercury	Unknown	2021	
	PCBs	Industrial	2019	
	Sedimentation/Siltation	Agriculture[1]		2002
	Selenium	Agriculture	2003	
	Toxaphene	Insecticide	2019	(2001)

Table 4-8
303(d) Listed Water Quality Limited Segments and Pollutants of Concern near the Sonny Bono Salton Sea NWR

Water Body	Pollutant/Stressor	Potential Sources	TMDL Completion Proposed	
			Date	Actual*
New River				
	Chlordane	Pesticide	2019	
	Chlorpyrifos	Insecticide	2019	
	Copper	Unknown	2019	
	DDT	Insecticide	2019	(2002)
	Diazinon	Insecticide	2019	
	Dieldrin	Insecticide	2019	
	Hexachlorobenzene	Unknown	2021	
	Mercury	Unknown	2019	
	Nutrients	Agriculture, municipal/out-of-state	2006	
	Organic Enrichment/ Low Dissolved Oxygen	Wastewater/waste dumping, out-of-state	2006 ongoing	
	Pathogens	Confined animal feed lots, municipal point sources, out-of-state, wastewater		2002
	PCBs	Industrial	2019	
	Sediment	Unknown[1]		2003
	Selenium	Agriculture	2019	
	Toxaphene	Insecticide	2019	(2002)
	Toxicity	Unknown	2019	
	Trash	Unknown/out-of-state[1]		2007
	Zinc	Unknown	2021	
Imperial Valley Agricultural Drains				
	Chlordane	Unknown	2021	
	DDT	Unknown	2019	(2005)
	Dieldrin	Insecticide	2019	
	Endosulfan	Insecticide	2019	
	PCBs	Unknown	2019	
	Sedimentation/Siltation	Agriculture		2005
	Selenium	Agricultural return flows	2019	
	Toxaphene	Insecticide	2019	(2005)

*(year) is the date of the TMDL for Sediment/Siltation that partly addresses DDT and Toxaphene, since sediment serves as a carrier.
[1] Being addressed by USEPA approved TMDL

Source: (CRWB 2011, http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/tmdl/rb7_303d_list.shtml)

These pollutants come from multiple sources including agricultural return flow, which can contain pesticides and fertilizers; dredging of agricultural drains; wastewater; out-of-state or country, industrial point sources; illegal waste dumping; and unknown sources. Point source and stormwater runoff pollutants are regulated under the Federal CWA and the California Porter-Cologne Act.

The Regional Water Board is in the process of developing TMDLs to address impairments identified on the 303(d) list. The TMDL quantifies the amount of a pollutant that a water body can receive and still meet water quality standards identified in the Board's Basin Plan (CRWB 2005a). For pollutants such as nutrients and trash, the Regional Water Board proposes establishing TMDLs in cooperation with USEPA and Mexico (CRWB 2002b, CRWB 2003, CRWB 2006b).

As noted in Table 4-8, six TMDLs in the Salton Sea watershed have been completed by the Board to date: Alamo River Sedimentation/Siltation TMDL (approved by USEPA on June 28, 2002); New River Pathogen TMDL (approved by USEPA on August 14, 2002); New River Sedimentation/ Siltation TMDL (approved by USEPA on March 31, 2003); New River Trash TMDL (approved by USEPA on September 24, 2007); Imperial Valley Drains Sedimentation/ Siltation TMDL (approved by USEPA on September 30, 2005); and Coachella Valley Stormwater Channel Bacterial Indicators TMDL (approved by USEPA on April 27, 2012) (http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/tmdl/ tmdl_completed_projects.shtml). Four other TMDLs are in development: New River Dissolved Oxygen; New River Volatile Organic Compounds (VOCs); Salton Sea Nutrients; and Palo Verde Outfall Drain Bacterial Indicators TMDL.

Each TMDL's implementation strategy is somewhat different. The Sedimentation/ Siltation TMDLs involve a voluntary compliance program that works actively with the IID and the Imperial County Farm Bureau, who work with the individual farmers (CRWB 2005b). The Imperial Valley has been divided into ten hydrologically isolated drainshed areas, which are monitored monthly for TMDL compliance. Farmers in each of these drainsheds are to work together to ensure compliance. Each drainshed is required to meet at least twice per year in order to report to the TMDL Program Director about what best management practices they are implementing and how they are working. The Director then submits a report to the Colorado River Basin Regional Water Quality Board containing this information. If monitoring data shows that a particular drainshed is continuously out of compliance, a meeting is called so that farmers in that drainshed can determine changes that need to be made in order to achieve compliance (CRWB 2005b). Progress is slowly being made but focused efforts are necessary to meet the 2014 sediment targets (CRWB 2007b).

The Salton Sea, rivers, and drains are monitored by the Colorado River Basin Regional Water Quality Board, other agencies, irrigation districts, and consultants (CDWR and CDFG 2006). Specific water quality improvement projects in both Mexico and the U.S. aim to improve water quality, such as a new wastewater treatment plant and sanitation program in Mexicali. An extensive wetlands demonstration project by the IID was constructed on the New River in 2000 to remove certain pollutants from agricultural drainage and the river (Tetra Tech 2006). Monitoring results from 2001 to 2005 indicated that both constructed wetland sites were able to remove a substantial portion of the incoming load of monitored contaminants: nitrogen, phosphorus, suspended sediment, and pathogens. Selenium was removed in one wetland but retained in the other. The Salton Sea Ecosystem Restoration Program's Science Panel considered four water quality parameters to be the most important for consideration in

restoration of the Sea's ecosystem: selenium, hydrogen sulfide, water temperature, and dissolved oxygen (CDWR and CDFG 2006, CDWR and CDFG 2008).

Salinity levels in the Salton Sea are increasing and are expected to rise dramatically as the Sea continues to recede (SSA 2008). The concentrations of other total dissolved solids (TDS) are also rising due to the high rate of evaporation as well as the amount and quality of the freshwater inflow. Records indicate that in 2008 the Salton Sea was 30 percent saltier than the ocean at 48,000 milligrams per liter (mg/l) (CDWR and CDFG 2008). As shown in Table 4-9, a few terminal lakes are below this salinity level while Mono Lake and the Great Salt Lake (the second saltiest water body in the world) are higher (McClurg 2005).

Table 4-9
Comparison of Salinities in Western Terminal Lakes and the Ocean

Water Body	Size (sq. mi.)	Salinity (mg/l)
Salton Sea, CA	365	48,000
Pyramid Lake, NV	188	4,300
Walker Lake, NV	50	15,000
Mono Lake, CA	59-69	80,000
Great Salt Lake, UT	1,800	230,000
Pacific Ocean	-	35,000

Source: (McClurg 2005)

The Basin Plan's water quality objective for total dissolved solids (salinity) in the Salton Sea is to stabilize salinity at 35,000 mg/l. The average salinity in the Sea in 2004 was 48,000 mg/l; by 2010 the average salinity had risen to 51,829 mg/l (approximately 52 parts per thousand [ppt]) (USACOE and California Natural Resources Agency 2011). The Basin Plan acknowledges the difficulty and costs associated with attempting to achieve this water quality objective for the Salton Sea. Specifically, the Basin Plan states:

> "Because of the difficulty and predicted costliness of achieving salinity stabilization of Salton Sea, it is unreasonable for the Regional Board to assume responsibility for implementation of this objective. That responsibility must be shared jointly by all of the agencies that have direct influence on the Sea's fate. Additionally, there must be considerable public support for achieving this objective, without which it is unlikely that the necessary funding for Salton Sea salinity control will ever be realized" (CRWB 2006a).

The New, Alamo, and Whitewater rivers have average salinity concentrations of 2,636, 1,987, and 1,132 mg/l respectively (USACOE and California Natural Resources Agency 2011), which results in lower salinity conditions in the Salton Sea near these tributaries. Between 2004 and 2011, the average salinity in the New River has increased by about 23.6 percent and average salinity in the Alamo River has increased by about 15.8 percent (USACOE and California Natural Resources Agency 2011).

The hypersaline condition of the Salton Sea affects the ability of aquatic species to grow and survive. Saltwater fish species cannot tolerate salinity levels greater than 60,000 mg/l (CDWR and CDFG 2006), which is why Mono Lake and Great Salt Lake support brine shrimp and brine flies but no fish (McClurg 2005). If the present amount of water entering the Salton Sea did not change, just stabilizing the Sea at its current salinity would require that more than four

million tons of salt be removed each year (Cohen and Hyun 2006). However, the effects of the QSA and ongoing water conservation practices in the Imperial Valley are contributing to the decline in water levels within the Sea. If predictions regarding the volume of water remaining in the Sea in twenty years are correct and the Sea's volume shrinks by 60 percent, the salinity levels in the Sea will triple (Cohen and Hyun 2006).

As the inflow into the Sea decreases, areas around the perimeter of the Sea are drying out, exposing the former sea floor. The relatively flat topography at the edges of the Sea, this drying process has exposed large areas along the southern edge of the Sea including Red Hill Bay, which is included within the northeastern portion Unit 2. Air quality will likely be adversely affected due to fine wind-blown dust (Cohen and Hyun 2006). Plans to address the declining sea level, its consequences, and the issue of decreasing water inputs to the sea are the focus of many coordinated efforts, such as the Salton Sea Integrated Water Management Plan (SSA 2008).

Restoration concepts for the Salton Sea are discussed in the Salton Sea Ecosystem Restoration Program Preferred Alternative Report and Funding Plan (CDWR and CDFG 2007). The preferred restoration alternative includes construction of a diked saline habitat complex near the Refuge at the south end of the sea and a combination of exposed playa, marine sea, and saline habitat complex on Refuge property that is currently below water at the south end of the sea. Planning and pre-construction for this restoration effort was scheduled to take place between 2008 and 2014, however, it is currently unclear if this schedule will be met. In response to the immediate need to protect fish and wildlife species dependent on the Salton Sea, the California Legislature appropriated funds for the initial restoration of a range of aquatic habitats to support fish and wildlife, as well as to refine information needed to successfully manage the restored habitat through an adaptive management process. The Salton Sea Species Habitat Conservation (SCH) project is one of the State's initial Salton Sea restoration proposals. A Draft Environmental Impact Statement/Environment Impact Report (EIS/EIR) was prepared for this project and released for public review in 2011 (USACOE and California Natural Resources Agency 2011). Portions of the Sonny Bono Salton Sea NWR are included within the boundaries of the State's preferred alternative for the SCH project.

Groundwater. Groundwater quality varies in each of the basins (CDWR 2003). In the Imperial Valley Groundwater Basin, much of the groundwater is undesirable for domestic or irrigation uses (without treatment) due to the high concentration (greater than 2,000 mg/l) of total dissolved solids (TDS). Groundwater in certain areas of the basin also contains elevated levels of fluoride and boron. The Ocotillo-Clark Valley and West Salton Sea Groundwater Basins underlie a much smaller portion of the Refuge including the westernmost portions of Unit 1 and the small area of dry land at the western edge of the Refuge's Open Water Unit. These groundwater basins contain high concentrations of total dissolved solids (TDS), sulfate, chloride, boron and fluoride. Near the Sea, the Ocotillo-Clark Valley basin has TDS levels greater than 1,000 mg/l (CDWR and CDFG 2006). New River's flow helps recharge the basin but its pollutants contribute to degraded groundwater quality (CDWR 2003).

As described previously, the Basin Plan assigns municipal, industrial, and agricultural beneficial uses for groundwater resources in the Imperial and Coachella Valleys (CRWB 2006a). The following goals and management principles for protection of groundwater are included in the Water Quality Control Plan Colorado River Basin:

- Preservation and enhancement of groundwater, fresh and saline, for present and anticipated beneficial uses, taking social and economic factors into consideration;
- Preservation of the groundwater basins for storing water for beneficial uses;
- Control of water quality factors that can be regulated to preserve the integrity of useable ground water basins; and
- Encourage groundwater recharge with water of adequate quality.

Coachella Valley

Surface Water. The only water body in the Coachella Valley that is included on the USEPA approved 303(d) list of Water Quality Limited Segments is the Coachella Valley Storm Water Channel located well to the south of the Refuge. The pollutants of concern include DDT, dieldrin, PCBs, pathogens, and toxaphene.

Groundwater. Naturally occurring groundwater contains dissolved solids that vary in amount and composition. The quality of groundwater is dependent upon the source of the water, the type of water-bearing materials in which it occurs, and the hydrologic conditions governing the rates at which the groundwater moves (CDWR 1964). Outside factors can also affect groundwater quality. For example, additional dissolved material may be added through percolation of irrigation water, sewage, and other waste waters.

The groundwater within the various subbasins of the Coachella Valley Groundwater Basin exhibit marked variations in character and quality. There are four general types of groundwater present including one that is relatively low in dissolved solids with calcium or sodium bicarbonate as the major dissolved constituents; the second has relatively high total dissolved solids (i.e., sodium and sulfate); the third as equal parts calcium and sodium bicarbonate and sulfate; and the fourth type is high in total dissolved solids of sodium and chloride (CDWR and CDFG 2006). The groundwater beneath the Refuge contains distinctive levels of sodium sulfate.

Although the Coachella Valley groundwater basin has historically provided high quality water, regional water quality has declined since the 1930s (CVWD 2002). For instance, the concentration of TDS in 2000 ranged from 152 to 889 mg/l in the upper aquifer and 131 to 198 mg/l in the lower aquifer versus levels of about 250 mg/l in 1935. This is partly due to declining water levels, which allow total dissolved solids to migrate from the semi-perched zone down into the upper and lower aquifers. High TDS concentrations are associated with the importation of recharge water and the application of fertilizers, but are also associated with major faults. Near the San Andreas Fault and the extension of the Garnet Hill Fault, TDS concentrations exceed 1,000 mg/l (CVWD 2002).

Nitrate concentrations have also increased over time. During the 1930s, nitrate levels were typically less than 4 mg/l throughout the valley. However, by the late 1970s, nitrate levels had increased to more than 45 mg/l in wells adjacent to the Whitewater River. High nitrate levels are primarily associated with the application of fertilizers and the discharge of effluent from septic tanks and wastewater treatment plants (CVWD 2002).

The water quality of the Coachella Valley groundwater basin is also impacted by the addition of salts, which are added through natural recharge, wastewater percolation, fertilizers, irrigation, artificial recharge, and intrusion from the Salton Sea. In 1936, the net salt addition to the Coachella Valley groundwater basin was approximately 12,000 tons per year. By 1999, this figure had increased to about 265,000 tons per year. Approximately 65 percent of the regional salt addition occurs in the lower Coachella Valley, and most of this is associated with

the use of imported Coachella Canal water. Elsewhere in the basin, water quality has been impacted due to petroleum hydrocarbons, nitrates, and salts, which have led to the abandonment of several drinking water wells in the Coachella Valley (CRWB 2003).

Most recently, groundwater quality in the Coachella Valley Groundwater Basin has been studied by USGS in cooperation with the State Water Board. Groundwater samples, obtained in February and March 2007, were analyzed for a large number of organic constituents (VOCs, pesticides and pesticide degradates, pharmaceutical compounds, and potential wastewater-indicator compounds), constituents of special interest (perchlorate and 1,2,3-trichloropropane [1,2,3-TCP]), naturally occurring inorganic constituents (nutrients, major and minor ions, and trace elements), radioactive constituents, and microbial indicators. Most constituents detected in the samples were at concentrations below drinking water thresholds.

VOCs, pesticides, and pesticide degradates were detected in less than one-third of the grid well samples and all VOC and pesticide concentrations measured were below health-based thresholds. Potential wastewater indicators were detected in less than half of the wells sampled, and no detections were above health-based thresholds. Perchlorate was detected in a few samples and a few samples included elevated levels of arsenic, boron, molybdenum, or strontium. Most samples collected had concentrations of major ions and total dissolved solids below the non-enforceable thresholds set for aesthetic purposes. Major ions detected at concentrations above the SMCL-CA (California Department of Public Health secondary maximum contaminant level) thresholds included chloride, fluoride, sulfate, manganese, and total dissolved solids (Goldrath et al. 2009).

Watershed Management. The Coachella Valley Regional Water Management Group (a partnership of five Coachella Valley water purveyors: Coachella Water Authority, CVWD, Desert Water Agency, Indio Water Agency, and the Mission Springs Water District) released its Coachella Valley Integrated Regional Watershed Management Plan (WMP) in December 2010. The WMP addresses water management within the Coachella Valley Region, which generally consists of the lands included within the Whitewater River watershed. The WMP was prepared as an integrated regional water management approach that can effectively address the water issues and priorities of all pertinent agencies and stakeholders in the Coachella Valley.

Five goals are identified in the WMP: 1) optimize water supply reliability; 2) protect or improve water quality; 3) provide stewardship of water-related natural resources; 4) coordinate and integrate water resource management; and 5) ensure cultural, social, and economic sustainability of water in the Coachella Valley. These goals are supported by 13 specific and inter-related objectives. One of these objectives addresses the natural environment. This objective as stated in the WMP is to "Preserve the water-related local environment and restore, where feasible." The focus of this objective is to meet the requirements of Goal 3 (provide stewardship of water-related natural resources) (Coachella Valley Regional Water Management Group 2010).

As acknowledged in the WMP, the Coachella Valley supports important desert and riparian habitats. Additionally, runoff from the Valley is discharged into the biologically-rich Salton Sea. The way in which water is managed in the Valley will have a direct impact on the quality of these native habitats. Habitat may be subject to impacts or stress from invasive species, water quality degradation, or groundwater overdraft. The WMP recognizes that the lowering the water table (increasing the depth to groundwater) can significantly affect water availability to mesquite plants, which provide an important food source for listed and sensitive wildlife and

are an important physical component of the Valley's blowsand habitat. The lowering of the water table below the Refuge is believed to be the cause of the loss of most of the mesquite shrubs within the Refuge's sand field and sand dune habitats. The WMP is intended as the first step in an ongoing process of regional collaboration on issues relevant to water resources planning within the Coachella Valley (Coachella Valley Regional Water Management Group 2010).

4.4.7 Climate/Climate Change

4.4.7.1 Current Climatic Conditions in the Salton Basin

The Colorado River Hydrologic Region is California's most arid, with a climate described as subtropical desert (CDWR 1998). Very little precipitation falls in this area between the Mojave and Sonoran Desert. The western mountains have higher average annual precipitation than the desert areas, with snow falling above 5,000 feet. While most precipitation occurs during the winter, summer thunderstorms occasionally deliver rain and local flooding. As shown in Figure 4-17, the area around the Refuges receives about 2.63 inches of rain a year (CDWR 2008). The area's winter rains originate in the north Pacific Ocean, while summer storms typically come from southern Mexico. The vast Peninsular Ranges, which block coastal moisture from moving east into the region, also capture summer monsoonal moisture moving northwest from the subtropics. High intensity rains can sometimes occur during the mid-summer producing flash floods and severe erosion. There is also a history of impacts to the area as a result of periodic severe thunderstorms and major tropical storms (Conservation Biology Institute 2009).

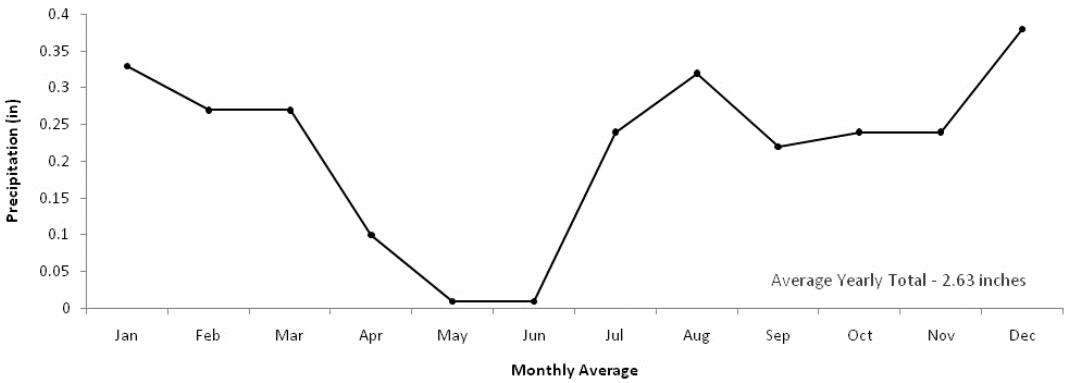


Figure 4-17. Monthly Precipitation in the Vicinity of the Sonny Bono Salton Sea NWR

To the north at Thermal, rainfall has averaged slightly more at 3.61 inches per year (CVWD 2008). Dry desert conditions also reflect the extremely high summer temperatures and cool winter nights. As seen in Table 4-10, four months of the year have an average high of over 100°F at Thermal, while annual high temperature averages 88.4°F. Summer daytime temperatures can occasionally exceed 125°F and winter temperatures rarely fall below freezing. When frosts do occur, they generally occur in December and January in both the Imperial Valley and Coachella Valley. In addition to the area's seasonal temperature ranges, large fluctuations in daily temperatures can also occur, which creates special challenges for all life forms in this region.

Climatic wind regimes in the Coachella Valley have and continue to play a significant role in shaping the valley floor and creating specialized habitats. As the desert floor heats up, cool ocean-modified air masses from the west are drawn into the Valley through the narrow San Gorgonio

Pass. This draw effect generates strong and steady winds, which pass over the most erosive portions of the valley floor, transporting large quantities of sand and dust throughout the region. The sand transport is limited to areas downwind with a path to the source below about 4 feet off the ground, while dust is spread around much more widely.

Table 4-10
Average Weather Conditions at Thermal FAA Airport 1971-2000

Month	Average High (°F)	Average Low (°F)	Rain
January	70.9	39.0	0.71
February	75.1	43.3	0.66
March	80.4	48.5	0.35
April	86.9	54.7	0.08
May	93.9	62.3	0.06
June	102.6	68.9	0.03
July	106.5	74.8	0.17
August	104.9	74.4	0.44
September	100.3	68.0	0.35
October	90.5	56.5	0.17
November	75.9	42.5	0.22
December	70.6	37.6	0.38
Annual	**88.4**	**56.0**	**3.61**

Source: (CVWD 2008)

Stronger winds tend to occur in the open mid-portion of the Valley, while lighter winds tend to occur closer to the foothills. In the northern portions of the Valley, the annualized wind pattern is from the west and northwest. Santa Ana conditions, which result from large domes of high pressure over Nevada and Utah, result in hot and dry northerly and northeasterly winds, which play a very limited role in sand transport, although such conditions do contribute to locally high levels of fugitive dust (CVAG 2007b).

Seasonal winds can be a problem in some portion of the Coachella Valley and Imperial Valley. Windstorms most frequently occur in the late spring and can cause extensive damage to unprotected soils, plants, structures, and vehicles. Airborne dust carried by these winds can compromise air quality and respiratory health.

4.4.7.2 Climate Change

Climate change is defined as the long-term change in the statistical distribution of weather patterns over periods ranging from decades to millions of years (CDM 2011). It is well documented and widely accepted that the Earth's climate has fluctuated and changed throughout history. Scientific evidence also acknowledges that world climate is currently changing as indicated by increases in global surface temperature, altered precipitation patterns, warming of the oceans, sea level rise, increases in storm intensity, changes in wind patterns, and changes in ocean pH (Bierbaum et al. 2007, Coastal Resources Center, University of Rhode Island and International Resources Group [CRC&IRG] 2009). This is significant because "climate is a dominant factor influencing the distributions, structures, functions and services of ecosystems" (CCSP 2008). Climate change, defined as any change in climate over time whether due to natural

variability or as a result of human activity (CCSP 2008), can interact with other environmental changes to affect biodiversity and the future condition of ecosystems.

Shifts in precipitation patterns and hydrological cycles, sea level rise, and more frequent and severe weather events (e.g., storms and storm surge) are the result of the warming of air and sea. These effects are already being experienced along the world's coastal regions and are expected to intensify in the coming years (CRC&IRG 2009). Changes in current climate patterns will have significant consequences for the world's coastal areas. Anticipated effects include accelerated coastal erosion and loss of land and property, flooding, saltwater intrusion, shifts in the distribution and abundance of valuable marine habitats, species and biodiversity, and the accelerated spread of exotic and invasive species (CRC&IRG 2009).

Based on the results of 21 global climate models that address a scenario (referred to as A1B) in which multiple energy sources, including fossil fuels, continue to be consumed, the conservative forecast for western North America is a linear change in mean temperatures ranging from +2.1 °C to +5.7 °C (+3.8 °F to +10.4 °F) and a linear change in mean precipitation ranging -3 percent to +14 percent through the end of the century (Friggens et al. 2012). Under this scenario, it appears that such changes will be most favorable for the desert scrub vegetation types found in the Mohave, Sonoran, and Chihuahuan deserts, which are all projected to expand (Friggens et al. 2012). However, predicting how species distributions and vegetation communities will change is difficult; and to date, very limited modeling to better understand the effect of this change on individual species, including birds, mammal, reptiles, invertebrates, and plants, has occurred. To address the uncertainties of how populations of species, potentially adapted to local conditions, will respond to a changing climate, Barrows and Murphy-Mariscal (2012) identify the need for a local-scale approach to modeling that takes into consideration the topographic and ecological complexities of a specific management area or species range.

In California, maximum, average, and minimum air temperatures have increased over the past century, with the greatest increase seen in minimum temperatures (Anderson et al. 2008). Precipitation on the other hand has been highly variable over this period with no statistically significant trend, and it is unknown how climate change could affect the amount, form, and timing of precipitation statewide. In southern California, temperatures are predicted to increase over time. These increases in temperature could result in extended periods of excessive heat and generally drier conditions (Cayan in Southern California Association of Governments [SCAG] 2009). Several of the more recent climate simulations for southern California suggest that summer temperatures will increase more than those in winter, with the effects felt most significantly in the interior areas of Southern California (Cayan in SCAG 2009). The combination of higher temperatures and potentially lower annual precipitation rates is likely to increase water demand in urban areas, which will in turn stress areas already affected by limited water supplies, including the receding Salton Sea and groundwater depletion in the Coachella Valley.

Climate change research and monitoring is ongoing and information about local and global climate conditions and trends continues to be expanded and updated. In a recent study, researchers found that global temperatures did not increase as quickly between 2000 and 2009 as they had in previous years (Solomon et al. 2010). This reduction in temperature increase appears to be the result of a ten percent decrease in water vapor in the stratosphere. The reason for this decline in water vapor is unknown; however, as a result of this decline, the rise in average global surface temperatures from 2000 to 2009 was approximately 25 percent lower than expected, with average temperatures rising only 0.1 °C (0.18 °F) during the period, rather than the 0.14 °C (0.25 °F) increase expected because of increases in other greenhouse gases (Solomon et al. 2010).

In addition to uncertainty with respect to how temperatures could be affected in southern California as a result of climate change, there is also uncertainty regarding changes in precipitation. Variability in location, timing, amount, and form of precipitation has raised issues related to the availability of water in California. The Department of Water Resources has determined that the Sierra snowmelt is shrinking and that melting is occurring earlier, shifting runoff from the spring further into the winter and causing winter flooding.

Changes in precipitation pattern and quantity throughout the Southwest may also impact potential water supply availability from the Colorado River. Concerns about climate uncertainty have resulted in the need to adapt existing flood management and water supply systems in response to changing conditions (Coachella Valley Regional Water Management Group 2010). One of the forest management strategies included in the California Water Plan Update 2009 addresses the need to better understand the hydrologic changes that could result from climate change, and recommends the establishment of long-term monitoring through the installation of stream gages, precipitation stations, water quality and sediment monitoring stations, and long-term monitoring wells.

4.4.8 Air Quality

4.4.8.1 Introduction

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 USEPA and the California Air Resources Board (CARB) 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 USEPA 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) eight hour standard, particulate matter equal to or less than 10 microns in size (PM_{10}), fine particulate matter equal to or less than 2.5 microns in size ($PM_{2.5}$), and lead (Pb). The Clean Air Act also permits States to adopt additional or more protective air quality standards.

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 a one-hour classification for O_3, sulfates (SO_4), hydrogen sulfide (H_2S), and visibility reducing particles.

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 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 PM_{10} are construction, demolition, and dust from paved and unpaved roads.

In March 2008, the USEPA revised the NAAQS for ground-level ozone, lowering the primary 8-hour ozone standard from 0.08 ppm to 0.075 ppm and revised the secondary 8-hour ozone standard,

making it identical to the primary standard. These new standards were reconsidered in 2009; however, in September 2011 the USEPA restarted efforts to implement the 2008 standards. According to the USEPA, the new primary standard is needed to protect the public from adverse health effects (e.g., respiratory illness, premature death from heart or lung disease) associated with ozone exposure, and the revised secondary 8-hour ozone standard is needed to protect against welfare effects, including impacts on sensitive vegetation and forested ecosystems.

In April 2012, the USEPA issued its final designations, which are based on air quality monitoring data, recommendations submitted by the states and tribes, and other technical information. Imperial County and the portion of Riverside County within the Salton Sea Air Basin were designated as nonattainment areas, as these areas currently exceed the 2008 ozone standards. The area designations and classifications were effective as of July 20, 2012.

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. The current national and state ambient air quality standards are provided in Appendix K. 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 Refuges of the Sonny Bono Salton Sea NWRC are both located within the Salton Sea Air Basin.

Another aspect of air quality associated with the Salton Sea is odor. The Salton Sea, like all bodies of water, emits odors produced as a result of decaying biomatter (e.g., algae, fish, plants). The intensity of the odors generated by the Salton Sea has typically varied with the seasons. The most intense odors are often produced during the late summer and early spring. When the high nutrient loads in the Sea, which tend to settle near the bottom, are stirred up by strong winds or collapsing temperature inversions, these nutrients become available to support massive algal blooms. As these algal blooms decompose, gasses, including hydrogen sulfide, are released into the atmosphere. Odors can also be generated when decomposing matter that has settled to the bottom of the Sea is moved back to the surface by strong winds.

On September 9, 2012, hydrogen sulfide from the bottom of the Sea was stirred up by a monsoonal thunderstorm, creating what is now referred to as the "Big Stink." Strong winds associated with the storm system carried the gases, which smelled like rotten eggs, across the Coachella Valley and through the Banning Pass into the South Coast Air Basin. The strong odor was detected in Riverside, the San Fernando Valley, and along coastal southern California. It was also carried west from the Salton Sea through the mountain passes into the Temecula Valley. Air samples taken on the afternoon of September 10 at several locations from the Salton Sea to the Riverside area showed a pattern of total sulfur gases from 149 ppb near the Salton Sea, to about 30 ppb in Indio and Thermal. The state air quality standard for hydrogen sulfide is 30 ppb, averaged over one hour, and the odor threshold for hydrogen sulfide is generally about 8 ppb.

As the Salton Sea recedes, the potential for large-scale odor events is likely to increase through about 2040. The South Coast Air Quality Management District plans to establish two hydrogen sulfide monitoring stations at the Salton Sea in summer 2013 and will share the data collected with the Imperial County Air Pollution Control District. A plan will also be developed for notifying the public of peak odor events. According to the Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report (California Department of Water Resources and CDFG 2006), circulation and mixing of the waters within the Salton Sea would continue to be driven primarily by winds, but by about 2040 when water depths are much shallower, the effects of thermal stratification are expected to be weaker, allowing more frequent mixing of surface and

bottom waters. The result would likely be a slightly less stratified vertical temperature profile with greater quantities of dissolved oxygen in deeper water areas. Under these conditions, the frequency and magnitude of mixing events that bring anoxic water with high concentrations of hydrogen sulfide, ammonia, and phosphorus to the surface are expected to decrease.

4.4.8.2 Sonny Bono Salton Sea NWR

The desert environment around the Salton Sea provides challenges to maintaining good air quality year around. High winds are prevalent and pick up dust and sand from natural and human sources. The Sand Hills to the southeast of the Sea are a natural feature that develops by wind. Areas of dry lakebed are naturally covered with fine sediment deposits that, when carried by wind, become particulate matter at high concentrations. The sources of windborne pollutants are not all local, as the Salton Sea Air Basin is strongly affected by pollutants blown in from adjacent air basins – the South Coast Air Basin to the northwest and from Mexico to the south. Today, air quality concerns related to public health are heighted due to the expanding area of dry lakebed being created as the Salton Sea recedes. Sea levels are predicted to continue to decline (Cohen and Hyun 2006), potentially increasing the amount of particulate matter in the air as sediments on the dried sea floor are eroded by the Region's prevailing winds (CLAO 2008).

The Salton Sea Air Basin is one of many air basins in the State defined and regulated by the CARB. Local management of Federal, State, and local air quality laws is carried out by Imperial County Air Pollution Control District (ICAPCD) for that portion of the air basin located within Imperial County. The Imperial County portion of the Salton Sea Air Basin is a State nonattainment area for ozone, moderate one-hour classification, and for PM_{10} and a Federal nonattainment area for eight-hour ozone standards and $PM_{10.}$

Ozone is an ingredient of smog that is mainly derived from hydrocarbon and nitrogen oxide gasses that are emitted by vehicles and industrial plants. It is capable of damaging the linings of a person's respiratory tract, resulting in lung damage, shortness of breath, and worsening of asthma symptoms. Nearly 20 percent of children and adolescents in Imperial County have asthma—one of the highest rates in the state (CLAO 2008). Elevated levels of ozone can also impact crop yields. Ozone violations in the air basin occur on most summer days when winds blow pollutants from the South Coast through the San Gorgonio Pass into the Coachella Valley or from Mexicali, Mexico into Calexico. The numbers of days each year that ozone levels exceed the 1-hour and 8-hour State and Federal standards varies considerably. As indicated in Figure 4-18, between 1998 and 2008, a slight downward trend is apparent for the Salton Sea Air Basin in the number of days of exceedance for each standard. In 2010, the ICAPCD issued the 2009 8-Hour Ozone "Modified" Air Quality Management Plan per USEPA requirements (ICAPCD 2010).

The CARB defines particulate matter (PM) as a complex mixture of tiny particles that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid (http://www.arb.ca.gov/aaqm/partic.htm). These particles vary greatly in shape, size, and chemical composition, and can be made up of many different materials such as metals, soot, soil, and dust. Particles 10 microns or less in diameter are defined as "respirable particulate matter" or "PM_{10}." Fine particles are 2.5 microns or less in diameter ($PM_{2.5}$) and can contribute significantly to regional haze and reduction of visibility in California. Extensive research indicates that exposure to outdoor PM_{10} and $PM_{2.5}$ levels exceeding current air quality standards is associated with increased risk of hospitalization for lung and heart-related respiratory illness, including emergency room visits for asthma. PM exposure is also associated with increased risk of premature deaths, especially in the elderly and people with pre-existing cardiopulmonary disease. In children, studies have shown associations between PM exposure and reduced lung function and increased respiratory symptoms and illnesses.

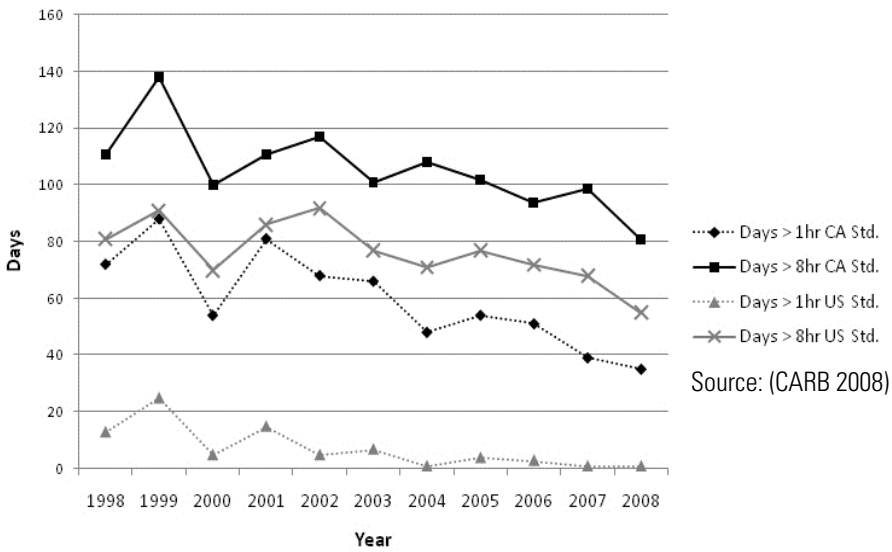


Figure 4-18. Ozone Non-Attainment Day Trends for the Salton Sea Air Basin, 1998-2008

Figure 4-19 depicts recent trends in the number of days each year that the State Standard for PM_{10} was exceeded. While improving since 2000, the levels rose again in 2006. An exceedance is not necessarily a violation. In 2003, the annual average standard for PM_{10} was lowered by CARB from 30 µg/m3 to 20 µg/m3, which is not to be exceeded. Sources of PM_{10} emissions in the air basin are 69 percent wind-blown dust from open lands, 13 percent unpaved road dust, seven percent farming operations, four percent paved road operations, three percent construction and demolition, and four percent other sources (Cohen and Hyun 2006). An unknown amount is transported from Mexico (ICAPCD 2008).

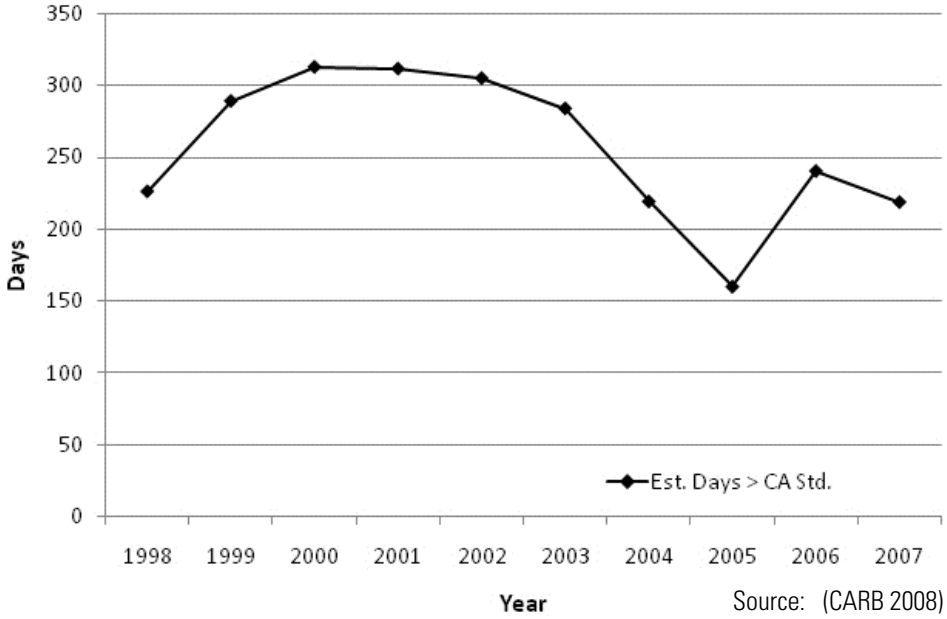


Figure 4-19. PM_{10} Non-Attainment Day Trends for the Salton Sea Air Basin, 1998-2007

In 2009, ICAPCD issued the "Final 2009 Imperial County State Implementation Plan for Particulate Matter Less Than 10 Microns in Aerodynamic Diameter. This document provides an overview of ICAPCD's PM_{10} control program and describes fugitive dust rules and analyses of control effectiveness. It also addresses the anticipated future impact of PM_{10} emissions from the receding Salton Sea on Imperial County air quality.

Air quality issues being addressed in the Region include proposals for new facilities in Imperial County, which could increase emissions (ICAPCD 2008). However, the biggest concern in this air basin is the potential human health hazard of an estimated 33 percent increase in fine wind-blown dust that may occur due to the exposure of more than 100 square miles of dusty lakebed in the next twenty years as the Salton Sea's level shrinks (Cohen and Hyun 2006, CLAO 2008).

The cost of implementing measures to control dust at Owens Lake, which was completely desiccated in the 1920s, has exceeded $400 million (Cohen and Hyun 2006). An analysis by ICAPCD of the effects on air quality in the Imperial Valley as a result of exposed sea beds at the Salton Sea indicates that the generation of wind-blown dust and the associated costs for controlling dust will be lower at the Salton Sea for various reasons, including differences in the composition of the sediments and in the frequency and intensity of high winds blowing across the exposed surface.

The sediments that will be exposed at the Salton Sea consist of sodium chloride, which is harder and less vulnerable to abrasion than the sodium carbonate found at Owens Lake (Imperial County 2009). In addition, peak wind speeds and the number of hours per year with wind speeds in excess of the wind-blown dust generation threshold are expected to be much lower than those experienced at Owens Lake (Imperial County 2009). Previous evaluations of this situation expressed concern regarding the delta of the New River where sand and fine sediments are considered particularly conducive to wind erosion (Cohen and Hyun 2006). It is however difficult to predict how much land under the present Salton Sea will eventually produce dust after exposure. The State's Salton Sea Ecosystem Restoration Program is seeking to address the air quality management issue, along with other issues of a lower and saltier Salton Sea (CLAO 2008, CDWR and CDFG 2006, CDWR and CDFG 2007).

4.4.8.3 Coachella Valley NWR

The South Coast Air Quality Management District (SCAQMD) is the local agency responsible for air quality assessment and improvement in the Coachella Valley, which is included within the Salton Sea Air Basin. Air quality, which is one of the most critical environmental issues affecting the Coachella Valley, can have profound impacts on the public's health, regional economy, and ecological resources. Although coordinated local, regional, and State efforts have resulted in improved air quality in recent years, the region continues to face significant air pollution challenges. Complicating the matter are two additional factors: varied and frequently extreme local climatic conditions, and the significant contribution to local air pollutants due to the import of pollutants from the Los Angeles and Riverside/San Bernardino air basins. The most significant air pollutant in the Coachella Valley is local suspended particulate matter (CVAG 2007a).

The Coachella Valley portion of the Salton Sea Air Basin is a State nonattainment area for ozone (extreme one-hour classification) and PM_{10} and a Federal nonattainment area for eight-hour ozone standards and PM_{10} (CARB 2012, SCAQMD 2009). SCAQMD is principally responsible for leading the regional effort to attain State and Federal air quality standards within the Coachella Valley portion of the Salton Sea Air Basin (CVAG 2007b).

The geophysical and climatic conditions of the Coachella Valley have a significant effect on regional air quality and the limited ability to control it. The mountains effectively isolate the valley causing

a hot, arid desert basin with sparse, widely spaced vegetation susceptible to severe drought conditions, excessive flooding, air inversions, and high winds, each of which influences regional air quality. Large-scale wind regime transports and deposits large quantities of blowing sand, which serve as an essential component of sandy habitats supporting a variety of specialized plant and wildlife species. Yet these winds also transport large quantities of dust, which can result in adverse environmental effects, especially to the human environment. Fugitive dust generated by construction and agricultural activities exacerbates air quality. The adverse health effects of dust in humans, including reduced lung capacity and function, can be severe (CVAG 2007b). The Coachella Valley is currently designated by the USEPA as a serious nonattainment area for 24-hour average PM_{10}.

In 2009, the District requested the Coachella Valley be redesignated from a Federal serious nonattainment area to an attainment area for PM_{10} because the Coachella Valley had not violated the federal 24-hour PM_{10} standard (150 μg/m3) from 2000 through 2008, excluding exceptional events (e.g., high wind driven dust storms, thunderstorm micro-bursts, wildfires). However, as of December 5, 2013, the Coachella Valley was still designated by the USEPA as a serious nonattainment area for PM_{10} (http://www.epa.gov/oaqps001/greenbk/ancl.html).

Most PM_{10} (e.g., dust, metallic and mineral substances, pollen, smoke, aerosols) in the Coachella Valley is generated locally by direct particle erosion and fragmentation, but others originate from the Los Angeles area. The Coachella Valley has a history of elevated PM_{10} levels, which are closely correlated to and primarily associated with fugitive dust emissions from grading and construction and the valley's natural wind processes. In January 1993, the Coachella Valley was reclassified from a "moderate" to "serious" non-attainment area for PM_{10} by the USEPA. Although the Coachella Valley achieved the Federal PM_{10} standard for several years in the mid-1990s, it now continues to be designated a "serious" non-attainment area for PM_{10}. To remedy this situation, the SCAQMD and CVAG jointly developed "Guidelines for Dust Control Plan Review for Coachella Valley Jurisdictions" in 2000, and prepared the 2002 Coachella Valley PM_{10} State Implementation Plan, which includes PM_{10} control program enhancements (CVAG 2007b).

The balance between urbanization, controlling PM_{10} emissions, and preserving sensitive biological habitat in the Coachella Valley is a delicate one. The Coachella Valley experienced rapid urbanization over the two past decades with increased grading, construction, and other land disturbances that have exacerbated the regional fugitive dust problem. More recent development has expanded into unprotected central areas of the valley, including the Thousand Palms area, where high winds, loose soils, and blowing sand predominate. Elements of the built environment (e.g., buildings, roads, vegetative windbreaks, fencing) can interrupt natural blowsand transport pathways and reduce the amount of sand reaching important sand dune habitat including the Refuge and Preserve, and the unique fauna and flora they support. Interference with these and other sand transport and deposition areas can severely compromise the long-term viability of sand dune/sand field habitat and the survival of endangered, threatened, and other sensitive species. Efforts have been undertaken to implement sand re-deposition projects to enhance sand availability in the Preserve east of Thousand Palms. Conversely, conflicts have occasionally arisen between the natural sand deposition process and human development where some now cite the protected Coachella Valley sand dunes as unacceptable sources of upwind sand (CVAG 2007b).

The Coachella Valley has a history of exceeding ozone standards, although less so over the last decade. The valley is classified as a severe ozone nonattainment area under the Federal CAA. Studies conducted by SCAQMD indicate that most ozone is transported to the region by coastal winds from Los Angeles area and improved air quality in the Coachella Valley would be partly dependent upon reduced ozone emissions originating from the west (CVAG 2007b).

4.4.8.4 Greenhouse Gas Emissions

There is general scientific consensus that increases in greenhouse gases (GHGs) in the atmosphere are a contributing factor to increases in average global temperatures. GHGs trap heat in the atmosphere, which in turn heats the surface of the Earth. Some GHGs occur naturally and are emitted to the atmosphere through natural processes, while others are created and emitted solely through human activities. The emission of GHGs through the combustion of fossil fuels (i.e., fuels containing carbon) in conjunction with other human activities, appears to be closely associated with global warming (State of California Office of Planning and Research 2008). The USEPA and the State of California identify the principal GHGs that enter the atmosphere because of human activities as: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (i.e., hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) (California Energy Commission 2006). The most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide.

Carbon dioxide enters the atmosphere through the burning of fossil fuels. Methane is emitted during the production and transport of coal, natural gas, and oil; it is also emitted as a result of livestock and other agricultural practices and the decay of organic waste in municipal solid waste landfills. Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Fluorinated gases are powerful, synthetic greenhouse gases that are emitted from a variety of industrial processes and are sometimes used as substitutes for ozone-depleting substances.

California is a substantial contributor of GHGs, emitting an estimated 463.6 million metric tons of carbon dioxide in 2000 (CARB 2011). California's gross emissions of GHGs did however decrease by 1.5 percent between 2000 and 2009. In addition, emissions in 2009 were 5.8 percent lower than 2008 estimates, which is likely due in part to the economic recession and higher fuel prices, which resulted in declines in on-road transportation, cement production, and electricity consumption (CARB 2011).

The impact of anthropogenic activities on global climate change is apparent in the observational record. Air trapped by ice has been extracted from core samples taken from polar ice sheets to determine the global atmospheric variation of carbon dioxide, methane, and nitrous oxide from before the start of the industrialization (approximately 1750) to over 650,000 years ago. For that period, it was found that carbon dioxide concentrations ranged from 180 ppm to 300 ppm. For the period from approximately 1750 to the present, global carbon dioxide concentrations increased from a pre-industrialization period concentration of 280 ppm to 379 ppm in 2005, with the 2005 value far exceeding the upper end of the pre-industrial period range (IPCC 2007a). The IPCC constructed several emission trajectories of GHGs needed to stabilize global temperatures and climate change impacts and concluded that a stabilization of GHGs at 400 ppm to 450 ppm carbon dioxide-equivalent concentration is required to keep mean global climate change below 2°C (3.6°F).

To address GHG emissions at the Federal level, President Obama on October 5, 2009, signed Executive Order 13514 on Federal Sustainability, setting measureable environmental performance goals for Federal agencies. Each Federal agency was required to submit a 2020 GHG pollution reduction target from its estimated 2008 baseline to the White House Council on Environmental Quality and to the Director of the Office of Management and Budget by January 4, 2010. On January 29, 2010, President Obama announced that the Federal government would reduce its GHG emissions by 28 percent by 2020. To achieve this goal, each Federal agency must develop a Sustainability Plan that defines how sustainability goals will be met, energy use will be reduced, long-term savings will be achieved, taxpayer dollars will be saved, and local clean energy jobs will be created.

In California, to avert the consequences of climate change, California Assembly Bill 32 (AB 32), the Global Warming Solutions Act of 2006. AB 32 establishes a State goal of reducing GHG emissions to 1990 levels by the year 2020. It also directed CARB to begin developing discrete early actions to reduce greenhouse gases while also preparing a scoping plan to identify how best to reach the 2020 limit. The CARB recently adopted a statewide 2020 GHG emissions limit and an emissions inventory, along with requirements to measure, track, and report GHG emissions by the industries it determined to be significant sources of GHG emissions. In addition, the CARB has developed a Scoping Plan that outlines California's strategies for reducing GHG emissions. The Governor of California has also set a long-range reduction goal of reducing GHGs to 80 percent below 1990 levels by 2050.

4.4.9 Contaminants

4.4.9.1 Introduction

Contaminants are human-made or naturally occurring substances that can be toxic to individual organisms or ecosystems through the alteration of biochemical processes. Unnatural sources of contaminants include pesticides, fertilizers, and industrial chemicals that can enter the environment through the air, water, or soil. Leaking chemical or fuel storage tanks, solid waste disposal sites, and industrial sites where spills were improperly managed are all potential sources of soil and/or groundwater contamination. The use of chemicals, particularly pesticides, in association with current and historical agricultural practices can also result in elevated levels of contaminants in the environment. Information concerning the presence and current disposition of hazardous wastes in a project area can be obtained from a variety of government databases.

The Resource Conservation and Recovery Act of 1976 (RCRA) (42 USC Section 6901-6987) was enacted to protect human health and the environment, reduce waste, conserve energy and natural resources, and eliminate the generation of hazardous waste as expeditiously as possible. The Hazardous and Solid Waste Amendments (HSWA) of 1984 significantly expanded the scope of RCRA by adding new corrective action requirements, land disposal restrictions, and technical requirements. The corresponding regulations in 40 CFR sections 260-299 provide the general framework for managing hazardous waste, including requirements for entities that generate, store, transport, treat, and disposed of hazardous waste. In California, USEPA has delegated most of the regulatory responsibilities to the State.

The Service's Environmental Contaminants (EC) Program provides support to Refuges in dealing with issues related to contaminants, including evaluation of potential threats to Refuge resources from contaminants through the Contaminants Assessment Process (CAP). The EC Program also assists Refuge staff in working with the State when necessary to address hazardous waste issues identified on a Refuge.

4.4.9.2 Sonny Bono Salton Sea NWR

At the Salton Sea, contaminant issues relate to many of the pollutants already discussed under the previous discussion of water quality. Accumulating contaminants through the food chain, or bioaccumulation, is an especially high risk at the Salton Sea (Roberts 1997a). After reconnaissance and detailed studies from 1986 through 1990, the Service found that fish and wildlife at the Salton Sea were at risk of being adversely affected by contaminants due to Federal irrigation projects operated by the Bureau of Reclamation (Bennett 1998, USDOI 2005). In particular, selenium, DDT (and its derivatives), and boron were found to be contaminants of concern in the water, sediment, and biota.

Selenium is a notorious wildlife contaminant because of the discovery in the early 1980s of its toxic levels in the food chain causing the death and deformity of wild birds drawn to the Kesterson Reservoir in California's Central Valley (Pitzer 2006). A naturally occurring trace element common in the West's soils and rocks, selenium is an essential dietary mineral at low levels but toxic when accumulations build to certain levels. A narrow difference lies between the level causing beneficial and detrimental effects, possibly the narrowest of any element. At Kesterson Reservoir, agricultural drainage into artificial wetlands was determined to be the cause of excess selenium levels. The resulting National Irrigation Water Quality Program (NIWQP) recommended that remediation planning for selenium was also necessary at the Salton Sea due to inflowing farm drainage (USDOI 2005).

In the Imperial Valley, the incoming Colorado River is relatively low in selenium: at the Imperial Dam diversion of the IID, the selenium levels are 2.0 μg/L to 5.0 μg/L (or parts per billion) (CRWB 2003). For comparison, at Kesterson Reservoir the agricultural drain water contained approximately 300 μg/L selenium (Ohlendorf et al. 1989). However, high evaporation rates allow selenium to concentrate in agricultural drainage water, particularly through subsurface drains. The median selenium concentration for water samples in surface drains was 6 μg/L while subsurface drains had 28 μg/L (Setmire et al. 1999). The highest concentration found in subsurface drains in the Imperial Valley is 360 μg/L (Setmire and Schroeder 1998), demonstrating the need for concern at the Salton Sea. Surface and subsurface drain waters are blended in the drainage system and eventually flow into the New and Alamo rivers. The Alamo River typically has 7 μg/L to 8 μg/L selenium and the New River 4 μg/L to 5 μg/L selenium (CRWB 2003). Salton Sea water, however, contains only 1.5 μg/L selenium making the lake a selenium sink (Westcot et al. 1988).

Selenium enters the Salton Sea as highly soluble salt (primarily as selenate and selenite) and waterborne concentrations are rapidly reduced to less than 2 μg/L as selenium assimilates into biota and settles as part of the organically rich sediments (CDWR and CDFG 2007). The water quality objective for selenium as established by the CRBRWQCB is 5 μg/L (4-day average). In general, selenium concentrations in the Alamo River are higher than the selenium concentrations in the New River, and both have higher selenium concentrations than the Salton Sea (USACOE and California Natural Resources Agency 2011).

In 2010, sediment samples taken in and around the Salton Sea, including the mouths of the New and Alamo rivers, were tested for contaminants as part of the environment analysis conducted in association with the preparation of an EIS/EIR for the Salton Sea SCH Project (USACOE and California Natural Resources Agency 2011). Mean selenium concentrations were 1.1 milligrams per kilogram (mg/kg) (range 0.54 to 2.3 mg/kg). The majority of sediment samples (63 percent) was less than 1 mg/kg of selenium and would be considered "low risk." The remaining 37 percent of the samples were between 1 and 4 mg/kg (only two samples exceeded 2.5 mg/kg) and were considered in the "level of concern" category. No sample exceeded the "toxicity threshold" value of 4 mg/kg (Amrhein and Smith 2011 in USACOE and California Natural Resources Agency 2011).

Different species of fish and birds have different sensitivities to selenium exposure, and it is important to recognize that reproductive impairment is one effect of excessive selenium exposure that comes at much lower level of exposure than levels that result in selenium toxicity (Skorupa 1998, Spallholz and Hoffman 2002). Chemically selenium is very similar to sulfur and it may take the place of sulfur during protein synthesis, causing the proteins to develop with a slightly different form. In the presence of excessive selenium, a developing embryo may develop enough malformed proteins to result in lethal deformities (Hoffman and Heinz 1988). The selenium concentration in agricultural drainage water of the Imperial Valley is elevated enough to cause some reproductive impairment but not high enough to pose a significant ecological threat to the

hundreds of thousands of birds that pass through the area while migrating. Biological studies conducted in the Salton Sea area have confirmed reduced reproduction of certain bird and fish species due to elevated selenium levels, including embryo mortality in black-necked stilt eggs; embryo mortality in colonial nesting waterbirds (great egrets [*Ardea alba*], snowy egrets [*Egretta thula*], black-crowned night herons [*Nycticorax nycticorax*]); and possible avian embryo abnormalities. In addition, Bennett (1998) identified selenium contamination at concentrations identified in the literature to cause reproductive impacts in fish. A variety of sub-lethal effects of excessive selenium exposure have also been documented (Hoffman et al. 2002), and there is speculation that selenium contamination may have affected the overall health and susceptibility to the avian botulism toxin that killed over 14,000 American white pelicans and brown pelicans at the Salton Sea in 1996 (Roberts 1997b).

Inflow of selenium loads to the Salton Sea could possibly be decreased locally through reduced tile drainage flows associated with agricultural water conservation practices (CDWR and CDFG 2006). The potential for reducing selenium levels was also assessed in artificial wetlands constructed near the New River. Although the levels of several pollutants in waters held in these artificial wetlands were successfully reduced, selenium was retained in the ponds, resulting in a recommendation that further risk assessment should be conducted to address the potential for bioaccumulation (Tetra Tech 2006). Concern has been expressed that as the Sea continues to recede, selenium in bottom sediments could enter the water column and become concentrated through the aquatic food web, eventually reaching toxic levels in birds (Cohen and Hyun 2006). In 2004, U.S. Geological Survey (USGS) recommended that restoration efforts in the Salton Sea address the possible remobilization of selenium from bottom sediment (Schroeder et al. 2002, Schroeder 2004).

An experiment was conducted at the Salton Sea that measured water-soluble selenium released from wetted sediment samples taken from the SCH Project area (USACOE and California Natural Resources Agency 2011). The result of this experiment indicated, "sediment selenium concentrations were positively related to organic carbon, but the oxidation rates and amount released into water did not appear affected by carbon content, salinity, location, or depth of sample core. Rather, the release of selenium appeared controlled by the amount of oxidizable iron present in sediments. If iron was present, the oxidized selenium adsorbed onto the iron and remained in the sediment, and less selenium would dissolve into pond water" (USACOE and California Natural Resources Agency 2011).

Organochlorine pesticides – mainly DDT (dichlorodiphenyltrichloroethane) and its metabolite DDE (dichlorodiphenyldichloroethylene) – have contributed to the decline in reproductive success of certain colonial nesting birds at the Salton Sea (Bennett 1998). Sediment carries DDT and DDE into the drains and rivers that empty into the Salton Sea, where it deposits on the Sea's bottom (Schroeder 2004). Although DDT has been banned since the 1970s by the USEPA and the State, this pesticide continues to persist in the environment (CRWB 2003). As result, the CRWB has targeted DDT in the Alamo River, New River, and Imperial Valley drains through its TMDL process, focusing initially on the control of sedimentation and siltation from agricultural lands (CRWB 2001, CRWB 2002a, CRWB 2005b).

The Alamo River in particular has been identified as having high concentrations of DDT metabolites in bottom sediments (Setmire et al. 1993). As a result of DDT and DDE's tendency to bioaccumulate, fish and bird specimens from the Alamo River have also had some of the highest concentrations of these pesticides in the State (CRWB 2001). Total DDT concentrations measured in fish tissue samples from the Alamo River exceed federal guidelines for human consumption and State's water quality objective (CRWB 2001, CRWB 2005a).

The DDE-induced thinning of birds' eggshells is a serious contaminant effect (Bennett 1998). Resident, fish-eating birds are likely at greatest risk from such pesticides, as are people who consume a significant amount of contaminated fish. Of particular concern is DDE. Even though DDE is not found at extremely high concentrations in the Sea's fish, research on the piscivorous birds found them to be exposed to this contaminant (Roberts 2000).

Impact analysis conducted for the alternative project sites considered as part of the Salton Sea SCH project identified high surface sediment DDE concentrations in the vicinity of the mouth of the Alamo River, where mean sediment concentrations were approximately 13 nanograms per gram (ng/g). Surface sediment DDE concentrations were lower to the east of the mouth of the New River, and lowest to the west of the river mouth (mean 1ng/g to 3 ng/g). The highest subsurface (5 to 30 centimeters deep) sediment DDE concentrations were found to the east of the mouth of the New River (mean approximately 9 ng/g) and immediately adjacent to the Alamo River mouth in Morton Bay (mean approximately 25 ng/g). The lowest DDE concentrations were found to the west of the mouth of the New River (mean approximately 1 ng/g) (Wang et al. 2011).

Boron is a trace contaminant that also bioaccumulates in certain Salton Sea biota (Setmire et al. 1993). Since excess levels of boron impair development of chicks by reducing weight gain, boron has received attention as a potential issue in developing plans for the Salton Sea's future (Cohen and Hyun 2006). A Service study concluded that boron in the Salton Sea system presents a low risk of impacts to birds, particularly wintering waterfowl (Roberts 1999). However, the study also cautioned that IID's intensive water conservation plans "may increase boron concentrations throughout the system and at all levels of the food chain", creating a need for appropriate monitoring and management actions. Boron is not on the Regional Water Board's list of pollutants found in local water bodies since overall boron concentrations at the Salton Sea are relatively low (CRWB 2007a, Roberts 1999).

The Service, as part of its EC Program, conducts contaminant studies on important wildlife species, such as migratory birds and threatened and endangered species (Roberts 1997a). The Service's contaminants specialists, in cooperation with the USGS's Biological Resources Division's Biomonitoring of Environmental Status and Trends (BEST) Program, have also developed tools such as CAP to assist in evaluating contaminant threats to national wildlife refuges.

The CAP 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. The CAP assists Refuge staff in prioritizing necessary sampling and/or cleanup actions, developing proposals for future investigations, and initiating pollution prevention activities. A CAP for the Sonny Bono Salton Sea NWR was completed in 2012, which includes the following summary of the contaminants issues:

> Selenium and DDE have been the contaminants considered most likely to have impacts on the fish and wildlife resources of the Refuge. While these issues are important and can result in reproductive failures in the wildlife present there, the long-term threat to the Refuge (in particular, that part located in open water of the Salton Sea) is the increasing hypereutrophication and hypersalinity of the Sea. Fish kills have become a relatively common occurrence at the Salton Sea, and several avian mortality events have been observed in the past 20 years. While selenium and DDE could be complicating factors in regards to disease resistance, concentrations of these constituents found at the Salton Sea are not the level where one would expect them to be drivers of these events.

The hypereutrophic conditions support regular algae blooms in the Salton Sea, which then die off and rob the water column of dissolved oxygen in the decay process. These processes can also lead to the generation of large volumes of hydrogen sulfide, both of which can result in large fish kills. Stressful conditions such as this can also make the fish more vulnerable to other pathogens and parasites (e.g., *Clostridium botulinum* and *Amyloodinium* sp.) that kill the fish outright or make them easy prey for piscivorous birds that are then exposed to toxins generated by those pathogens (i.e., botulism). The hypersaline conditions, which are expected to worsen as drainwater inputs decrease, are believed to be reaching the salinity tolerance of the aquatic species that live there. Once this point is reached, there would likely be a cascade of effects resulting in trophic collapse. In the future, the system is likely to be based on saline-tolerant microbes, brine shrimp, and brine flies. This would greatly reduce the diversity and numbers of wildlife currently supported by the Salton Sea.

Ultimately, we anticipate that DDE will continue to degrade to the point of being unlikely to result in any impacts to fish and wildlife. Selenium is better controlled at the source, so those efforts should focus on the areas upstream that generate selenium that can enter the Colorado River. Some efforts are already underway in part as a result of efforts by the National Irrigation Water Quality Program. Continued monitoring to confirm these reductions would be appropriate.

4.4.9.3 Coachella Valley NWR

No contaminants have been documented on the lands within the Coachella Valley NWR. The eastern half of the site contained no man-made facilities at the time of initial acquisition (USFWS 1986); however, there is evidence of past agricultural activity on the lands located immediately to the west of Washington Street. As a result of past agricultural activities, there is the potential for the presence of pesticides in surface soils on a portion of the site. In addition, if heavy farm equipment was used or stored on the previously cultivated site, there is also the potential for isolated areas of petroleum related contaminants in the surface soils. To date, no evidence of contamination (e.g., odors, ground discoloration) has been reported from this area.

In 1989, the Carlsbad Fish and Wildlife Office Environmental Contaminants staff conducted a pre-acquisition contaminant survey for two parcels located adjacent to the southwest corner of the Refuge. One parcel (7.7 acres), which supported blowsand habitat, had no evidence of past active use, although a few pieces of broken concrete pipe, likely a result of illegal dumping, were observed. The other parcel (10.5 acres) was farmed in 1970s, probably to grow alfalfa. Pesticides were probably used on the site. A small landfill, about 2.5 acres, was located between the two parcels. The site, which is no longer a part of the Refuge, contained old furniture, cans, bottles, and some old cars. No evidence of used oil, batteries, drums, or other hazardous waste was noted.

4.5 Biological Resources

4.5.1 Regional and Historical Context

Sonny Bono Salton Sea NWR

As part of the Colorado River delta, the Salton Sea lies in the geological depression known as the Salton Sink or Salton Trough that is the northern-most extension of the Gulf of California. The lowest point in the depression sits 278 feet below sea level, but this land is cut off from ocean water by a deposition of Colorado River sediment spanning the entire Gulf (Blake 1915).

Geologic records indicate the Colorado River periodically emptied through the northern part of the delta, and during these periods, some of which spanned centuries, the Salton Sink would flood with river water (Blake 1858, Sykes 1937). The water would fill the basin to a point where it would spill over the sediment berm, creating an outlet to the Gulf (Blake 1914). Because inflows were sporadic and evaporative rates high, this ephemeral lake (Lake Cahuilla) varied substantially in size and salinity (Patten and Smith-Patten 2004). Historically, there has been a large body of water present in the Salton Sink more often than there has not (Smith 1999).

The taming of the Colorado River with dams and levees channeled the river south to the Gulf of California. Nonetheless, inflows to the Salton Sink were maintained with diversions of Colorado River water for irrigation farming in the Imperial Valley. The quantity of water in the basin increased dramatically in 1905 when an irrigation canal broke, creating the Salton Sea. Since then, the Salton Sea has been receiving inflows in the form of agricultural runoff. The size of the Salton Sea has varied with the amount of agricultural production. Following the rapid flood-up, the lake surface elevation dropped 50 feet from the peak elevation. Over the following decades, the elevation rose again as more of the surrounding lands were converted to farmland and more water diverted from the Colorado River for irrigation purposes. This trend has now reversed and the levels in the Sea are receding.

Biologically, the Salton Sea is an important area for avian species as it is part of the Colorado River delta ecosystem and is located along the Pacific Flyway. Long before the Salton Sea was created birds migrated through the region and made use of ancient Lake Cahuilla (Patten and Smith-Patten 2004). Physical evidence of this includes the remains of birds excavated from middens found in Cahuilla and Kumeyaay Indian villages. Identification of these bones indicates the species hunted by Native American tribes are also commonly found at the Salton Sea today (Patten and Smith-Patten 2004). The earliest formal collection of birds also reflects the importance of the area to Pacific Flyway birds. The U.S. National Museum collected specimens from the Salton Sink as early as the 1890s and the first ornithological exploration of the Salton Sea was conducted by Grinnell in 1908 (Garrett et al. 2004).

Recognizing the importance of this area to flyway waterfowl, the Federal government established the 32,400-acre Salton Sea Migratory Waterfowl Refuge (known today as Sonny Bono Salton Sea NWR) in 1930 at the south end of the new lake. At that time, waterfowl was the primary management priority, but today, the priorities for the Refuge have expanded to include not only waterfowl, but also the management of habitat to support marsh birds, colonial seabirds, migratory shorebirds, and passerines.

Water availability, water use, and the introduction of new species have affected great changes in the ecology of the Salton Sea. The greatest driver of change has been water availability and its effect on salinity. Because the lake is situated in a basin, there is usually no outflow other than evaporation. Salts imported with the river water remain in the basin, naturally increasing the salinity of the lake. As the quantity of inflow to ancient Lake Cahuilla varied, the basin went through many periods of wetting and drying. Through all these changes, the wildlife adapted. Those with greater mobility had the luxury of seeking out the habitats and resources they needed. Others, like the desert pupfish, evolved the physiology to tolerate a wide range of conditions, and during the driest periods, isolated populations were able to persist in the small streams coming out of the surrounding mountains.

In the current Salton Sea, inflows have continued to deliver salt to the basin, but because the water is primarily agricultural runoff, it also contains fertilizers. In this warm and sunny environment those nutrients drive high rates of primary productivity and establish the base of a very vigorous food chain. This productivity has benefited some introduced species, such as barnacles (*Balanus amphitrite*), pileworms, and tilapia, which in turn provide year-around food for birds. While far from natural, the habitats created with this unusual water supply have made the Salton Sea an important migratory bird stop. The mosaic of highly productive habitats that include farmland, freshwater marshes, saline mudflats, and a very large saline lake provide variation in the landscape that a high diversity of avifauna can use.

Unfortunately, as addressed in Chapter 2, the continually rising salinity in the Sea is reaching a point where fish and invertebrate life may soon be limited. Efforts are currently underway to create sustainable, salinity stabilized, habitats designed to maximize future water supplies. While the total area will not be as large as the current Salton Sea, any sustainable habitat will help Pacific Flyway birds migrating through the region.

Coachella Valley NWR

As with many regions across the U.S., the history of the Coachella Valley landscape has been one of largely intact ecosystems becoming fragmented due initially to agricultural uses and later to development of homes, commercial uses, and the infrastructure and other uses needed to support development. Well before European occupation of this area, Cahuilla people occupied canyons on the southwestern edge of the Coachella Valley, where permanent streams flowed from the San Jacinto Mountains.

Euro-American settlers began migrating into the area around the 1870s. Additional growth was spurred on by the construction of the Southern Pacific railroad and the opening of public lands for settlement under the Homestead and Desert Land Acts. Being the halfway point between Yuma and Los Angeles, what is today the city of Indio, was selected by the Southern Pacific as an ideal train stop. At the southern end of the valley, Indio began as a construction camp for the railway and its artesian water was tapped to irrigate crops. A variety of small cities were soon established along the route of the railroad (CVAG 2007b, http://www.coachellavalleymuseum.org/; http://www.lonelyplanet.com/).

Development continued as water availability increased. A notable period of rapid urban and agricultural development occurred between 1950s and 1970s, when significant loss in sand dune and sand field habitat occurred throughout the Valley. In addition to conversion of the natural habitat to development, actions were also being taken to alter the sand movement in the Valley. Tamarisk (*Tamarix aphylla*) windbreaks were planted around developments to reduce wind speeds and reduce sand movement. By the 1970s, biologists and conservationists began to raise concerns about the effects these losses in blowsand habitat were having on specially adapted desert wildlife, in particular, effects to the Coachella Valley fringe-toed lizard. Between 1955 and 1982, approximately 90 percent of the blowsand habitat to the east of the Coachella Canal had been lost and what remained was fragmented into small parcels (England 1983). To the west of the Coachella Canal pre-settlement habitat had declined by 34 percent. What remained of the blowsand habitat was almost entirely within private ownership.

In 1980, the Service listed the Coachella Valley fringe-toed lizard as a threatened species and designated approximately 18 square miles north of I-10, east of Thousand Palms, west of Washington Street, and south of the Indio Hills as Critical Habitat for the species.

Approximately half of this area included habitat to support the lizard, while the remaining area was needed to ensure a continued source of sand to maintain suitable habitat areas for the lizard. During this same timeframe, CDFW was acquiring lands within the designated Critical Habitat area and other non-governmental organizations were also exploring possible acquisitions.

The Coachella Valley Fringe-toed Lizard Habitat Conservation Plan (HCP), which was completed in 1985 and approved by the Service in 1986, called for the establishment of three separate preserves to protect the lizard. The Preserve System consisted of the Coachella Valley Preserve (also known as the Thousand Palms Preserve), the Edom Hill-Willow Hole Preserve, and the Indian Avenue Preserve within the Whitewater River floodplain. The Coachella Valley Preserve, which includes the land now located within the boundaries of the Coachella Valley NWR, was to be cooperatively managed by BLM, the Service, CDFW, and The Nature Conservancy (TNC). The first acquisition associated with the NWR also occurred in 1985.

A management plan was prepared by TNC in 1986 and was superseded in 1995 by an updated management plan prepared by BLM to address new issues related to recreation, trails, and the introduction of desert pupfish to the preserve, among other issues. In 1994, a scoping study was prepared for CVAG by the Coachella Valley Mountains Conservancy that recommended the preparation of a MSHCP for the entire Coachella Valley and surrounding mountains to address current and potential future State and Federal endangered species issues within the area. As a result, the signatories of the HCP subsequently agreed that the existing plan could not adequately ensure the protection of the larger number of potentially threatened species in the Valley. Following this decision, the Coachella Valley MSHCP, which also addressed the requirements of a State NCCP, was prepared and ultimately approved by the Service in 2008 (additional details are provided under Conservation Planning Efforts). The MSHCP included the existing conservation lands including the Coachella Valley Fringe-toed Lizard Preserve System, established in 1986, and the lands were subsumed into and are now managed as part of the MSHCP Reserve System. The MSHCP expanded management within the previous Preserve System to include among other things the protection of additional species and the fluvial sand transport process.

4.5.2 Conservation Planning Efforts

A variety of local, regional, State, and national conservation planning efforts are underway that have the potential to influence the manner in which the lands and/or species included within the Refuges of the Sonny Bono Salton Sea NWRC are managed. The most relevant of these planning efforts are described below.

Desert Landscape Conservation Cooperative

The Sonny Bono Salton Sea NWR and Coachella Valley NWR are included within the boundaries of the Desert LCC. LCCs are applied conservation science partnerships between the Service and other Federal agencies, states, tribes, non-governmental organizations (NGOs), universities and stakeholders within a geographically defined area. Each LCC functions within a specific landscape, but it is also part of a national and, ultimately, international network. LCCs are true cooperatives formed and directed by land, water, wildlife, and cultural resources managers and interested public and private organizations.

The LCCs represents a broader vision of conservation that includes working with partners to ensure that science capacity is in place so that we can successfully address the anticipated conservation challenges of the 21st Century. Within the boundaries of the Desert LCC, a number of management challenges have been identified. These include fish and wildlife response to climate change; invasive species; wildland fire; protection of trust species; water availability and water quality; wildlife recovery and restoration; protection of cultural resources; climate impacts on agriculture and grazing; forest resilience; and renewable energy.

A primary objective of the LCCs is to inform resource management decisions and actions that can address landscape-scale stressors such as habitat fragmentation, genetic isolation, invasive species, and water scarcity, all of which are accelerated by climate change. LCCs are also intended to reflect the principles and practices of adaptive management in all of their activities, especially in developing conservation strategies, evaluating their effectiveness, and revising them.

U.S. Shorebird Conservation Plan

The Sonny Bono Salton Sea NWR is located along the Intermountain West Flyway region of the U.S. Shorebird Conservation Plan (Brown et al. 2001). This very large region stretches from Canada to Mexico and from the Rocky Mountains to the Sierras Nevada and Cascade Mountains. According to the U.S. Shorebird Conservation Plan, the most important issue facing shorebird conservation in this region is "the enormous human-driven competition for water" (Brown et al. 2001). The plan includes five goals for this region: 1) manage habitat to sustain thriving shorebird populations; 2) monitor and assess shorebird distribution and abundance; 3) research to facilitate shorebird conservation; 4) outreach to inform and develop a supportive constituency for long-term shorebird conservation; and 5) facilitate a process that integrates shorebirds concerns with land management planning.

The Intermountain West Regional Shorebird Plan (Oring et al. 2000) provides more site-specific information regarding shorebird-related management, research, monitoring, outreach, and planning activities within the Intermountain West Flyway region. The Salton Sea is identified as an important wetland supporting a range of breeding, migrating, and wintering shorebirds. The plan identifies degradation of water quality as a major issue at the Salton Sea, due in part to significant increases in salinity levels, as well as the inflow of drainage water that may contain elevated levels of selenium, boron, and organochlorines (Oring et al. 2000). The five goals for the Intermountain West Region are similar to those described for shorebird conservation at the national level.

North American Waterbird Conservation Plan

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 marsh birds. The Sonny Bono Salton Sea NWR is located in Bird Conservation Region 33. The Sea itself is identified by the Waterbird Conservation Plan as one of the region's important interior waterbird habitats (Kushlan et al. 2002).

Eighty percent of the species addressed in the Waterbird Plan are colonial nesters. 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 lakes, marshes, and riparian zones within the Intermountain West Region provide important wetland habitat for

some 40 waterbird species, including a significant number of the world's eared grebes, American white pelicans, white-faced ibises, and California gulls.

According to the Waterbird Plan, the greatest threat to waterbird populations in the Intermountain West Region is the competing demands for human uses of water, while another threat of regional significant is the presence of contaminants (e.g., mercury, DDT and its breakdown products). The Waterbird Plan states, "Because of the West's feast-or-famine water regime, the Intermountain West regional plan will stress the necessity of conserving a network of high-quality wetland habitats with secure water sources in order to provide options for waterbirds during drought and flood cycles" (Kushlan et al. 2002).

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." Ten species known to occur on the Sonny Bono Salton Sea NWR or the area immediately surrounding the Refuge are identified as high concern species in the Waterbird Plan: black skimmer, blue-footed booby (*Sula nebouxii*), magnificent frigatebird (*Fregata magnificens*), snowy egret (*Egretta thula*), tricolored heron (*Egretta tricolor*), wood stork, Arctic tern (*Sterna paradisaea*), brown booby (*Sula leucogaster*), gull-billed tern, and little gull (*Larus minutus*). Of these, black skimmer, snowy egret, and gull-billed tern have all breed on the Refuge on an occasional or regular basis. Six additional species identified as high concern species including Brandt's cormorant, black storm-petrel (*Oceanodroma melania*), ancient murrelet (*Synthliboramphus antiquus*), Laysan albatross (*Phoebastria immutabilis*), Ross's gull (*Rhodostethia rosea*), and bridled gull (*Onychoprion anaethetus*), have also been observed on the Refuge, but these observations are rare and are considered unusual occurrences.

North American Waterfowl Management Plan

The purpose of the North American Waterfowl Management Plan as stated by the North American Waterfowl Management Plan Committee (Plan Committee), an international body that provides leadership and oversight for the activities undertaken in support of the North American Waterfowl Management Plan, is "to sustain abundant waterfowl populations while preserving the traditions of wildfowling and achieving broad benefits to biodiversity, ecosystem processes and the people of North America. Plan goals will be accomplished by partnerships that conserve habitats and sustain populations, guided by sound science" (http://www.fws.gov/birdhabitat/NAWMP/Planstrategy.shtm, accessed July 17, 2012).

This plan is a continental wildlife conservation initiative that seeks to restore waterfowl populations in Canada, the U.S., and Mexico to the levels recorded during the 1970s—a benchmark decade for waterfowl. The Plan, which is currently being updated, provides population objectives for most North American waterfowl, including ducks, geese, and swans. According to the 1998 update of this plan, the species of geese that commonly overwinter on the Sonny Bono Salton Sea NWR had stable or increasing population trends between 1986 and 1997 (North American Waterfowl Management Plan Committee 1998).

Sonoran Joint Venture Bird Conservation Plan

The mission of the Sonoran Joint Venture (SJV) is to protect, restore, and enhance bird populations and habitats in the southwestern United States and northwestern Mexico through collaborative partnerships. The steps to achieving this mission are addressed in the SJV Bird Conservation Plan, which provides the biological foundation for the bird conservation activities of the SJV. The SJV Bird Conservation Plan also summarizes the status of avian species within the areas (i.e., much of Arizona, southern California, the Mexican states of Sonora, Sinaloa, Baja California, and Baja California Sur, and the Gulf of California and its endemic-

rich islands) covered by the plan, prioritizes these species, provides conservation recommendations, and lists Focus Areas for conservation action.

The SJV is divided into four ecological Regions, each of which has unique habitats, birds, and conservation issues. The Sonny Bono Salton Sea NWR and the Coachella Valley NWR are located within the Arid Borderlands Region of the SJV. This region comprises Mojave, Sonoran, and Vizcaino Desert scrub and many wetland and island habitats. The Salton Sea is identified as a focus area within the Arid Borderland Region. Focus areas are considered important tools for conserving species of concern (SJV Technical Committee 2006).

Of the various priority bird species identified for the Arid Borderland Region, the Sonny Bono Salton Sea NWR supports 45 species of continental concern, 45 species of regional concern, and 13 stewardship species. In addition, the Salton Sea is the only saline lake in the Region with a substantial wintering shorebird population.

Due to the presence of a variety of significant wetlands within the SJV, the SJV has also prepared a Waterfowl Management Supplement (Supplement) that addresses regional waterfowl conservation. The expansive wetlands in the SJV area provide wintering habitat for significant populations of waterfowl. Noted in the Supplement are the more than 25,000 snow and Ross's geese and over 50 percent of the Pacific Flyway's ruddy ducks that winter at the Salton Sea (Beardmore 2007). Of the species identified in the Supplement as having high continental priority, brant (*Branta bernicla*), mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and lesser scaup (*Aythya affinis*) are present at the Salton Sea at various times of the year.

Desert Bird Conservation Plans

The Desert Bird Conservation Plan addresses the protection and management of the habitats within the Mojave and Colorado Deserts and their associated bird populations (California Partners in Flight 2009). The plan identified 14 focus species, which were chosen to emphasize the ecological associations of individual species, as well as species of conservation concern. Of the 14 bird species, the current range of seven of these species is included within portions of the Sonny Bono Salton Sea NWR (i.e., burrowing owl [*Athene cunnicularia hypugaea*], Gila woodpecker [*Melanerpes uropygialis*], ladder-backed woodpecker [*Picoides scalaris*], ash-throated flycatcher [*Myiarchus cinerascens*], verdin [*Auriparus flaviceps acaciarum*], crissal thrasher [*Toxostoma crissale coloradense*], and black-throated sparrow [*Amphispiza bilineata*]) and the current range of 11 focal species include areas within the Coachella Valley NWR (i.e., burrowing owl, ladder-backed woodpecker, ash-throated flycatcher, common raven [*Corvus corax*], verdin, black-tailed gnatcatcher [*Polioptila melanura*], crissal thrasher, Le Conte's thrasher [*Toxostoma lecontei*], phainopepla [*Phainopepla nitens*], Lucy's warbler [*Oreothlypis luciae*], and black-throated sparrow).

Applicable Species Recovery Plans

Species recovery plans are prepared by the Service to delineate reasonable actions believed necessary to recover and/or protect listed species. These plans include information about a listed species' life history, habitat requirements, historical and current abundance and distribution, and threats and reasons for listing. In addition, the plans include conservation measures, recovery goals and strategies, downlisting criteria, and guidance on how and when conservation measures should be implemented. The recovery plans are intended to serve as guidance documents for agencies, landowners, and the public. Recommended actions generally include protection, enhancement, and restoration of those habitats deemed important for recovery, monitoring, research, and public outreach.

Recovery plans applicable to the Sonny Bono Salton Sea NWR include the Yuma Clapper Rail Recovery Plan (USFWS 1983, USFWS 2010c) and Desert Pupfish Recovery Plan (USFWS 1993). The Coachella Valley Fringe-toed Lizard Recovery Plan (USFWS 1985) is applicable to the Coachella Valley NWR. (No recovery plan or recovery outline has been completed for Coachella Valley milk-vetch, as its recovery is addressed in the Coachella Valley MSHCP). The recommendations provided in these recovery plans have been considered during the development of the CCP. Recovery plan recommendations specific to the Sonny Bono Salton Sea NWR and the Coachella Valley NWR are reflected in the CCP's goals, objectives, and strategies.

California Wildlife Action Plan

The California Wildlife Action Plan (CDFG 2007) 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.

The Sonny Bono Salton Sea NWR and Coachella Valley NWR are located within the area identified by the Action Plan as the Colorado Desert Region. The major stressors affecting the wildlife and habitat of the Colorado Desert Region, as identified by the Action Plan, include water management conflicts and water transfer effects, inappropriate off-road vehicle use, loss and degradation of dune habitats, growth and development, and invasive species (CDFG 2007).

The Action Plan recognizes the Salton Sea as one of the most significant aquatic systems in the Colorado Desert Region and includes a number of recommended conservation actions to address the protection of this resource. These and other recommended conservation actions that apply to the management of both the Sonny Bono Salton Sea NWR and Coachella Valley NWR include:

- Restore and maintain the Salton Sea ecosystem in a form that will provide vitally important aquatic habitats;
- Set ecosystem restoration goals for bird species by reviewing habitat needs on a species-by-species basis;
- Improve the quality of water that flows into the Salton Sea by addressing both the quality of agricultural drainage water and water in the Alamo and New rivers;
- Ensure that environmental impacts to the Salton Sea and its associated resources resulting from water transfers are mitigated;
- Working cooperatively among Federal, State, and local agencies, develop and invest in restoration and protection efforts for the Salton Sea;
- Working cooperatively among Federal, State, and local agencies and nongovernmental conservation organizations, protect and restore biologically significant habitats in the Coachella Valley;
- Ensure that infrastructure development projects are designed and sited to avoid harmful effects on sensitive species and habitats; and
- Provide greater resources to eradicate or control and limit introductions of invasive species in the region.

Regional Multiple Species Habitat Conservation Planning Efforts

Coordinated, comprehensive efforts to protect multiple species listed as threatened or endangered under the Federal and State Endangered Species Acts, or otherwise identified as species of conservation concern, have been approved for the Coachella Valley and are underway in the Imperial Valley. In return for actively participating in the implementation of these plans, those entities involved in the process receive ESA incidental take authorizations and some legal certainty about continuing their covered activities, such as water operations and infrastructure projects.

Coachella Valley Multiple Species Habitat Conservation Plan (MSHCP). The north end of the Salton Sea Basin is covered by the Coachella Valley MSHCP (CVAG 2007a), which was given final approval by the Service in 2008. Located completely within Riverside County, this conservation plan envisions the conservation of over 240,000 acres of open space and the protection of 27 plant and animal species. Significant habitat linkages and wildlife corridors are to be safeguarded through a system of open space parks, trails, and reserves. While CVAG serves as the lead agency, the participants include Riverside County, CVWD, IID, and the cities of Cathedral City, Coachella, Indian Wells, Indio, La Quinta, Palm Desert, Palm Springs, and Rancho Mirage. The Coachella Valley NWR is located within the boundaries of this MSHCP.

The Coachella Valley MSHCP provides a regional vision for balanced growth to meet the requirements of Federal and State endangered species laws, while promoting enhanced opportunities for recreation, tourism, and job growth. The MSHCP is essentially a map and set of guidelines, which lay out a 75-year growth and preservation plan for the region. It is intended to set aside sensitive land for conservation on behalf of the listed or "covered" species while mapping out zones for builders to develop without the fear of litigation.

Lower Colorado River Multi-Species Conservation Program. The IID and the Coachella Valley Water District are also signatories to the Lower Colorado River Multi-Species Conservation Program (IID 2006, USBOR 2008). This Bureau of Reclamation-led program only encompasses the lower river from Hoover Dam to the Mexican border and does not extend into the Salton Sea Basin. However, the IID's water diversion (and power production) from its facilities on the lower Colorado River are covered. The MSCP's incidental take authorization is for 50 years, beginning in April 2005 (USBOR 2008). The Plan envisions creating 8,100 acres of riparian, marsh, and backwater habitat for four listed species and 16 other native species along the lower Colorado River.

Imperial Valley Habitat Conservation Plan (HCP)/Natural Community Conservation Plan (NCCP). The IID is also currently working with the Service and CDFW on the preparation of the Imperial Valley HCP/NCCP. The Imperial Valley HCP, initiated in 2000, and the NCCP, initiated in 2006, are intended to cover a range of activities including the implementation of water conservation projects and mitigation measures associated with the conservation and transfer of up to 300,000 acre-feet/year of Colorado River water, compliance with the cap on IID's annual diversions of Colorado River water, adaptive habitat management and monitoring, and IID Water Department operations including water delivery and drainage. An HCP is a broad-based landscape level federal planning tool utilized to achieve long-term biological regulatory goals and provide legal protection to discretionary activities covered by the ESA. NCCP is generally described as a collaborative state effort to identify and provide for the measures necessary to conserve and manage natural biological diversity at the ecosystem scale within a Planning Area

while allowing other covered activities to occur. For permitting purposes, an approved HCP is required to receive an Incidental Take Permit for federal threatened or endangered species, while a NCCP provides similar coverage from a state perspective. These permits are expected to cover listed and non-listed species that may become listed in the future (http://www.iid.com/index.aspx?page=235, accessed on July 18, 2012).

4.5.3 Refuge Habitats and Vegetation

4.5.3.1 Introduction

Habitat describes the place or set of environmental conditions in which plants and animals naturally live and grow. Habitats are more specific descriptions of locations within a biome or region, which have a distinct assortment of species. Temperature and precipitation are primary factors in determining locations of different natural habitats, but desert habitats, such as those present on the Coachella Valley NWR, are also distinguished by physical differences in slope, soil substrate, solar and wind exposure, and water supply (CVAG 2007b). The quality of a habitat can be influenced by the level of human disturbance that has or is occurring on the site. In the case of the Sonny Bono Salton Sea NWR, many of the habitats present on the Refuge are highly managed to meet the special needs of the Refuge's migratory and resident bird species.

4.5.3.2 Sonny Bono Salton Sea NWR

Overview

The information provided in this section comes from a variety of sources including previously prepared documents related to the management of the Refuge over the years, the Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report (CDWR and CDFG 2007), the draft EIS/EIR for the Salton Sea SCH Project (USACOE and California Natural Resources Agency 2011), and in field data provided by the Refuge Manager and Wildlife Biologist.

Prior to the commencement of agricultural activities at the south end of the Sea, the upland portions of the Refuge were likely vegetated with Salton Sea saltbush and alkali scrub-woodland (The Redlands Institute 2002). Today, this portion of the Refuge is highly managed to address specific wildlife purposes, including support of nesting seabirds and attracting wintering geese away from adjacent agricultural lands. The managed and native habitats present on the Refuge are illustrated in Figures 4-20a, 20b, 20c, and a breakdown of the acreage of the various habitat types is presented in Table 4-11. A more detailed description of each habitat type follows.

Refuge wetlands support migratory and resident bird species (Mark Stewart/USFWS)

Wetlands

The wetlands that occur within the Refuge include those associated with the Salton Sea (e.g., open water, shoreline, associated shallow water areas), those associated with the New and Alamo rivers as they cross through the Refuge, the drainage and irrigation channels that extend through the Refuge, and the permanent freshwater cattail marsh, shallow seasonal wetlands, and permanent open water (saline) wetlands managed by the Refuge to support a range of avian species.

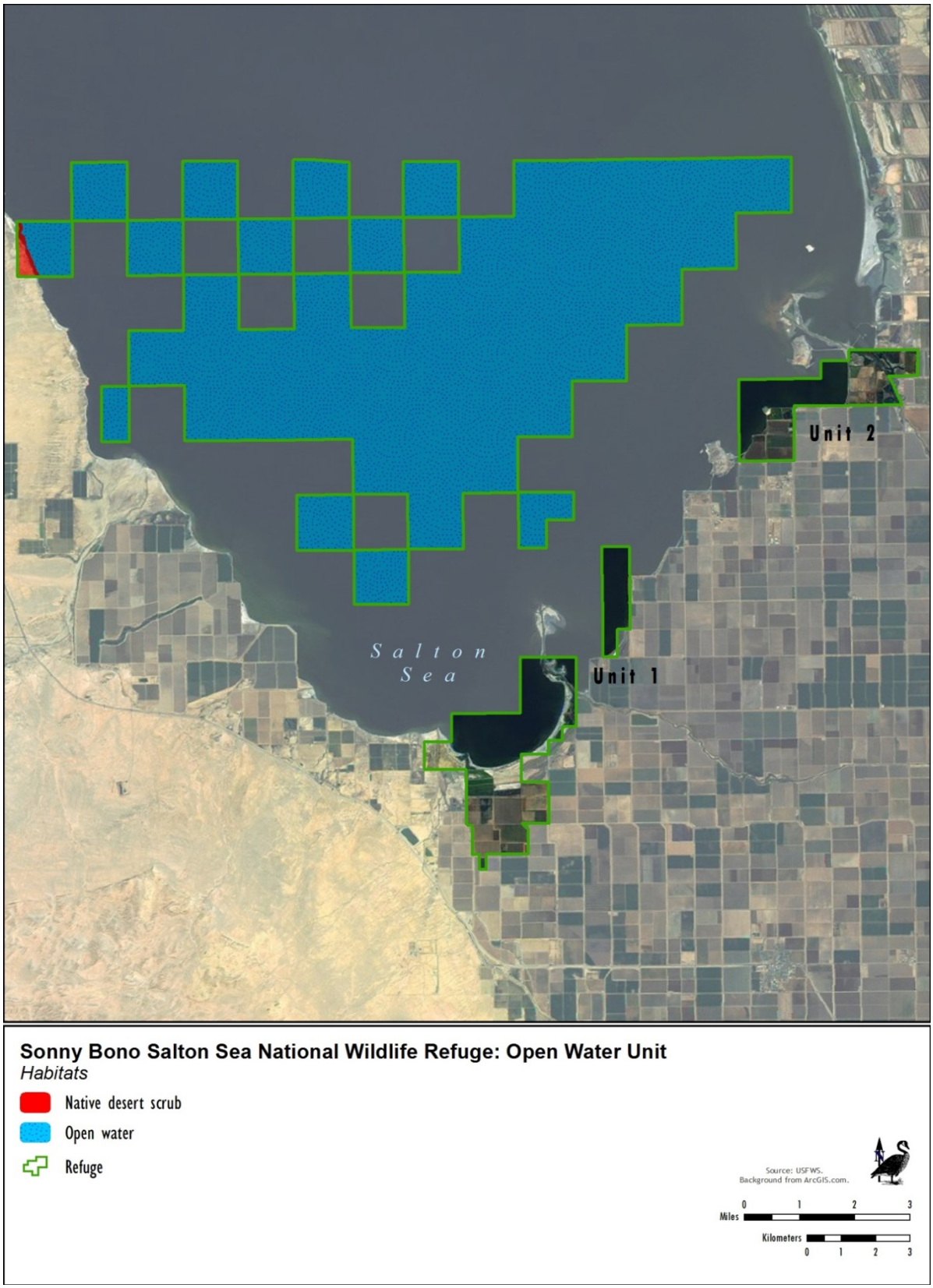


Figure 4-20a. Habitats of the Sonny Bono Salton Sea NWR (Open Water)

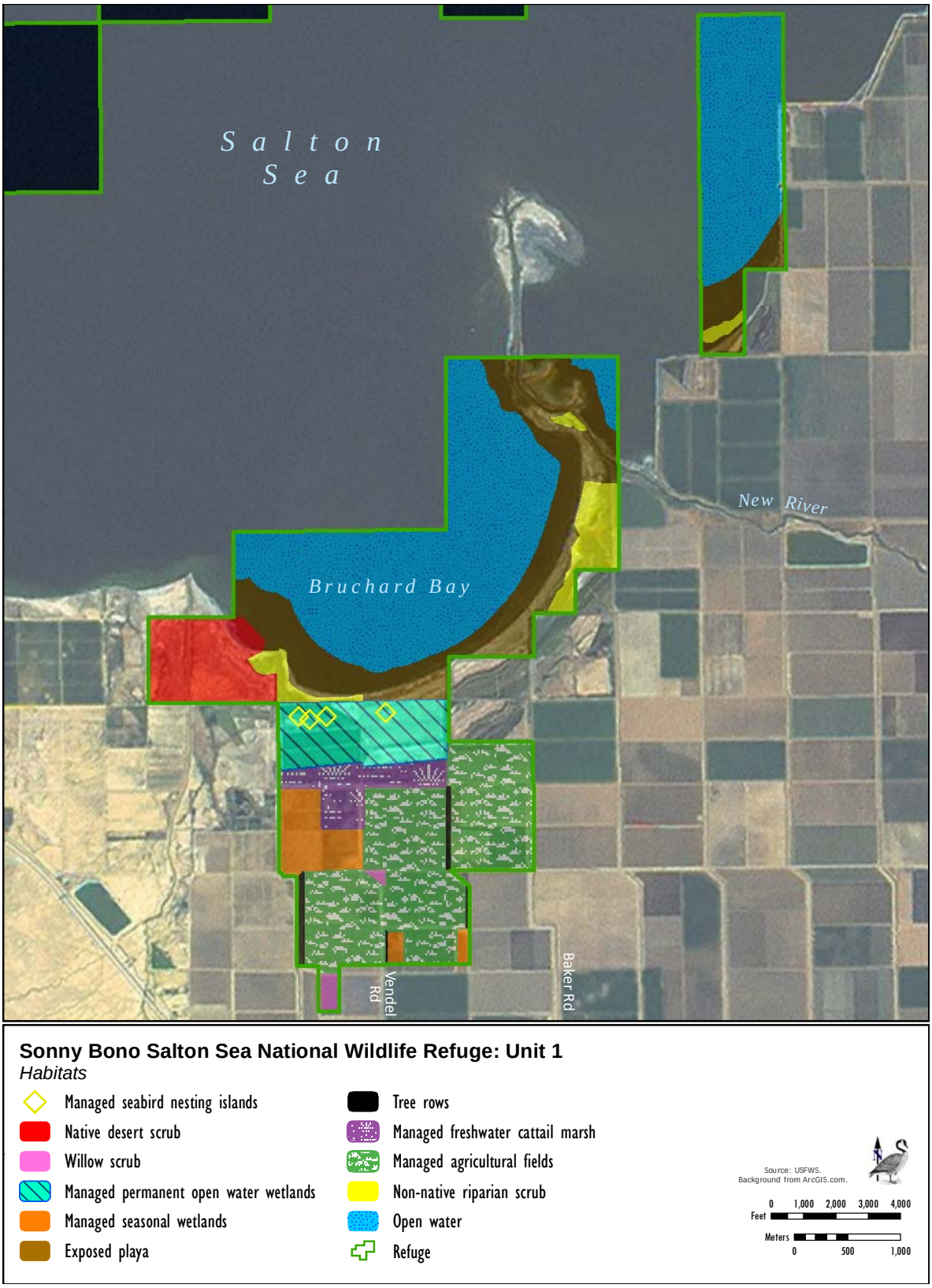


Figure 4-20b. Habitats of the Sonny Bono Salton Sea NWR (Unit 1)

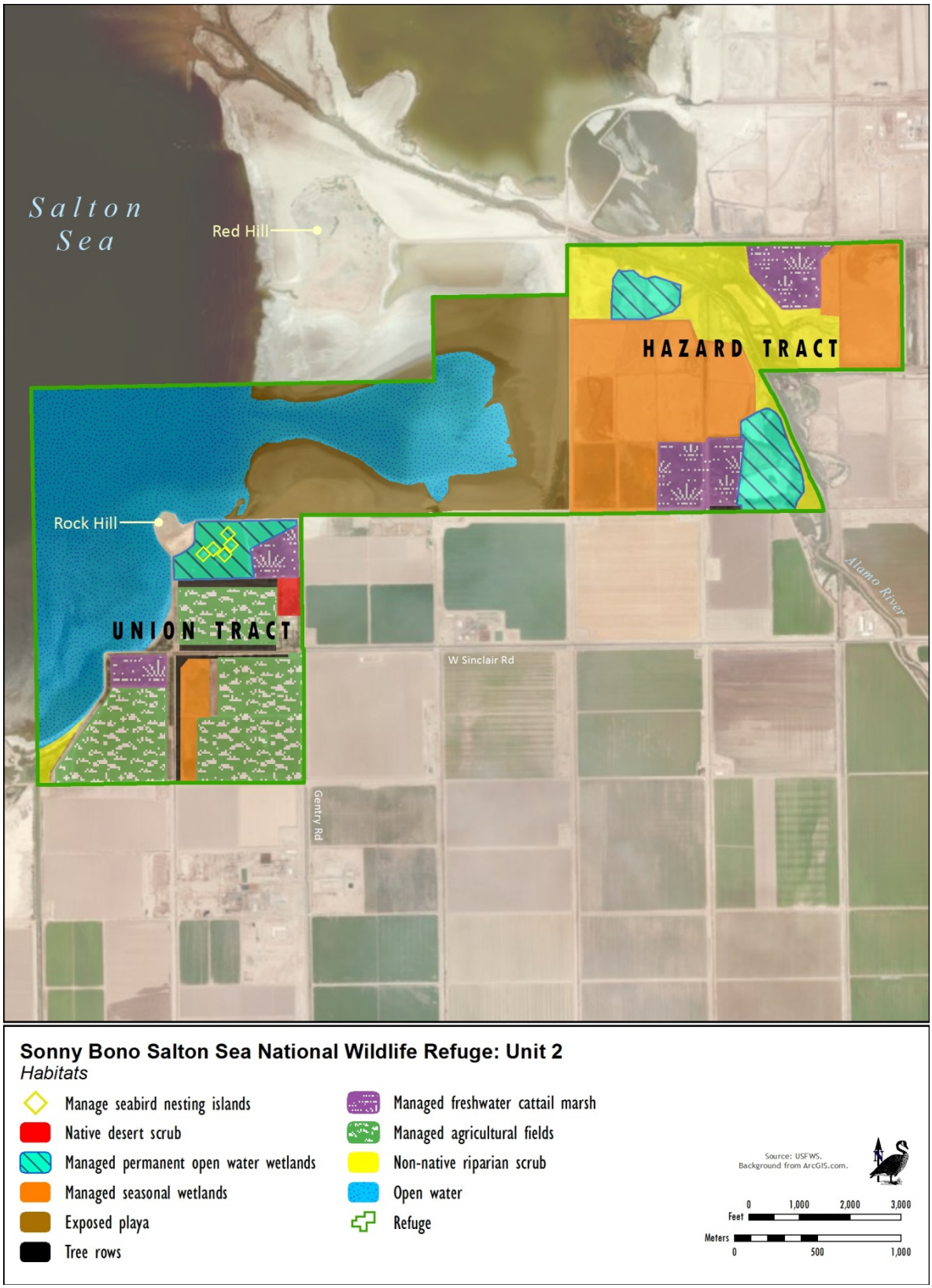


Figure 4-20c. Habitats of the Sonny Bono Salton Sea NWR (Unit 2)

Table 4-11 Summary of the Native and Managed Habitats Present on the Sonny Bono Salton Sea NWR	
Habitat Type	**Approximate Acreage**
Open Water (Salton Sea)	34,536
Shoreline/Shallow Water (3 feet or less of water depth)	1,200
Agricultural Fields (Managed)	849
Shallow Seasonal Wetlands (Managed)	559
Freshwater Cattail Marsh (Managed)	202
Permanent Open Water Wetlands (Managed)	143
Native Desert Scrub	92
Tree Rows (Managed)	62
Riparian Scrub	15
Total Acreage	**37,658**

Under section 404 of the CWA, wetlands are defined as "areas that are inundated or saturated by surface or ground water at a frequency sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Three parameters are used in the field to delineate wetlands: hydrophytic vegetation (more than 50 percent of dominant plants are adapted to anaerobic soil conditions), hydric soils (soils classified as hydric or that exhibit characteristics of a reducing environment), and wetland hydrology (inundation or soil saturation during at least 5 percent of the growing season = 18 days in Southern California) (USACOE and California Natural Resources Agency 2011).

Waters of the U.S. refers to areas under the jurisdiction of the USACOE pursuant to section 404 and is generally defined by the ordinary high water mark. The USACOE's jurisdiction can extend beyond the ordinary high water mark, to the limit of the wetland, when adjacent wetlands are present. The Salton Sea is defined as a navigable water, and its tributaries, the New and Alamo rivers, are defined as Waters of the U.S. For purposes of assessing impacts to Waters of the U.S., the Salton Sea SCH Project determined that the Salton Sea's ordinary high water mark was 231 feet below mean sea level (USACOE and California Natural Resources Agency 2011).

Open Waters of the Salton Sea. The open waters of the Salton Sea, which currently cover approximately 34,536 acres of the Refuge, include those waters that exceed a depth of three feet, which is the vast majority of the Salton Sea. The area of greatest use by fish and birds in the open water is concentrated along the near shore areas, the area that extends a distance of about 0.6 miles (one kilometer) from the shore (CDWR and CDFG 2007). This area is used primarily by waterbirds, including those that feed on fish and invertebrates. The open water is used by birds for loafing, foraging, rafting, and as a staging area prior to migration. It also provides birds with protection from most predators. Some species, such as eared grebe, rely on open water almost exclusively during their stay at the Salton Sea, while others (e.g., waterfowl, gulls, pelicans) use open water for a portion of their daily or seasonal activities. Until recently, these areas also provided important habitat for pelagic spawners, such as orangemouth corvina (*Cynoscion xanthulus*).

As the Salton Sea continues to recede, the extent of open water habitat within the Refuge will continue to decline, with some areas converting to shoreline/shallow water habitat and other areas to unvegetated, exposed playa. As the waters in the Salton Sea recede, salinity levels will increase, reducing habitat quality for prey species such as tilapia and pileworms, which have historically supported large numbers of migratory birds (Cohen and Hyun 2006, Anderson et al. 2007).

Salton Sea Shoreline and Shallow Waters. At present, there are about 1,200 acres of shoreline/shallow water (i.e., a water depth of three feet or less) habitat within the Refuge boundary. These shallow shoreline areas, particularly those occurring along the edges of Bruchard Bay and Red Hill Bay, support an invertebrate community that serves as the forage base for numerous migratory and resident shorebirds (CDWR and CDFG 2007). Shorebird use of these areas is generally concentrated in depths of six inches or less where invertebrate prey can be captured by wading and probing. The perimeter of the Salton Sea (wetted edge) to a depth of three feet generally represents the area where forage resources can be captured by shorebirds (CDWR and CDFG 2007). This area also functions as a resting area for many birds and provides nesting opportunities for species such as snowy plover (*Charadrius alexandrines*) and black-necked stilt.

American avocets are often observed along the Salton Sea shoreline (Mark Stewart/USFWS)

Shallow water habitat areas can support desert pupfish, as well as other fish and invertebrates. These areas also represent important spawning and nursery areas for tilapia. Smaller fish in shallow waters feed on invertebrates as well as algal material (CDWR and CDFG 2007), and in turn contribute to forage base for a number of the Refuge's fish-eating birds, including black skimmer, Caspian tern, Forster's tern, great blue heron, and many others.

As the open waters of the Salton Sea recede, these shallow water areas will convert to unvegetated, open playa. Proposals by various Federal and State agencies to convert some of these previously inundated areas to managed open water habitat are currently being evaluated. Some projects would provide shallow water habitat, while others would provide deeper water habitat to support fish species favored by the Sea's fish-eating birds.

Managed Permanent Open Water Wetlands. The Refuge currently manages seven areas of permanent open water habitat. Three of these areas (totaling 31 acres) are located in the Hazard Tract on Unit 2 and provide open water to support waterfowl and diving birds. The other four permanent open water wetlands (with two located north of the Refuge headquarters [37 acres] and two located in Unit 1 [75 acres]) are shallower and support waterfowl, shorebirds, wading birds, and nesting seabirds. Three of these impoundments include island habitat managed specifically to support nesting gull-billed terns and black skimmers.

Two of these ponds extend six to seven feet deep and receive water directly from the Alamo River. The remaining impoundments are typically managed at a depth of two to three feet with shallow areas, including mudflats, around the pond edges. Water is supplied to these wetlands via the IID network of supply ditches. Birds foraging in these areas feed primarily

on invertebrates and fish, and whether deep or shallow these habitats are limited in emergent aquatic vegetation by having higher salinity concentrations. Vegetation, typically salt cedar and iodine bush (*Allenrolfea occidentalis*), grows along the levees, which comprise the pond perimeters.

Riparian Scrub. The 15 acres of riparian scrub vegetation mapped within the Refuge occur along the Alamo and New rivers, and in a few places along the southern edge of Bruchard Bay in Unit 1. The predominant riparian species in these areas is salt cedar, a non-native species that has invaded many riparian sites within the southwest. Some small stands of arrow weed (*Pluchea sericea*) also occur within the Refuge's riparian areas. Control of salt cedar is occurring in portions of the Refuge, particularly in Unit 1. Once removed, the salt cedar is replaced with native vegetation, including Goodding's black willow and screwbean mesquite.

The drainage channels and irrigation canals that extend through the Refuge typically have earthen sides and periodically support riparian vegetation. The conditions in these waterways change over time based on use of an individual ditch, level of salinity, and frequency and timing of vegetation clearing (USACOE and California Natural Resources Agency 2011); therefore, habitat quality is generally low.

Managed Freshwater Cattail Marsh. On the Refuge, freshwater marsh is represented primarily by areas constructed and managed to support cattail marsh, although California bulrush (*Scirpus* [*Schoenoplectus*] *californicus*) may also be present. About 200 acres of cattail marsh are managed on the Refuge for the primary purpose of supporting Yuma Ridgway's rail, although other secretive marsh birds including black rail, least bittern, American bittern (*Botaurus lentiginosus*), sora (*Porzana carolina*), and Virginia rail (*Rallus limicola*) also occur here.

American bittern (Tim Anderson)

Other species associated with these freshwater marsh areas include pied-billed grebe (*Podilymbus podiceps*), common gallinule (*Gallinula galeata*), northern harrier (*Circus cyaneus*), marsh wren (*Cistothorus palustris*), blue grosbeak (*Passerina caerulea*), red-winged black bird (*Agelaius phoeniceus*) and yellow-headed blackbird (*Xanthocephalus xanthocephalus*) (Patten et al. 2003). The operation of these managed marshes is dependent upon the availability of fresh water.

These marsh areas are flooded perennially and support vegetative communities consisting primarily of cattails that are interspersed with areas of shallow open water and islets. Some of these ponds may support narrow bands of iodine bush scrub around their perimeter. The perimeter of other ponds may support non-native invasive plants such as common reed. Areas of common reed marsh can be found at the edge of water along both the Alamo and New rivers, especially within 0.5 mile of the Salton Sea.

Over time, the Refuge's managed cattail ponds can become overgrown, supporting dense, impenetrable cattail stands that no longer provide optimum habitat for rails. Options for ensuring adequate habitat to accommodate rails and other secretive marsh birds include rotating managed pond areas by creating new cattail marsh adjacent to existing marsh habitat.

Once the new habitat is established, the existing overgrown marsh can be cleared or burned and used as seasonal wetland habitat until cattails are once again established.

Managed Shallow Seasonal Wetlands. Approximately 560 acres of shallow seasonal wetlands are maintained in diked ponds within Units 1 and 2 of the Refuge. Water levels in these ponds are manipulated through flash flooding in the spring and summer to support moist soil conditions for propagating marsh plants in a variety of growth stages for diverse wildlife use, particularly waterfowl and shorebirds. The highest bird use in these areas occurs in fall and winter, but the drawdown of water in some ponds is delayed to provide habitat for spring and even summer shorebirds. Almost all migratory waterbirds make some use of these habitats. Over the years, the plant species present have included alkali bulrush, watergrass, sprangle-top grass, wigeongrass (*Ruppia maritima*), swamp timothy, and cattail.

The ponds in the eastern portion of the Refuge, primarily in the Hazard Tract, are managed primarily for waterfowl use. These ponds are opened seasonally for waterfowl hunting.

Upland Vegetation

Desert Scrub. Approximately 92 acres of the Refuge support desert scrub habitat. These areas generally occur in three locations: along the western shore of the Salton Sea to the south of Salton City; to the southwest of Bruchard Bay in Unit 1; and just to the north of the Refuge headquarters in Unit 2. This habitat has experienced various levels of disturbance over the years. The least disturbed areas support quail bush scrub/desert holly scrub vegetation. This native upland vegetation type, which occurs in a few scattered locations on the Refuge, is dominated by quail bush (*Atriplex lentiformis*) and desert holly (*Atriplex hymenelytra*).

Managed Agricultural Fields. Approximately 850 acres of agricultural fields are managed on the Refuge, primarily to provide forage for wintering geese. In 2012, the primary crop produced in these fields was rye grass, although a variety of crops have been cultivated over the years, to achieve Refuge purposes, including alfalfa, wheat, milo, and millet. In the past, some fields were maintained through cooperative farming practices, although no cooperative farming currently occurs on the Refuge. In addition to providing forage for wintering geese, these fields also support wintering populations of sandhill cranes, and provide foraging, roosting, and breeding opportunities for a variety of other resident and migratory birds.

Tree Rows. Along the edges of some of the Refuge's agricultural fields are tree rows, planted in the past to provide more diverse habitat. These tree rows, which include native and non-native tree species, include honey mesquite, screwbean mesquite, blue palo verde, Mexican palo verde, fairy duster (*Calliandra eriophylla*), sweet acacia (*Acacia farnesiana*), catclaw acacia (*Acacia greggii*), and desert ironwood. The trees provide beneficial habitat for a range of native birds and other wildlife.

4.5.3.3 Coachella Valley NWR

Plant Communities and Vegetation Types

The Coachella Valley's terrestrial habitats are diverse and include creosote bush scrub; mixed scrub, including yucca and cholla cactus; desert saltbush; sandy soil grasslands; and desert dunes (Dimmitt 2000). Higher elevations are dominated by pinyon pine and California juniper, with areas of manzanita and Coulter pine. In addition to hardy perennials, more than half of the desert's plant species are herbaceous annuals, and appropriately timed winter rains produce abundant early spring wildflowers. In the southern portion of the region, the

additional moisture supplied by summer rainfall fosters the germination of summer annuals and supports smoke tree (*Psorothamnus spinosus*), ironwood, and palo verde (CDFG 2007).

The valley floor, which includes the lands within the Coachella Valley NWR, is situated in the central portion of Coachella Valley and is characterized by open and gently sloping land. This relatively flat and low-lying terrain includes areas of shifting and blowing sands generally supporting only sparse vegetation. Although the plant communities present within the boundary of the Coachella Valley NWR are not as diverse as those found in the other portions of the valley, those communities that are present represent core habitat areas for a number of species endemic to the Coachella Valley. Table 4-12 provide the estimated acreage of each vegetation type within the Refuge, and Figure 4-21 illustrates the distribution of the vegetation types within the Refuge.

Table 4-12
Summary of the Vegetation Types Present on the Coachella Valley NWR

Habitat Type	Approximate Acres
Creosote bush scrub	2,873
Desert Dunes (including sand fields)	216
Desert wash	23
Saltbush scrub	1
Disturbed (dominated by Sahara mustard)	410
Disturbed (unvegetated, ruderal, ornamental trees)	54
Total Acreage	3,577

The following description of the natural communities present on the Coachella Valley NWR is taken from the Final Recirculated Coachella Valley MSHCP (CVAG 2007a) and the Final Recirculated Coachella Valley MSHCP EIR/EIS (CVAG 2007b).

Sand verbena in bloom in desert dune habitat (USFWS)

Desert Dunes. This natural community is described by the Holland system (1986) as active desert dunes, while the vegetation classification system in the Manual of California Vegetation (Sawyer et al. 2008) refers to this as desert sand - verbena series. Also referred to as the aeolian sand community, desert dunes are characterized by shifting and blowing sands and supporting only sparse vegetation.

The desert dune community, or aeolian sand community, can be further divided into these sub-communities: active sand dunes; sand hummocks; ephemeral sand fields; and stabilized and partially stabilized desert sand fields. These sand habitats are characterized by low perennial plant diversity, very high annual or ephemeral plant diversity, and a very diverse array of invertebrates.

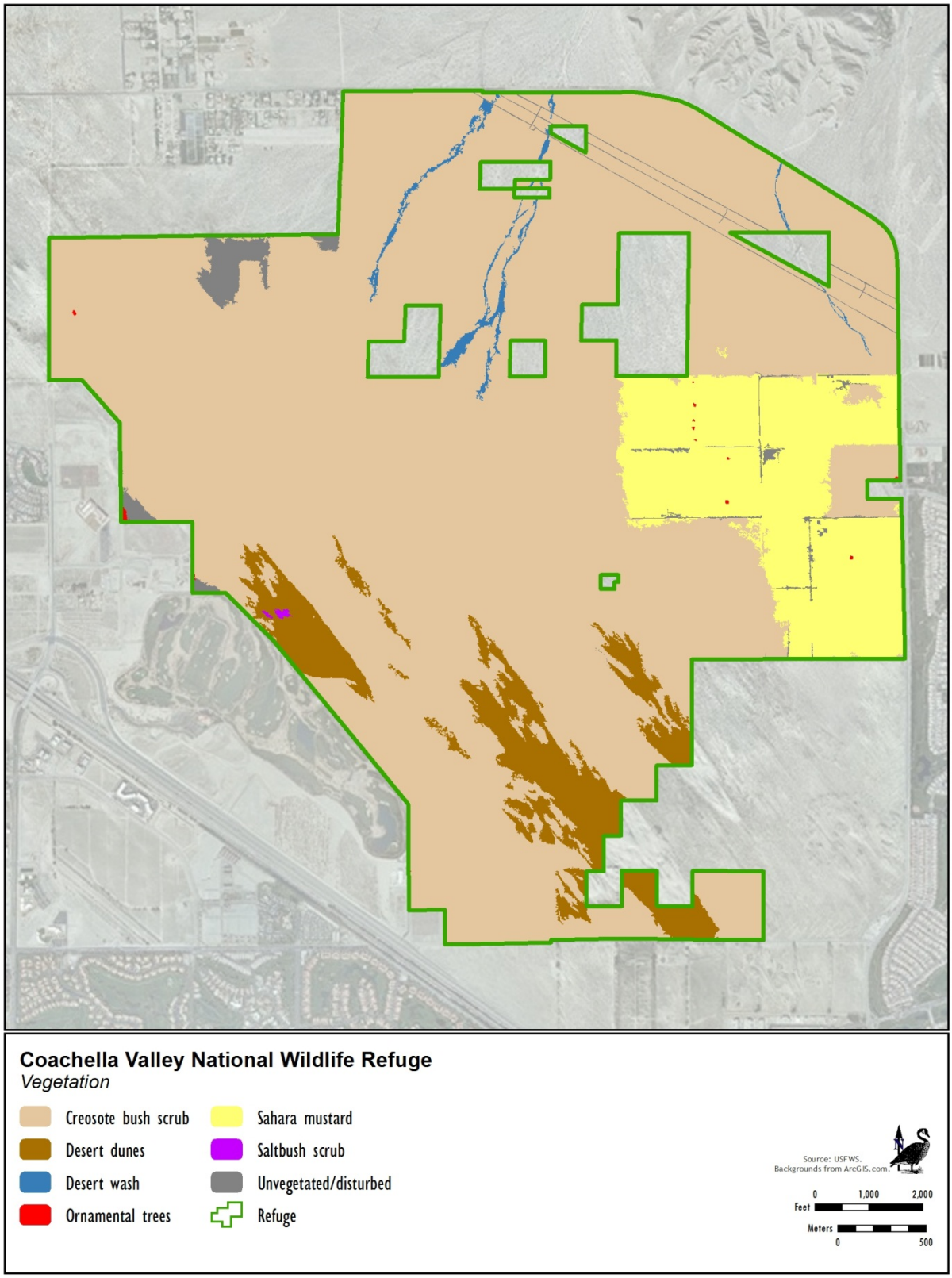


Figure 4-21. Vegetation Types Present on the Coachella Valley NWR

Active sand dunes are present in exposed areas on the valley floor where high wind conditions convey sand and persistently shift the sand dunes. "Active" refers to the fact that windbreaks have not impaired the aeolian (windborne) processes that contribute to sand transport, accumulation, and depletion in the sand fields. Because the dunes are continually shifting and accumulating sand, perennial plant cover is very low with much of the surface exposed or barren for most of the year.

Creosote bush (USFWS)

Perennial shrub species that may be present include creosote bush (*Larrea tridentata*), four-wing saltbush (*Atriplex canescens*), California croton (*Croton californicus*), sandpaper plant (*Petalonyx thurberi*), and indigo bush (*Psorothamnus arborescens*). Annual wildflowers can also be observed following periods of high seasonal rainfall. Within the Refuge's active dune habitat, Coachella Valley milk-vetch, an annual or short-lived perennial plant endemic to the Coachella Valley, is more abundant in years of adequate rainfall. Other annual native plants may include sand verbena (*Abronia villosa*) and dune primrose (*Oenothera deltoides*). In recent years, Sahara mustard, an invasive annual plant, has been present in increasing numbers.

Dune primrose (USFWS)

There are roughly 420 acres of active desert dunes mapped in the Thousand Palms Conservation Area, including 216 acres located on the Refuge in 2011. The location and amount of dune habitat on the Refuge varies, as indicated in Figure 4-22. As part of the Management and Monitoring Program to be implemented in association with the Coachella Valley MSHCP, these active desert dunes will be assessed to determine if they are more susceptible to stabilizing factors than similar dune areas to the west (CVAG 2007b).

Active desert sand fields are areas of active sand movement, with little or no vegetation, where accumulated sand is not of sufficient depth to form classic formations that characterize dune systems. The distinction between this community and active desert sand dunes is the absence in sand fields of prominent dune landforms. While not in dune formation, sand within these fields is actively being deposited and depleted to form sheets of desert sand. Like the dunes, active desert sand fields are generally unable to support extensive vegetation due to the active aeolian processes. Sand often piles up against creosote bush, mesquite, and other perennials to create hummocks or mounds that can support other plants and wildlife.

Sand fields may intergrade with active dunes, and stabilized and partially stabilized dunes and sand fields. Vegetation varies from scant cover of widely scattered shrubs and annual wildflowers to denser shrub cover. This community occurs within a creosote bush scrub matrix. Typical species include four wing saltbush, creosote bush, and indigo bush. There are approximately 3,543 acres of active desert sand fields mapped in the Coachella Valley MSHCP, including those present within the Refuge.

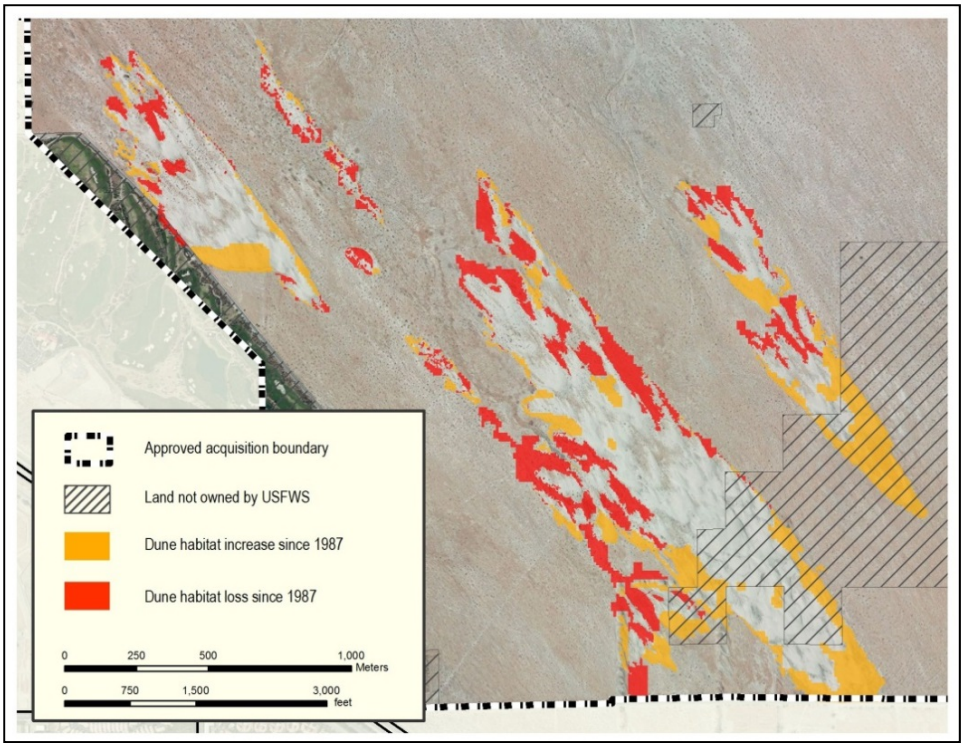


Figure 4-22. Changing Dune Formations - Coachella Valley NWR

Due to a variety of changing circumstances (e.g., construction of the Union Pacific Railroad lines, I-10, and other roads, installation of windbreaks, upwind development) that have cut these areas off from fresh sources of sand, stabilized and partially stabilized sand fields have replaced the active sand dunes and sand fields in large portions of the Coachella Valley MSHCP area. Stabilized and partially stabilized sand fields are areas on the valley floor where vegetation grows more readily and consists primarily of scattered herbs and shrubs. As in active sand dune areas, the dominant natural community is the creosote bush scrub. This sub-community is not identified in the Coachella Valley MSHCP as being present in the Thousand Palms Conservation Area, but there are likely small areas within the Refuge that have experienced sufficient disturbance to meet the definition of stabilized and partially stabilized desert sand fields.

Mesquite Hummocks. This community, which is described by the Holland system (1986) as mesquite hummocks and classified in the Manual of California Vegetation (Sawyer et al. 2008) as mesquite series, is composed of large clumps of low growing honey mesquite shrubs. In the Thousand Palms Conservation Area, the mesquite shrubs form hummocks over sand dunes in locations typically associated with higher soil moisture.

The Coachella Valley MSHCP identified several areas within the Coachella Valley NWR that supported mesquite hummock vegetation in the early 2000s. However, as of 2012, most of this vegetation has either died or is severely degraded. The reason for the declined in the presence of mesquite hummocks on the Refuge is suspected to be reductions in soil moisture associated with a declining water table.

Creosote Bush Scrub. The creosote bush scrub present on the Refuge is defined as Sonoran creosote bush vegetation per the classification system in the Manual of California Vegetation (Sawyer et al. 2008). A variety of series including creosote bush series, creosote bush- white bursage series, Teddy-bear cholla series, and Ocotillo series are recognized within this classification. Holland (1986) includes Sonoran mixed woody and succulent scrub and Sonoran creosote bush scrub within the Sonoran creosote bush vegetation classification (CVAG 2007a).

Sonoran creosote bush scrub is the most widespread vegetation type in the Colorado Desert. Dominated by creosote bush, Sonoran creosote bush scrub occurs on approximately 14,754 acres within the Thousand Palms Conservation Area, including 2,873 acres on the Coachella Valley NWR. This community is characterized by individual creosote bush shrubs (ranging from about 1.5 to just under 10.0 feet [0.5 to 3 meters] in height) that are broadly spaced and typically separated by bare ground. Species diversity is very low. The codominant species in the community is burrobush (*Ambrosia dumosa*), a much shorter shrub that ranges from about eight inches to just under two feet (20 to 60 centimeters) in height. The sparse nature of this community can temporarily change in late winter/early spring if winter rains are sufficient to support a variety of short-lived flowering annuals.

The Sonoran mixed woody and succulent scrub community is the second most abundant community in the Coachella Valley MSHCP, and is the only Sonoran desert community in the plan area with substantial dominance of cacti and other stem succulents. It is similar to creosote bush scrub but more varied and usually with a higher plant density. In addition to creosote bush and other associated perennial shrubs, typical species found in this community on the Refuge include golden cholla (*Opuntia echinocarpa*), pencil cholla (*Opuntia ramosissima*), and barrel cactus (*Ferocactus cylindraceus*).

Golden Cholla (USFWS)

Saltbush Scrub. This community is described by the Holland system (1986) as desert saltbush scrub and identified as the fourwing saltbush series in the Manual of California Vegetation (Sawyer et al. 2008). The desert saltbush scrub community can include various species of saltbush in a nearly uniform stand of shrubs, forming a more complete cover than in creosote bush scrub. Occurring in areas with fine-textured, poorly drained soils with high salinity and/or alkalinity, this community is often composed of a nearly uniform stand of shrubs about three feet (one meter) tall forming a more complete cover than in creosote bush scrub. A one-acre area of saltbush scrub, characterized by the presence of four-winged saltbush, which prefers dryer, coarser soils, is supported near the western edge of the Refuge.

Desert Wash. Desert washes form a distinct habitat that connects the mountains and the valley floor. They emerge from canyon mouths as high-banked watercourses and cut through the alluvial plain. As a wash descends the plain, it broadens and the watercourse branches out. Farther from the canyons, washes become broader, shallower, and less defined, so that the physical differences between the washes and the alluvial plain are diminished. It is the latter situation that exists on the Refuge, which includes the bottom most reaches of the Thousand

Palms Wash, one of the few good remaining examples of sandy desert wash habitat in the Coachella Valley.

Limited vegetation is associated with the southern end of the Thousand Palms Wash, which extends into the north central portion of the Refuge and occupies approximately 23 acres within the Refuge. Those species typically associated with desert washes that have been documented on the Refuge include smoke tree, dyeweed (*Psorothamnus emoryi*), sweetbush (*Bebbia juncea aspera*), and sandpaper plant.

Disturbed Areas. Approximately 464 acres of previously disturbed habitat, primarily old agricultural fields, are present on the Refuge. The dominated species in this area is the invasive plant, Sahara mustard.

4.5.4 Wildlife

4.5.4.1 Sonny Bono Salton Sea NWR

Introduction

The information presented below is derived primarily from the Salton Sea Ecosystem Restoration Program Draft Programmatic Environmental Impact Report (CDWR and CDFG 2006); the draft EIS/EIR for the Salton Sea SCH Project (USACOE and California Natural Resources Agency 2011), Birds of the Salton Sea (Patten et al. 2003) for descriptions of status and habitats on the Refuge; Birds of North America Online for range and habitat descriptions from various authors; studies on patterns of abundance, distribution, annual phenology, and habitat associations (Shuford et al. 2000); and observations made by Refuge staff.

Birds

The Sonny Bono Salton Sea NWR supports a diverse and abundant array of bird species. Although the species that are present during the different seasons of the year vary, the numbers of birds present on the Refuge are relatively high year round. More than 420 species of birds have been documented on or nearby the Refuge and at least 93 species of birds have been recorded nesting on the Refuge at one time or another. (A list of the documented species is provided in Appendix C.) The Salton Sea is recognized as a globally important bird area by the American Bird Conservancy and the National Audubon Society (California Audubon Society Important Bird Areas http://ca.audubon.org/iba/iba_sites.shtml). In addition, the Refuge was designated a Western Hemisphere Shorebird Reserve Network site in 2002 because it supports more than 20,000 shorebirds annually.

Wintering Birds. The Salton Sea is the winter destination for many migratory birds. The abundant food resources of the region help prepare wintering birds for the spring migration and upcoming breeding season. For many years, American white pelicans have wintered at the Sea, often in the tens of thousands (Patten et al. 2003), to forage on the fish present within the Sea. In addition, large numbers of eared grebes have historically stopped at the Sea to feed on pileworms and barnacle larvae. Wintering and migrating

American white pelicans (Mark Stewart/USFWS)

eared grebes have numbered in the hundreds of thousands, but over a million have been documented in a single survey; almost the entire North American population (Jehl 1988).

Upland habitats of the Imperial Valley also attract wintering birds. About one third of the mountain plover (*Charadrius montanus*) worldwide population winters on the region's agricultural lands (Shuford et al. 2000), and wintering sandhill cranes (*Grus canadensis*) are also noteworthy because this area represents one of their few southern California wintering areas. During a typical winter, 30,000 snow geese and Ross' geese migrate to the south end of the Salton Sea. In accordance with Refuge purposes, Refuge staff spend considerable time preparing for this winter influx of geese and other waterfowl, cultivating wetland plants in ponds to be flooded up in winter and farming rye grass in the upland units to lore geese to the Refuge and away from commercial agricultural fields.

The white-faced ibis (*Plegadus chihi*) occurs in large numbers at the Salton Sea as a winter visitor and migrant. Wintering white-faced ibis can be observed foraging in the agricultural fields to the south of the Salton Sea, as well as within the managed fields located within the Refuge (Shuford et al. 2002). The area around the Salton Sea also supports a small, irregular breeding population of this species. Results of bird counts conducted for the Salton Sea in 1999 indicated a peak count in October of approximately 37,400 white-faced ibis. These counts were made of ibis returning to nighttime roosts after foraging in irrigated fields in the Imperial Valley.

White-faced ibis (Jenny E. Ross)

Migrant Birds. Another category of birds supported by the Refuge are migrant birds that use the wetlands as feeding and resting stops on their journeys between breeding and wintering grounds. Migratory birds moving south for the winter generally begin arriving at the Refuge in late summer, and are most abundant in the fall. Spring migration generally occurs from February through May for species heading north. Shorebirds, in particular, make use of the shallow wetlands of the Salton Sea. American avocet, black-necked stilt, western sandpiper (*Calidris mauri*) and long-billed dowitcher (*Limnodromus scolopaceus*) are easy to find in great numbers both in spring and fall. In addition, the Refuge's upland tree rows support migrating flycatchers, warblers, and vireos.

The Salton Sea is renowned for attracting the occasional stray migrant, often triggering a rare bird alert. Unusual visitors include wayward Neotropical songbirds, uncommon seabird and waterfowl species, vagrants channeled to the area by the surrounding geography, and the occasional birds that are just completely off-course. Magnificent frigatebirds, blue-footed boobies, brown boobies, neotropic cormorants (*Phalacrocorax brasilianus*), roseate spoonbills (*Platalea ajaja*), and wood storks are frequently noted.

Only a few raptor species, including American kestrel (*Falco sparverius*), northern harrier, and red-tailed hawk (*Buteo jamaicensis*), may be observed on the Refuge year-round, while a variety of raptors migrate through the Imperial Valley in small numbers during winter and

fall. Ospreys (*Pandion haliaetus*) are rare visitors to the Imperial Valley, that if present might be observed at any time of the year near open water areas, as they prey almost entirely on fish. Sharp-shinned hawks (*Accipiter striatus*) are uncommon winter migrants. On the Refuge, they may be observed in the agricultural fields in fall and winter and on rare occasions, they can be observed in the spring. Like the sharp-shinned hawk, the Cooper's hawk (*Accipiter cooperii*) and ferruginous hawk (*Buteo regalis*) are also uncommon winter migrants.

Male northern pintail (Jenny E. Ross)

Waterfowl are an important component of the migratory bird population on the Refuge. Refuge habitats, including the open waters of the Salton Sea, the northern portions of the New and Alamo rivers, various drainage and irrigation channels, as well as the managed wetlands (i.e., shallow, seasonal wetlands, open water, freshwater cattail marsh) and agricultural fields support a diverse and abundant waterfowl population, with six species of geese, one species of swan, and 31 species of ducks documented on the Refuge. Excluding snow and Ross's geese, which are discussed under wintering residents, the most abundant migratory waterfowl on the Refuge include ruddy duck (*Oxyura jamaicensis*), northern pintail, northern shoveler (*Anas clypeata*), American wigeon (*Anas americana*), and green-winged teal (*Anas crecca*) (Shuford et al. 2002).

Summer Residents. Summer residents, the third category of the birds that use the Refuge, are present in much smaller numbers than are wintering birds. Many of the summer residents arrive at the Refuge with the intent of breeding and raising their young, while others make post-breeding migrations to the Sea. Of the breeding birds, Caspian terns, gull-billed terns, and black skimmers are among the most conspicuous. The tern and skimmer colonies nest on islands where they have the greatest chance of avoiding predation from land mammals. The Refuge maintains two ponds, each with several nesting islands, for these birds. Additionally, brown pelicans can be seen loafing on these islands. They migrate to the Sea after breeding on islands in the Gulf of California, Mexico. In past years, thousands of brown pelicans have spent the summer at the Salton Sea, feeding on tilapia, before returning to Mexico for the next breeding season.

Nesting double-crested cormorant (Jenny E. Ross)

Year-round Residents. The most notable year-round resident bird is the federally listed endangered Yuma Ridgway's rail; however, the Salton Sea's location on the Pacific Flyway draws in many migratory birds that have established year-round residency to take advantage of the abundant resources. Other resident secretive marsh birds present on the Refuge include least bittern and California black rail. The double-crested cormorant , a common, year-round resident of the Salton Sea, is present on the Refuge in greatest numbers during the winter months; however, populations remain steadily in the thousands throughout the year. Double-crested cormorants have established several significant breeding colonies on and around the Sea. In 1996, a particularly large colony was established on Mullet Island off the southeastern shore of the Salton Sea. In

1999, this fish-eating bird was one of the most numerous bird species at the Salton Sea, with the peak number (18,504 individuals) occurring in January of that year (Shuford et al. 2002). This species has also been observed nesting along the Alamo River and at the New River delta (USACOE and California Natural Resources Agency 2011, Shuford et al. 2000). Historically, there were numerous heron and egret rookeries around the Salton Sea, but as the Sea has receded, these numbers have declined.

The Imperial Valley supports a large resident population of burrowing owls. Burrowing owls can often be observed on the tops and slopes of ditch banks along the edges of agricultural land where they nest in burrows, but they also readily use artificial owl boxes buried along these ditches. The Refuge maintains a number of owl boxes that these owls routinely occupy.

Other resident birds commonly encountered on the Refuge include the greater roadrunner (*Geococcyx californianus*), crissal thrasher, verdin, Gambel's quail (*Callipepla gambelii*), Abert's towhee (*Pipilo aberti*) and common ground dove (*Columbina passerine pallescens*). In the wetlands, songs of the common yellowthroat (*Geothlypis trichas occidentalis*) and marsh wren fill the morning air. Many of these wetlands are managed specifically for the Yuma Ridgway's rail and other secretive marsh birds.

The long-billed curlew (*Numenius americanus*) is present at the Salton Sea and on the Refuge throughout the year, but the largest number of curlews can be observed during the winter months. Curlews do not breed in the area and those that spend the summer at the Sea are believed to be first-year birds, which are most often observed in the vicinity of Red Hill, Obsidian Butte, and Bruchard Bay (USACOE and California Natural Resources Agency 2011). Long-billed curlews are generally observed in greater numbers in the agricultural fields of the Imperial Valley than along the mudflats and shoreline of the Salton Sea (Shuford et al. 2002). On the Refuge, this species is frequently observed in areas of managed seasonal wetlands.

Long-billed curlew (Kirk Gilligan/USFWS)

Mammals

Approximately 40 species of mammals have been documented on the Refuge. The most common include coyote, raccoon, muskrat (*Ondatra zibethicus*), striped skunk (*Mephitis mephitis*), desert cottontail (*Sylvilagus audobonii*), round-tailed ground squirrel (*Spermophilus tereticaudus*), and western pocket gopher (*Thomomys bottae*). At least 17 species of rodents and 12 species of bats are known from the area. A list of the documented species is provided in Appendix C.

Reptiles and Amphibians

A total of 18 species of reptiles and four species of amphibians, some of which represent non-native species, have been documented on the Refuge. Some of the common terrestrial reptiles include side-blotched lizard (*Uta stansburiana*), desert spiny lizard (*Sceloporus magister*), western diamond-backed rattlesnake (*Crotalus atrox*), and gopher snake (*Pituophis catenifer*). These species occur in upland habitats, especially in habitat associated with agricultural

development (USACOE and California Natural Resources Agency 2011). Spiny softshell turtles (*Apalone spinifera*), bullfrogs (*Lithobates catesbeianus*), and Rio Grande leopard frogs (*Lithobates berlandieri*) can be found in the New and Alamo rivers and agricultural drains. Checkered garter snake (*Thamnophis marcianus*) occurs in agricultural drains and marshes (Crayon 2011). A species list is provided in Appendix C.

Fish and Other Aquatic Organisms

Initially, the fish and invertebrates present in the Salton Sea arrive via the Colorado River, and over time entered the Sea via other rivers, creeks, and drains. Between 1929 and 1956, non-native fish were introduced into the Sea on more than 20 occasions and included more than 30 different species (USACOE and California Natural Resources Agency 2011). As the salinities in the Sea increased, other species of fish were introduced.

Fish in the Sea were supported by a wide range of aquatic organisms including phytoplankton, zooplankton, and benthic and water column macroinvertebrates. Macroinvertebrate species include diptera (flies), corixids (water boatmen), benthic polychaetes such as pileworms and a spionid worm (*Streblospio benedicti*), amphipods (*Gammarus mucronatus* and *Corophium louisianum*), ostracods (seed shrimp), and a barnacle, while zooplankton is dominated by copepods (USACOE and California Natural Resources Agency 2011).

The most abundant fish in the Sea today are tilapia, which have been determined to be hybrids of Mozambique tilapia (*Oreochromis mossambicus*) and Wami River tilapia (*O. urolepis hornorum*). These fish, called California Mozambique hybrids ("Mozambique hybrid tilapia"), are extensively used as forage by birds due to their range in size classes and location within the water column.

The shallow waters of the Sea, as well as some of the drainage channels and managed wetland areas on the Refuge all have the potential to support desert pupfish (*Cyprinodon macularius*) (discussed in more detail below under Federal and State Listed Species). The shallow water areas also provide important spawning and nursery habitat for tilapia, and support sailfin molly (*Poecilia latipinnna*) and other smaller fish.

Until recently, these shallow water areas also provided habitat for pelagic spawning fish such as orangemouth corvina. Orangemouth corvina, along with Gulf croaker (*Bairdiella icistia*) and sargo (*Anisotremus davidsoni*), have not been detected in the Sea since 2003 and are probably no longer present due to the Sea's increased salinity (USACOE and California Natural Resources Agency 2011).

The Alamo and New river mouths provide areas of reduced salinity and higher dissolved oxygen, but Mozambique hybrid tilapia continues to be the only fish species to be recently collected in these areas. Common carp (*Cyprinus carpio*), threadfin shad (*Dorosoma petenense*), striped mullet (*Mugil cephalus*), striped bass (*Morone saxatilis*), and mosquitofish (*Gambusia affinis*), which can be found upstream in these rivers, are believed to occasionally enter the Sea from these rivers.

Invertebrates in the Alamo River and agricultural drains include plankton, snails, midge larvae (chironomids), Asiatic clams (*Corbicula fluminea*), and crayfish (USACOE and California Natural Resources Agency 2011). Fish species present in the New River include blue tilapia (*Oreochromis aureus*), common carp, and channel catfish (*Ictalurus punctatus*) and other species reported in the Alamo and/or New rivers include orangemouth corvina, Mozambique

tilapia, channel catfish, flathead catfish (*Pylodictis olivaris*), red shiner (*Cyprinella lutrensis*), and largemouth bass (*Micropterus salmoides*).

Fish in the agricultural drains include sailfin molly, red shiner, mosquitofish, longjaw mudsucker (*Gillichthys mirabilis*), common carp, desert pupfish, shortfin molly (*Poecilia mexicana*), porthole livebearer (*Poeciliopsis gracilis*), Mozambique tilapia hybrids, redbelly tilapia (*Tilapia zillii*), and possibly blue tilapia (*Oreochromis aureus*).

Salinity in the Salton Sea is expected to exceed the tolerance of most fish species currently present in the near future, thereby eliminating the food source for piscivorous (fish-eating) birds that use the Sea. When salinity levels will reach inhabitable levels for fish is unknown, but it could be within a few years to a decade or more (USACOE and California Natural Resources Agency 2011).

4.5.4.2 Coachella Valley NWR

Introduction

The information presented below is derived from the Final Recirculated Coachella Valley MSHCP (CVAG 2007a), Final Recirculated Coachella Valley MSHCP EIR/EIS (CVAG 2007b), Biological Opinion for the Coachella Valley MSHCP (USFWS 2008b), and Service staff field observations.

Birds

A year-long avian survey has not been conducted for the Refuge to date; however, based on information collected for the larger Coachella Valley Preserve, at least 40 species of birds would be expected to utilize the Refuge at some point during the year, including Gambel's quail, red-tailed hawk, common raven, greater roadrunner, mourning dove (*Zenaida macroura*), verdin, and phainopepla. More than 183 bird species have been recorded for the larger Coachella Valley Preserve; however, species diversity and bird abundance is likely limited within the Refuge boundary by the lack of water on the site, as well as the minimal vegetative cover present on the Refuge during much of the year.

Greater roadrunner (Tim Anderson)

Mammals

A survey to identify the range of mammals present on the Refuge has not been conducted to date. Approximately 80 species of mammals have been documented within the larger Sonoran Desert of southern California, including many species of rodents (Bunn et al. 2007). Between 2002 and 2005, Barrows and Allen (2007) studied the temporal and spatial abundance patterns of species occurring across the desert sand dune landscape in the Coachella Valley. During their study, they observed the following mammals within active dune habitat Coachella Valley round-tailed ground squirrel, desert kangaroo rat (*Dipodomys deserti*), Merriam's Kangaroo Rat (*Dipodomys merriami*), Palm Springs pocket mouse (*Perognathus longimembris bangsi*), and desert pocket mouse (*Cheatodipus pencillatus*). Both the Palm Springs pocket mouse and Coachella Valley round-tailed ground squirrel are endemic to the Coachella Valley. Common

species in other areas of the Refuge likely include desert cottontail, coyote, black-tailed jackrabbit (*Lepus californicus*), and kit fox (*Vulpes macrotis*).

Reptiles and Amphibians

A total of 66 reptiles and 16 amphibians have been documented within the larger Sonoran Desert of southern California (Bunn et al. 2007). A Refuge-wide survey for herpetological species has not been conducted, therefore, the number of such species supported on the Refuge is not known. The following reptiles, which were observed by Barrows and Allen (2007) in Coachella Valley active dune habitat during a study conducted between 2002 and 2005, are likely to be supported on the Refuge: Coachella Valley fringe-toed lizard, flat-tailed horned lizard, desert iguana (*Dipsosaurus dorsalis*), zebra-tailed lizard (*Callisaurus draconoides*), western whiptail lizard (*Aspidoscelis* [*Cnemidophorus*] *tigris*), western banded gecko (*Coleonyx variegatus*), side-blotched lizard, sidewinder (*Crotalus cerastes*), and western shovel-nosed snake (*Chionactis occipitalis*). Additional species including coachwhip (*Masticophis flagellum*) and gopher snake (*Pituophis catenifer*) have also been observed (pers. comm. Jack Crayon, CDFW).

Arthropods

Arthropods such as ants, beetles, and crickets have been documented in active dune habitat and many other species are anticipated. Some of these organisms are preyed upon by the Coachella Valley fringe-toed lizard and other reptile species. The endemic Coachella Valley giant sand treader cricket (*Macrobaenetes valgum*) and the Coachella Jerusalem cricket (*Stenopelmatus cahuilaensis*) are supported on the Refuge.

4.5.5 Federal and State Listed Species and Other Special Status Species

4.5.5.1 Sonny Bono Salton Sea NWR

Federal Listed Species

The Sonny Bono Salton Sea NWR supports two federally listed endangered species, Yuma Ridgway's rail and desert pupfish; however, no designated Critical Habitat occurs within the Refuge boundary. Below is a summary of the status and life history of these species.

Yuma Ridgway's Rail (*Rallus obsoletus yumanensis*). The Yuma clapper rail, now referred to as the Yuma Ridgway's rail, was listed as an endangered species by the Service on March 11, 1967 (32 FR 4001). This rail was subsequently listed by the State of California as endangered in 1971, but reclassified as threatened in 1978. The species is only listed as endangered by the Service in the U.S., although the majority of the population is found in Mexico (USFWS 2006b). The initial species recovery plan, approved in 1983, is in the process of being revised (USFWS 2010c).

The Yuma Ridgway's rail is one of the smaller subspecies of Ridgway's rail, with adult males standing eight inches (20 to 23 centimeters) tall and weighing less than 10 ounces (266.8 grams) on average (USFWS 2010c). Females are slightly smaller. This is the only subspecies of Ridgway's rail found in freshwater marshes. Historically, cattail/bulrush marshes in the Colorado River Delta were the likely stronghold for the species. However, this habitat has been all but eliminated due to diversions from the lower Colorado River for agriculture and municipal uses. Presently, this rail is found along the lower Colorado River system from Nevada to the delta in Mexico, and at the Salton Sea, California and Cienega de Santa Clara, Mexico. The vast majority of the habitat is man-made and highly managed. At the Salton Sea,

extensive Yuma Ridgway's rail habitat exists in managed ponds on Sonny Bono Salton Sea NWR and the Imperial Wildlife Area (USFWS 2006b).

Habitat quality of the existing riparian marshes that support this rail is successional and will degrade if allowed to become overly decadent (USFWS 1983, USFWS 2010c). Historically, seasonal flooding provided a natural disturbance regime, revitalizing the marsh ecosystem. However, with the loss of large flood events on the Colorado River, productive marshland only exists at managed sites where controlled burns have been the most common method of removing excessive vegetation. Because nearly all the existing habitat is human-made, no critical habitat has been designated for this subspecies.

Apart from habitat loss and degradation, the other threats to the Yuma Ridgway's rail include continuing land use changes in floodplains, human activities, environmental contaminants (particularly increases in selenium levels), and reductions in connectivity between core habitat areas (USFWS 1983, USFWS 2010c). With respect to environmental contaminants, high levels of selenium have been shown to result in acute toxicity, chronic poisoning and tissue damage, and reproductive impairment (e.g., developmental abnormalities, embryo mortality, and reduced survival or growth of young) in birds. The results of several studies conducted in core Yuma Ridgway's rail areas found selenium levels in sediment, vegetation, invertebrates, fish, and surrogate bird species high enough to indicate the potential for exposure and adverse effects to the rails (USFWS 2006b, USFWS 2010c).

In 2006, the Service completed a 5-year review for the Yuma Ridgway's rail (USFWS 2006b) to examine its status since listing. The 5-year review concluded that no change to the current endangered status was warranted for the rail due to continuing threats; however, five recommendations were made for future actions to move recovery of the species forward. Three recommendations are relevant to the Refuge's rail population and/or the management actions implemented by the Refuge in support of the rail. These include:

- Implement new survey protocol and training for all cooperating agency personnel;
- Develop management plans on Federal and State lands supporting significant populations of breeding Yuma Ridgway's rails; and
- Develop information on the effects of selenium on Yuma Ridgway's rail habitats and reproduction.

In 2010, the Service issued a draft revised recovery plan for the rail that describes the actions needed to downlist or delist the species. Per the draft plan, consideration for downlisting of the species can occur when annual surveys document a stable or increasing population trend over five consecutive years, habitat management plans are in place for all important Federal and State-owned habitat areas, and long-term contracts for water supplies at the Sonny Bono Salton Sea NWR and Imperial State Wildlife Area in California are in place. Consideration for delisting of the species can occur when annual surveys document an additional five consecutive years of a stable or increasing population trend; the amount of habitat needed to support the desired minimum population size in the U.S. is established and protected, and management plans are in place for that habitat; an assessment of the risks of selenium to the species is completed and protective measures implemented if needed; and a secure water supply for the Cienega de Santa Clara in Mexico is established (USFWS 2010c).

Nine impoundments are managed on the Sonny Bono Salton Sea NWR to support Yuma Ridgway's rail habitat and surveys for this species and other marsh birds of interest have been conducted on the Refuge every spring since 1977. In 2012, surveys of the managed

impoundments and several other unmanaged sites were conducted involving three separate counts in each location. Counts ranged from 49 to 72 birds throughout the survey area. The overall average density of 0.64 birds per hectare represented a decline in numbers compared to the 2011 survey results. The decline may be the result of water conservation measures that reduced the amount of water provided to rail impoundments in 2012. In 2013, irrigation levels in these impoundments will be increased to 2011 levels to determine if lower water flows may have contributed to the decline in overall density in 2012. The average density of rails in 2012 also varied greatly among sites, with low rail densities encountered in several managed sites located in Unit 2. These low densities may indicate that the vegetation in the impoundments has become too dense and/or that too much sediment has accumulated within the impoundments, reducing open water areas and effecting overall water flow.

Desert Pupfish (*Cyprinodon macularius macularius*). The desert pupfish was listed as endangered by the State of California in 1980 and federally listed as endangered on March 31, 1986 (51 FR 10842). Compared to the historic range of this species, which occurred throughout the lower Colorado and Gila Rivers systems, desert pupfish are now found only in small, rather isolated, populations around the Salton Sea and the Colorado River delta (Moyle 2002). The decrease in their distribution range, along with continued threats to already diminished extant populations, are the primary reasons for listing this species as endangered (USFWS 1986). The desert pupfish recovery plan, adopted in 1993 (USFWS 1993), provides downlisting criteria; however with respect to delisting, the recovery plan states that the insoluble threats and limited habitat render the delisting of this species as infeasible in the foreseeable future.

The recovery plan defines a secure status for the desert pupfish in the U.S. as formal protection of habitat and water rights for a minimum of ten years, with a legally-binding, long-term (greater than 25 years) agreement in place for future management of each naturally-occurring subpopulation, as well as the maintenance of a genetically pure, self-sustaining, stable or increasing (viable) population (USFWS 1993). For these purposes, a viable population is understood to be no fewer than 500 overwintering adults or existing numbers, whichever is greater, in a normal sex ratio with in-situ reproduction and recruitment sufficient to maintain that number (USFWS 1993).

A small fish measuring less than three inches in length, the desert pupfish occupies shallow water of desert springs and creeks, cienegas and the margins of larger water bodies (Minckley 1973). They can survive in aquatic habitats with high temperatures and salinities, although they likely prefer a less stressful environment.

Desert pupfish (Jenny E. Ross)

Since the 19th century, desert pupfish habitat has been impacted by stream bank erosion, the construction of water impoundments that dewatered downstream habitat, excessive groundwater pumping, the application of pesticides to nearby agricultural areas, and the introduction of non-native aquatic species (e.g., Mozambique tilapia, red-belly tilapia, sailfin molly, shortfin molly, bullfrogs) as both predators and potential competitors (USFWS 1993, 2010b). These threats continue as human development and the demand for water increases.

Critical habitat for the desert pupfish has been designated within Carrizo Wash and Fish Creek Wash, part of the San Filipe Creek watershed (USFWS 1986), but no areas of critical habitat occur within the Sonny Bono Salton Sea NWR.

Historically, desert pupfish occurred in the lower Colorado River in Arizona and California, extending from about Needles downstream to the Gulf of California and into its delta in Sonora and Baja. Desert pupfish also inhabited springs, seeps, and slow moving streams in the Salton Sink basin and backwaters and sloughs along the Colorado River.

The Salton Sea, its slow moving tributary streams, irrigation drains, and shoreline pools once supported large pupfish populations, however, the numbers of pupfish in these areas began a sharp decline in the mid- to late 1960s. CDFW surveys show desert pupfish populations currently occur in the drains that discharge directly into the Salton Sea, in shoreline pools of the Salton Sea, and in several artificial refugia (Nicol et al. 1991, Black 1980). Pupfish are not known to occur in the New or Alamo rivers, because of the high sediment loads, excessive velocities, and presence of predators. Pupfish may be encountered in near shore areas of the Salton Sea and have been identified at the Red Hill Marina in past years.

Within the Refuge, desert pupfish occur in some of agricultural canals that extend through the Refuge and drain into the Sea (Moyle 2002, Saiki et al. 2010), and they may be present in some of the Refuge's managed water areas, although these areas are managed for avian species, not desert pupfish.

California Least Tern (*Sternula antillarum browni*). The California least tern is a Federal and State listed endangered migratory seabird that nests in California and Baja California from April to September (Thelander et al. 1994). Least terns nest in open sandy or gravelly shores near their feeding grounds. Adults roost on the ground and fish in shallow estuaries, river mouths, lagoons, and other shallow habitats. They are opportunistic feeders and have been known to eat more than 50 types of fish, including anchovies, shiner surfperch, and topsmelt (Thelander et al. 1994). Courtship takes place away from the nest colony on open beaches and tidal flats. Incubation can take up to 28 days and the young fledge by the time they are 28 days old (Zeiner et al. 1990).

California least tern (Tim Anderson)

In recent years, small numbers of California least terns have established nests on an irregular basis along the southeast Salton Sea shoreline. Because of the accessibility of these ground-nesting seabirds to predators, the edge of the receding Salton Sea provides only marginally suitable breeding habitat. In 2011, three pair of least terns established nests at the Salton Sea; however, all nesting attempts were unsuccessful (Marschalek 2012). The only least tern activity observed on the Refuge involves least terns flying over the Refuge on route to other locations.

Least Bell's Vireo (*Vireo bellii pusillus*). The least Bell's vireo was added to the State of California's list of endangered species in 1980 and was listed as endangered by the Service on May 2, 1986 (51 FR 16474). The least Bell's vireo was included on the Federal Endangered Species List because of a significant range-wide population decline related to extensive habitat

loss and degradation resulting from exotic plant invasion, urban development, and expansion of agricultural practices into riparian zones, as well as brood parasitism by the brown-headed cowbird (*Molothrus ater*) (USFWS 1998). The Service issued a draft recovery plan in March 1998 (USFWS 1998); however, the recovery plan has never been finalized.

A five-year review of the least Bell's vireo, which was completed in September 2006 (UFSWS 2006c), recommended downlisting the least Bell's vireo from endangered status to threatened status due to an increase in population size since its listing in 1986; an increase in the number of least Bell's vireo breeding locations throughout southern California; and regional efforts to conserve and manage suitable breeding habitat for the species throughout its range.

The least Bell's vireo is a small insectivorous, Neotropical migrant songbird. It is drab olive-gray in color above and mostly white below, with some gray on the upper breast and yellow on the flanks (USFWS 1998). This subspecies has indistinct white spectacles and two faint wing bars, with males and females having identical plumage.

Least Bell's vireos are obligate riparian breeders, typically inhabiting structurally diverse woodlands along watercourses that feature dense cover within three to six feet (0.9 to 1.8 meters) of the ground and a dense, stratified canopy (Goldwasser 1981, USFWS 1998). The understory in these areas is typically dominated by mulefat (*Baccharis salicifolia*), California wild rose (*Rosa californica*), poison oak (*Toxicodendron diversilobum*), sandbar willow (*Salix exigua*), young individuals of other willow species, and several perennial species (USFWS 1998). Important canopy species include mature arroyo willows (*Salix lasiolepis*) and Goodding's willows and occasional cottonwoods (*Populus* spp.), western sycamore (*Platanus racemosa*), or coast live oak (*Quercus agrifolia*). Least Bell's vireos primarily forage and nest in riparian habitat, but they may also use adjoining upland habitats (Kus 2002).

Least Bell's vireos feed primarily on invertebrates, especially lepidopteran larvae, within willow stands or associated riparian vegetation (Miner 1989, Brown 1993), but also occasionally forage beyond the limits of riparian vegetation, entering upland habitat within about 100 feet (30.5 meters) of the riparian edge (Kus 2002). Least Bell's vireo feeding behavior largely consists of gleaning prey from leaves or woody surfaces while perched or hovering and, less frequently, by capturing prey by aerial pursuit.

Least Bell's vireos winter in southern Baja California, Mexico, where they occupy a variety of habitats, including mesquite scrub within arroyos, palm groves, and hedgerows bordering agricultural and residential areas (Kus 2002). These birds generally arrive in southern California breeding areas by mid-March to early April, with males arriving before females and older birds arriving before first-year breeders (Kus 2002). Least Bell's vireos generally remain on the breeding grounds until late September, although some post-breeding migration may begin as early as late July (USFWS 1998).

The selection of nesting sites does not appear to be limited to riparian stands of a specific age, although least Bell's vireo are typically characterized as preferring early successional habitat. It is likely that vegetation structure, rather than the age of the vegetation determines site use.

Early successional riparian habitat tends to consist of dense scrub cover preferred by the vireo for nesting, while also providing a structurally diverse canopy for foraging (USFWS 1998).

Historic loss of riparian habitat contributed to the decline of this species, as did nest parasitism by cowbirds (Franzreb 1989, USFWS 1998, Kus 2002). In cases of nest parasitism, vireos will

either abandon their nests or fledge cowbird chicks rather than least Bell's vireos. It is believed that cowbirds did not historically occur within the least Bell's vireo's range, and therefore, least Bell's vireos have not evolved adequate defenses to avoid loss of productivity due to parasitism (Franzreb 1989, Kus 2002).

Since its listing in 1986, the least Bell's vireo population in the U.S. has increased tenfold, and the number of known territories has increased from 291 to 2,968 (USFWS 2006c). The population has grown during each five-year period since the original listing, although the rate of increase has slowed over the last 10 years. There has only been a slight shift northward in the species' overall distribution; therefore, despite a significant increase in overall population numbers, the population remains restricted to the southern portion of its historic range (USFWS 2006c).

The availability of appropriate habitat within the Refuge to support breeding least Bell's vireos is very limited. Documented observations of this vireo on and in the vicinity of the Refuge are described as accidental and occurring during migration. Two observations of this species were made on the Refuge in 2003, but no nesting activity was observed (CH2M Hill 2003).

Southwestern Willow Flycatcher (*Empidonax traillii extimus*). The southwestern willow flycatcher was listed as endangered by the State of California in 1991 and listed as endangered by the Service effective March 29, 1995 (60 FR 10694). The decision to list this subspecies as endangered was based on extensive loss and modification of breeding habitat, with consequent reductions in population levels. This situation was found to be compounded by increases in brood parasitism by the brown-headed cowbird, resulting in reduced reproductive success and further reductions in population levels (USFWS 2002). A final recovery plan for the southwestern willow flycatcher was prepared in 2002. The recovery plan established management units within larger recovery units for the flycatcher, and recovery goals were set for each management unit. The preparation of a five-year review for the subspecies was announced in 2008, but has not yet been completed.

The southwestern willow flycatcher, a recognized subspecies of the willow flycatcher, is a small Neotropical migratory bird that breeds in riparian ecosystems in the southwestern United States and is believed to winter in the vicinity of Costa Rica (Sogge et al. 2010) in habitats where water or saturated soils are present. This passerine bird measures approximately 5.75 inches (15 centimeters) in length and weighs about 0.42 ounces (12 grams) (USFWS 2002). It has a grayish-green back and wings, whitish throat, light grey-olive breast, and pale yellowish belly. Two wingbars are visible; the eye ring is faint or absent. The upper mandible is dark; the lower is light with a yellowish tone.

The nesting habitat of this subspecies is generally restricted to relatively dense riparian habitats associated with rivers, swamps, and other wetlands, including lakes and reservoirs (Bent 1960, USFWS 2002). Surface water or saturated soil are typically, but not always, present year round or seasonally, and ground water is generally at a depth of less than 6.5 to 10 feet (two to three meters) within or adjacent to nesting habitat (USFWS 2002, Sogge et al. 1997, 2010).

Breeding habitat vegetation generally includes dense tree or shrub cover, with or without a higher overstory that is at least 10 feet (three meters) tall and has a dense twig structure, with considerable green foliage (Sogge et al. 2010). Many patches within the habitat that typically include tall canopy vegetation also include dense midstory vegetation that ranges from 6.5 to 16.4 feet (two to five meters) in height (Sogge et al. 2010). This flycatcher has, however,

demonstrated adaptability in habitat selection, nesting in native vegetation where available, but also in thickets dominated by the non-native tamarisk (*Tamarix* sp.) and Russian olive (*Elaeagnus angustifolia*) and in habitats where native and non-native trees and shrubs are present in essentially even mixtures (USFWS 2002). Despite this variability in plant species composition or height, occupied sites almost always have dense vegetation in the patch interior, and these patches are often interspersed with small openings, open water, or shorter/sparser vegetation, creating a mosaic that is not uniformly dense (Sogge et al. 2010).

Southwestern willow flycatchers typically arrive on breeding grounds between early May and early June (Ellis et al. 2008, Moore and Ahlers 2009), with the males generally arriving first. Eggs can be present as early as mid-May but more often are laid in late May to mid-June. Chicks can be hatched from late May through early August and typically fledge from mid-June through mid-August. The later fledglings are often the result of re-nesting attempts. Breeding adults generally leave the breeding grounds in early to mid-August but may stay later if they fledged young late in the season (Sogge et al. 2010).

The southwestern willow flycatcher is an insectivore that forages within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage (Bent 1960). It also forages in areas adjacent to nest sites, which may be more open. Although the diet of breeding flycatchers can vary between years and habitat types, their diet can include a wide range of insects such as bugs (Hemiptera), bees and wasps (Hymenoptera), flies (Diptera), leafhoppers (Homoptera), and dragonflies (Odonata) (Sogge et al. 2010).

Habitat on the Refuge to support nesting southwestern willow flycatcher is only marginally suitable. The probability of southwestern willow flycatchers nesting on the Refuge is low, but the willow flycatcher has been recorded within the Niland quadrangle and is likely to be the subspecies, Empidonax traillii extimus, based on subspecies distribution within California and other portions of the U.S. Four southwestern willow flycatcher nesting territories were identified along San Felipe Creek, a tributary of the Salton Sea that enters the Sea along its western shore.

State Listed Species

The Refuge includes habitat to support nine State listed species. These include the endangered bald eagle (*Haliaeetus leucocephalus*), Gila woodpecker, little willow flycatcher, and desert pupfish (discussed under Federal listed species), as well as the threatened California black rail, Yuma Ridgway's rail (discussed under Federal listed species), Swainson's hawk (*Buteo swainsoni*), greater sandhill crane (*Grus canadensis tabida*) and bank swallow (*Riparia riparia*) (CDFG 2011).

Bald Eagle (*Haliaeetus leucocephalus*). The bald eagle was first listed as endangered by the State of California in 1971 and reconfirmed as endangered in 1980. The bald eagle is an occasional visitor to the Salton Sea, migrating through the area in winter. On rare occasions, this eagle is present at the Sea in the fall. Bald eagles may be observed foraging for fish in the Salton Sea or roosting nearby. They also have been known to prey on birds, mammals, or carrion in the adjacent agricultural fields. There are no suitable nesting areas within the Refuge. During avian surveys conducted in June 2010 in the vicinity of the New River, one juvenile bald eagle was observed in the area (USACOE and California Natural Resources Agency 2011).

Swainson's Hawk (*Buteo swainsoni*). The Swainson's hawk was listed as threatened by the State of California in 1983. It is a rare migrant visitor to the Salton Sea area, likely traveling through the area to breeding areas in the Central Valley area of California or the Great Basin bioregions or heading south to wintering areas in South America (Woodbridge 1998).

California Black Rail (*Laterallus jamaicensis coturniculus*). Listed as threatened by the State of California in 1971, California black rails occur in two disjunct locations, the western Arizona and southern California area and the Sacramento Valley and San Francisco Bay area. These rails also occur in Mexico, but their status is unknown (Conway and Sulzman 2007). When present, California black rails can occur in saline, brackish, or freshwater emergent wetland habitats. Due to their secretive nature, these rails are rarely observed.

In 1999, as part of a multi-disciplinary reconnaissance survey of the Salton Sea, the Point Reyes Bird Observatory (Shuford et al. 2000) surveyed marsh habitats around the Sea, including on the Refuge, in an effort to detect the presence of the California black rail. Although this rail was previously documented as a rare breeder at and around the Salton Sea (Shuford et al. 2000), no black rails were detected. A subsequent survey conducted in 2000/2001, also produced no rail observations on the Refuge (Conway and Sulzman 2007). In both cases, the habitat areas with the potential to support black rails were only surveyed once. With respect to the 1999 survey, Shuford et al. (2000) made this statement about their results, "Although black rail occurrence around the Sea is expected to be sporadic, reflecting frequent and extensive marshland modifications in the area, the lack of detections of this species in 1999 likely reflects an absence of a systematic survey rather than of the species itself." In both 2011 and 2012, the presence of black rails on the Sonny Bono Salton Sea NWR was confirmed when their calls were noted as part of a marsh bird surveys conducted within the Refuge's managed cattail marshes.

Greater Sandhill Crane (*Grus canadensis tabida*). This subspecies of sandhill crane was listed as a threatened species by the State in 1983. It is a winter visitor to the Refuge, usually occurring in small numbers within the managed agricultural fields in Unit 1. The greater sandhill cranes that occur on the Refuge are considered part of Lower Colorado River Valley Population of Greater Sandhill Cranes, which is the smallest of the migratory populations of sandhill cranes in North America (Kruse et al. 2012). The current wintering distribution of this population of crane is concentrated at Cibola NWR and on adjacent areas belonging to the Colorado River Indian Tribes in southwestern Arizona, with a few birds wintering at the Sonny Bono Salton Sea NWR and along the Gila River in Arizona (Kruse et al. 2012).

Greater sandhill crane (Jenny E. Ross)

Gila Woodpecker (*Melanerpes uropygialis*). The Gila woodpecker was declared an endangered species by the State of California in 1988 (CDFG 2008). The decline of this species in California is attributed to the loss of riparian forests along the Lower Colorado River Valley (McCreedy 2008). In the Imperial Valley, this woodpecker inhabits areas of remnant riverine forest that harbor large cottonwoods, as well as date palm groves and larger shade trees and tree rows, such as those found on the Sonny Bono Salton Sea NWR. The diet of the Gila woodpecker consists of beetles, butterflies and moths, ants, cicadas, and mistletoe berries

(McCreedy 2008). This species is rarely observed north of Calipatria, but has been recorded on the Wister Unit (Patten et al. 2003) and its presence was anecdotally noted by birding groups such as Sea and Sage Audubon in 2009 and 2010; however, locations were not recorded (USACOE and California Natural Resources Agency 2011).

Little Willow Flycatcher (*Empidonax traillii brewsteri*). The State of California listed all subspecies of willow flycatchers present in California as endangered in 1991. There is a high potential for this species to be present on portions of the Refuge, particularly in the spring where it is likely found in riparian habitat along portion of the New or Alamo rivers or adjacent to other waterways and impoundments. Suitable habitat for the species may include areas of native scrub species or tamarisk scrub and woodland areas.

Most observations of this bird occur between mid-May and the first half of June. A total of 27 individuals were observed during 2010 surveys along both the New and Alamo rivers within tamarisk riparian habitat, which may indicate that these areas are an important for migratory stopover for the willow flycatcher (USACOE and California Natural Resources Agency 2011).

Bank Swallow (*Riparia riparia*). This species was listed as threatened by the State in 1989. The bank swallow is an uncommon transient to the area, passing through during migration. It has been documented in the vicinity of the Salton Sea between late March and early May, early June through September, and as a casual visitor in winter (Patten et al. 2003).

Other Special Status Species

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 2008* (USFWS 2008a). 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 2008 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 2008 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 for the Sonny Bono Salton Sea NWR are those bird species included in the BCR 33 (Sonoran and Mojave Deserts, U.S. portion only) List, USFWS Region 8 List, and the National List. Table 4-13 lists the Birds of Conservation Concern that have been observed or are expected to occur on the Sonny Bono Salton Sea NWR.

Table 4-13
Birds of Conservation Concern Observed on or near the Sonny Bono Salton Sea NWR

Common Name	Scientific Name	Foraging Habitat(s)	Abundance on SBSSNWR	Included on BCC List		
				BCR 33	Region 8	U.S.[1]
Least bittern✧	*Ixobrychus exilis*	marsh	uncommon	Yes	No	No
Reddish egret	*Egretta rufescens*	marsh	occasional	No	No	Yes
Bald eagle	*Haliaeetus leucocephalus*	marsh	occasional (fall/winter)	Yes	Yes	Yes
Swainson's hawk	*Buteo swainsoni*	farmland	occasional (winter)	No	No	Yes
Peregrine falcon	*Falco peregrinus*	farmland, beach[Δ]	uncommon	Yes	Yes	Yes
Prairie falcon	*Falco mexicanus*	farmland	uncommon	Yes	No	No
Black rail✧	*Laterallus jamaicensis*	marsh	occasional	Yes	Yes	Yes
Snowy plover✧	*Charadrius alexandrinus*	beach	uncommon	Yes	Yes	Yes
Mountain plover	*Charadrius montanus*	farmland	uncommon (fall/winter)	Yes	Yes	Yes
American oystercatcher	*Haematopus palliatus*	marsh	one time sighting	No	No	Yes
Solitary sandpiper	*Tringa solitaria*	marsh	occasional	No	No	Yes
Lesser Yellowlegs	*Tringa flavipes*	marsh, farmland	seasonally common (fall)	No	No	Yes
Whimbrel	*Numenius phaeopus hudsonicus*	farmland, beach	common	Yes	Yes	Yes
Long-billed curlew	*Numenius americanus*	farmland, beach	common; abundant (winter)	Yes	Yes	Yes
Hudsonian godwit	*Limosa haemastica*	beach	one time sighting	No	No	Yes
Marbled godwit	*Limosa fedoa fedoa*	beach	common	Yes	Yes	Yes
Red knot	*Calidris canutus roselaari*	beach	occasional	Yes	Yes	Yes
Semipalmated Sandpiper	*Calidris pusilla*	beach	occasional (fall)	No	No	Yes
Dunlin	*Calidris alpina*	beach	common (spring)	No	No	Yes
Buff-breasted Sandpiper	*Tryngites subruficollis*	beach	one time sighting	No	No	Yes
Short-billed dowitcher	*Limnodromus griseus*	beach	common (spring)	No	Yes	Yes

Table 4-13
Birds of Conservation Concern Observed on or near the Sonny Bono Salton Sea NWR

Common Name	Scientific Name	Foraging Habitat(s)	Abundance on SBSSNWR	Included on BCC List		
				BCR 33	Region 8	U.S.[1]
Gull-billed tern✧	*Sterna nilotica vanrossemi*	beach, farmland, open water	common (spring/summer)	Yes	Yes	Yes
Black skimmer✧	*Rynchops niger*	beach, open water	common	Yes	Yes	Yes
Yellow-billed cuckoo	*Coccyzus americanus*	riparian	occasional (summer)	Yes	Yes	Yes
Flammulated owl	*Otus flammeolus*	no data	one time sighting	No	Yes	Yes
Elf owl	*Micrathene whitneyi*	no data	one time sighting	Yes	No	Yes
Burrowing owl✧	*Athene cunicularia hypugaea*	farmland	common	Yes	Yes	No
Short-eared owl	*Asio flammeus*	farmland	rare	No	No	Yes
Black swift	*Cypseloides niger*	no data	6 sightings	No	Yes	Yes
Costa's hummingbird✧	*Calypte costae*	shrubland	unusual	Yes	Yes	Yes
Calliope hummingbird	*Stellula calliope*	shrubland	rare (spring)	No	Yes	Yes
Rufous hummingbird	*Selasphorus rufus*	developed*	unusual	No	No	Yes
Allen's hummingbird	*Selasphorus sasin*	no data	8 sightings	No	Yes	Yes
Lewis's woodpecker	*Melanerpes lewis*	developed*	occasional	No	Yes	Yes
Gila woodpecker✧	*Melanerpes uropygialis*	developed*	unusual	Yes	No	No
Williamson's sapsucker	*Sphyrapicus thyroideus*	no data	one time sighting	No	Yes	No
Nuttall's woodpecker	*Picoides nuttallii*	no data	one time sighting	No	No	Yes
Olive-sided flycatcher	*Contopus cooperi*	riparian	occasional (fall)	No	Yes	Yes
Willow flycatcher	*Empidonax traillii*	riparian	common (spring)	No	Yes	Yes
Loggerhead shrike✧	*Lanius ludovicianus*	shrubland, farmland	occasional	No	Yes	Yes
Bell's vireo	*Vireo bellii*	riparian	occasional	Yes	Yes	Yes

Table 4-13
Birds of Conservation Concern Observed on or near the Sonny Bono Salton Sea NWR

Common Name	Scientific Name	Foraging Habitat(s)	Abundance on SBSSNWR	Included on BCC List		
				BCR 33	Region 8	U.S.[1]
Pinyon jay	*Gymnorhinus cyanocephalus*	no data	2 sightings	No	Yes	Yes
Horned lark✧	*Eremophila alpestris*	farmland	common	No	No	Yes
Oak titmouse	*Baeolophus inornatus*	no data	one time sighting	No	No	Yes
Cactus wren✧	*Campylorhynchus brunneicapillus*	shrubland	unusual	No	Yes	No
Bewick's wren	*Thryomanes bewickii*	riparian, shrubland	rare	No	No	Yes
Sage thrasher	*Oreoscoptes montanus*	shrubland, farmland	occasional	No	Yes	No
Bendire's thrasher	*Toxostoma bendirei*	no data	4 sightings	No	Yes	Yes
Sprague's pipit	*Anthus spragueii*	farmland	occasional	No	No	Yes
Blue-winged warbler	*Vermivora cyanoptera*	no data	one time sighting	No	No	Yes
Virginia warbler	*Oreothlypis virginiae*	no data	7 sightings	No	Yes	Yes
Lucy's warbler✧	*Oreothlypis luciae*	riparian	occasional	Yes	No	Yes
Yellow warbler	*Dendroica petechial brewsteri*	riparian	occasional	No	Yes	No
Prairie warbler	*Dendroica discolor*	no data	2 sightings	No	No	Yes
Bay-breasted warbler	*Dendroica castanea*	no data	one time sighting	No	No	Yes
Cerulean warbler	*Dendroica cerulea*	no data	one time sighting	No	No	Yes
Prothonatory warbler	*Protonotaria citrea*	no data	one time sighting	No	No	Yes
Common yellowthroat✧	*Geothlypis trichas sinuosa*	uplands	occasional	Yes	Yes	No
Green-tailed towhee	*Pipilo chlorurus*	uplands	unusual	No	Yes	No
Spotted towhee	*Pipilo maculatus*	shrubland	occasional (spring)	No	Yes	No
Brewer's sparrow	*Spizella breweri*	shrubland	common	No	No	Yes

Table 4-13 Birds of Conservation Concern Observed on or near the Sonny Bono Salton Sea NWR						
Common Name	Scientific Name	Foraging Habitat(s)	Abundance on SBSSNWR	Included on BCC List		
				BCR 33	Region 8	U.S.[1]
Black-chinned sparrow	*Spizella atrogularis*	no data	3 sightings	Yes	Yes	Yes
Sage sparrow	*Amphispiza belli*	shrubland	rare	No	Yes	No
Song sparrow✧	*Melospiza melodia*	riparian, marsh	common	No	Yes	No
Harris's sparrow	*Zonotrichia querula*	riparian, shrubland	occasional	No	No	Yes
McCown's longspur	*Rhynchophanes mccownii*	farmland	occasional (winter)	No	No	Yes
Smith's longspur	*Calcarius pictus*	no data	2 sightings	No	No	Yes
Painted bunting	*Passerina ciris*	no data	5 sightings	No	No	Yes
Dickcissel	*Spiza americana*	no data	one time sighting	No	No	Yes
Tricolored blackbird	*Agelaius tricolor*	farmland	occasional	No	Yes	Yes
Lawrence's goldfinch	*Spinus lawrencei*	shrubland	occasional	Yes	Yes	Yes

[1] National List
✧ Species breeds regularly or sporadically on the Refuge
Δ Shoreline of the Salton Sea, including mudflats and open playa adjacent to the Sea
* Area developed with buildings and/or planted with large trees
Source: (USFWS 2008a)

California Species of Special Concern. CDFW (CDFG 2009) maintains a list of special status mammals, birds, reptiles, amphibians, and fish. The taxa on this list, which are considered to be those of greatest conservation need in California, include species, subspecies, or distinct population of a species native to California that generally fall into one or more criteria:

- Officially listed under the State and/or Federal Endangered Species Acts;
- State or Federal candidate for possible listing;
- Meet the criteria for listing, even if not currently included on any list;
- California Species of Special Concern, as defined by CDFW;
- Biologically rare, very restricted in distribution, declining throughout their range, or have a critical, vulnerable stage in their life cycle that warrants monitoring;
- Populations in California that may be on the periphery of a taxon's range, but are threatened with extirpation in California;
- Closely associated with a habitat that is declining in California at an alarming rate; and
- Designated as a special status, sensitive, or declining species by other state or federal agencies, or non-governmental organization.

The State also maintains a special plants list entitled "Special Vascular Plants, Bryophytes, and Lichens List" (CDFG 2010). "Special Plants" is a broad term used to refer to all the plant taxa inventoried by CDFW's California Natural Diversity Database (CNDDB), regardless of their legal or protection status. Special Plants include vascular plants, high priority bryophytes (mosses, liverworts, and hornworts), and lichens. Special Plant taxa, which can include vascular plants, high priority bryophytes (e.g., mosses, liverworts, and hornworts), and lichens, are species, subspecies, or varieties that fall into one or more categories:

1) Listed by the State or Federal government as endangered, threatened, or rare;
2) A candidate for state or federal listing as endangered, threatened, or rare;
3) Taxa which meet the criteria for listing, even if not currently included on any list, per the California Environmental Quality Act Guidelines;
4) BLM, USFWS, or USFS Sensitive Species;
5) Taxa listed in the California Native Plant Society's *Inventory of Rare and Endangered Plants of California*;
6) Taxa that are biologically rare, very restricted in distribution, or declining throughout their range but not currently threatened with extirpation;
7) Population(s) in California that may be peripheral to the major portion of a taxon's range but are threatened with extirpation in California; and
8) Taxa closely associated with a habitat declining in California at a significant rate.

Presented in Table 4-14 are animal species, identified as Species of Special Concern by the State of California, which have been observed on the Sonny Bono Salton Sea NWR in the past or have the potential to occur on the Refuge based on their habitat needs and historic distribution. No insects, reptiles, or plants occur or are expected on the Refuge that have been identified as Species of Special Concern by the State of California.

Table 4-14
California Species of Special Concern Observed or with the Potential to Occur on the Sonny Bono Salton Sea NWR

Scientific Name	Common Name
BIRDS[1]	
First Priority	
Dendrocygna bicolor	fulvous whistling-duck
Pelecanus erythrorynchos	American white pelican
Mycteria americana	wood stork
Piranga rubra	summer tanager
Agelaius tricolor	tri-colored blackbird
Second Priority	
Branta bernicla	brant
Ixobrychus exilis	least bittern
Charadrius montanus	mountain plover
Chlidonias niger	black tern
Athene cunicularia	burrowing owl
Chaetura vauxi	Vaux's swift

Table 4-14 California Species of Special Concern Observed or with the Potential to Occur on the Sonny Bono Salton Sea NWR	
Scientific Name	**Common Name**
Contopus cooperi	olive-sided flycatcher
Pyrocephalus rubinus	vermilion flycatcher
Lanius ludovicianus	loggerhead shrike
Progne subis	purple martin
Dendroica petechia	yellow warbler
Passerculus sandwichensis spp. rostratus	large-billed savannah sparrow
Ammodramus savannarum	grasshopper sparrow
Third Priority	
Aythya americana	redhead
Circus cyaneus	northern harrier
Grus canadensis spp. canadensis	lesser sandhill crane
Charadrius alexandrines	snowy plover (interior population)
Gelochelidon nilotica ssp. vanrossemi	gull-billed tern
Rynchops niger	black skimmer
Asio otus	long-eared owl
Asio flammeus	short-eared owl
Cypseloides niger	black swift
Toxostoma bendirei	Bendire's thrasher
Toxostoma crissale	crissal thrasher
Vermivora luciae	Lucy's warbler
Scientific Name	Common Name
Icteria virens	yellow-breasted chat
Xanthocephalus xanthocephalus	yellow-headed blackbird
MAMMALS[2]	
Taxidea taxus	American badger
Lasiurus xanthinus	western yellow bat

[1]CDFG 2008
[2]Woodbridge1986

Those California Species of Special Concern that have been observed or have the potential to occur on the Refuge are addressed here. Bird species are listed first in order of priority, followed by animal species.

Fulvous Whistling-Duck (*Dendrocygna bicolor*). A former breeding and declining wintering population of fulvous whistling-duck occurs primarily to the south of the Salton Sea. This duck is associated with fresh emergent wetlands, lacustrine, and riverine habitats. When it nested in the Imperial Valley, its nests were typically constructed on high ground in dense cattails near the southern end of Salton Sea. It has been observed at the Alamo River delta near Red Hill and within Unit 1 of the Refuge. A nocturnal feeder, the adult fulvous whistling-duck feed is almost totally granivorous, feeding on the seeds of various grasses, sedges, and other

emergent vegetation by dabbling and diving. It is generally observed on or near the Refuge in low numbers (less than five) between March and August. There are no recent records of this species breeding on the Refuge.

American White Pelican (*Pelecanus erythrorhynchos*). The American white pelican, which has likely migrated through the lower Colorado River Delta area for centuries, is known to have established a breeding colony at the Salton Sea within about ten years of the Sea's creation and continued nesting at the Sea up to the 1950s. Today, the American white pelican can be observed at the Sea throughout the year, although it primarily occurs here as a migrant or winter resident.

The Salton Sea has been an important wintering site for approximately 30 percent of the North American breeding population of American white pelicans and at times has supported a substantial proportion of the species' world population (USACOE and California Natural Resources Agency 2011). As recently as 1999, nearly 23,000 individuals were observed in aerial surveys at the Sea (Shuford et al. 2000). Wintering birds, which are generally present from mid-October to mid-April, have been observed congregating at the New and Alamo river mouths, loafing on sandbars and mudflats, and foraging in shallow water. However, in 2009, the American white pelicans were most abundant in August with almost 3,000 individuals recorded at the southern end of the Sea. These numbers declined in the fall but the species remained a consistent visitor throughout the year. This species was also observed during Summer 2010 surveys near the mouths of the New and Alamo rivers and along the shoreline foraging within the Sea in rafts of several hundred (USACOE and California Natural Resources Agency 2011).

The Salton Sea continues to be a site of major white pelican concentrations from populations that breed in the north. Migration to the Sea by individual pelicans from Clear Lake NWR in northern California was confirmed in 1991 by studies involving radio telemetry. In 2000, in an attempt to identify patterns in migratory movements of American white pelicans from three Montana breeding colonies east of the Continental Divide, researchers analyzed band return data from pelicans banded as juveniles at their breeding sites beginning in 1991 (Hendricks and Johnson 2002). The results of this analysis indicated the Salton Sea was a particularly important wintering area for American white pelicans from two of the three Montana colonies.

Shuford and Gardali (2008) documents the potential for catastrophic losses of white pelicans where large numbers congregate during migration or winter. This species is particularly vulnerable at the Salton Sea and Río Colorado Delta, as most of the western population travels through these areas in the nonbreeding season. High counts of white pelicans at the Salton Sea in the 1980s and 1990s ranged from about 25,000 to 33,000 birds (Shuford et al. 2002), and nearly 9,000 (10 to 15 percent of the western population) died in an avian botulism disease outbreak there in 1996.

Historically, white pelicans have been impacted by the loss of foraging and nesting habitat and by human disturbance, with white pelican populations in the western part of North America declining over the past four to five decades (Shuford and Gardali 2008). Water management and distribution decisions both at the Salton Sea and elsewhere in California have the potential to further reduce the quantity and quality of foraging habitat for this species.

Wood Stork (*Mycteria americana*). In California, wood storks are almost entirely limited to the southeastern portion of the Salton Sea, where they occur in small numbers during the post-breeding season. In 1999, this species was present July through October, with the highest

numbers of storks recorded during the month of August (Shuford et al. 2000). These individuals are representative of the northward post-breeding dispersal of wood storks nesting in Mexico.

Until the 1970s, wood storks were numerous at the Salton Sea; however, numbers have experienced a steep decline since that time (Shuford et al. 2002). Peak numbers of individuals reaching the Salton Sea ranged between 200 and 300 through 1987, but since have remained mostly under 75, with considerably lower numbers in some years. Wood storks have been observed on the Refuge along the edge of the Salton Sea, as well as along the lowermost portions and delta of the Alamo River. These storks forage in shallow bays, marshy backwaters, canals, and drains, but most recently appear to prefer areas around the mouths of the New and Alamo rivers. Wood storks, in general, feed primarily on fish but also on aquatic snails, crustaceans, amphibians, and occasionally even birds, mammals, and plant material; however, its diet has not been well studied in California (Shuford et al. 2002).

Brant (*Branta bernicla*). Until the 1960s, this small goose was not likely to be found at the Salton Sea. However, in the early 1960s, brant began wintering in the Gulf of California and using an overland spring migration route to reach their nesting grounds. The route follows northward over the Salton Sink and mountain passes of eastern San Diego County (Shuford and Gardali 2008). Most brant using this route appear to fly nonstop to the Pacific coast, but some are grounded by storms, strong headwinds, or other factors and end up spending the spring and/or summer on the Refuge. The result is the presence of flocks of up to 500 brant occurring annually at the Salton Sea (Shuford and Gardali 2008). Brant also occasionally are observed in the managed water areas of the Refuge during the winter months, when some brant stop to winter on the Refuge rather than continuing on to the Gulf of California.

Pair of brant (John Fitch)

Least Bittern (*Ixobrychus exilis*). Least bitterns are residents of the Salton Sea and Colorado River wetlands, although additional individuals migrate to the area in summer. The least bittern occurs on the Refuge year-round, but the size of the population is unknown (Shuford and Gardali 2008). In 2012, only three least bitterns were detected on the Refuge during the annual spring marsh survey.

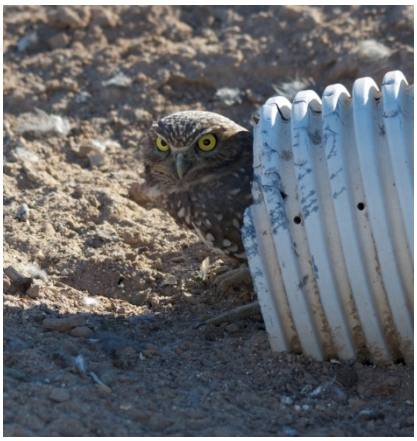
Bitterns forage in the managed freshwater cattail marshes on the Refuge and along the shoreline and mudflats of the Salton Sea. They feed mainly on small fish, crayfish, insects, and occasionally on amphibians and small mammals.

Mountain Plover (*Charadrius montanus*). This species of plover winters in shortgrass plains, plowed fields, open sagebrush, and sandy deserts. A large proportion of the North American wintering population occurs in the Imperial Valley with as many as 3,700 individuals present in any one year (Shuford and Gardali 2008). The species does not breed in the region and is strictly present during the winter where it forages for invertebrates in barren, freshly plowed, and burned agricultural fields. This species has been observed within agricultural fields near the New and Alamo rivers in the vicinity of the Refuge. The species is nomadic and has been recorded near the mouth of the New River and at Red Hill (Patten et al. 2003).

Black Tern (*Chlidonias niger*). The Salton Sea is the only major stopover site in California outside of the breeding range for the black tern. This bird can be observed foraging over the shallow waters of Salton Sea or over managed water areas and flooded agricultural fields south of the Sea. Little information is available about the ecological requirements of the black tern in California. At the Salton Sea, the black tern may forage on insects, as it does in other areas, or it may prey on small fish (Shuford and Gardali 2008).

Black terns are common at the Salton Sea in the spring (April and May) and abundant in the fall (August through November) (Cooper 2004). Patten et al. (2003) estimated up to 15,000 black terns at the Salton Sea in early August, but the only census conducted for the area (Shuford et al. 2002), which occurred between August 13 and 16, 1999, documented 4,011 individuals (Shuford and Gardali 2008). Therefore, the total numbers of the species present at the Salton Sea post breeding is uncertain. There is no evidence of breeding by this species at the Salton Sea.

Burrowing Owl (*Athene cunnicularia*). To the south of the Salton Sea, burrowing owls nest along unlined irrigation drains and forage over adjacent agricultural fields. The species ranges widely in much of California but is generally uncommon where it does occur. Populations of burrowing owls in the Imperial Valley are widespread and relatively common throughout the agricultural area.



Burrowing owl in artificial nesting habitat (Mark Stewart/USFWS)

This species forages largely on insects, along with small mammals, reptiles, birds, and carrion. Burrowing owls use existing burrows, particularly ground squirrel burrows, for shelter and nesting cover. The Refuge maintains a number of artificial owl burrows that provide nesting opportunities and shelter for burrowing owls. During surveys conducted in 2010, burrowing owls were observed on several occasions near the southern edge of the Salton Sea, including along Bruchard Road adjacent to Bruchard Bay and along Hatfield Road north of Estelle Road (USACOE and California Natural Resources Agency 2011).

Vermilion flycatcher (*Pyrocephalus rubinus*). The vermilion flycatcher is present in the area around the Salton Sea in limited numbers year-round. Historically, this species nested in the area, but there are no recent breeding records for the immediate area around the Refuge. Vermilion flycatchers can occur in arid scrub, around agricultural areas, and in open riparian woodland habitat. In the lower Colorado River Valley, they are found most often in riparian woodland, but mesquite, surface water, and agricultural lands are frequently nearby (Shuford and Gardali 2008).

Loggerhead Shrike (*Lanius ludovicianus*). Although the loggerhead shrike is present year-round on the Refuge, it occurs at very low numbers. This species is typically found in grassland, coastal sage scrub, broken chaparral, agricultural fields, riparian, and open woodland habitats. On the Refuge, suitable habitat is limited to arrow weed thickets, desert holly scrub, iodine bush scrub, quailbush scrub, screwbean mesquite bosque, tamarisk scrub, and tamarisk woodland. Several individuals were observed along the southern edge of the Salton Sea on numerous occasions during surveys conducted in the summer of 2010. The

vegetation in which they were observed included tamarisk trees and mesquite bushes located adjacent to the Alamo River, and most commonly adjacent to the Sea's shoreline within low stature tamarisk scrub or perching on dead snags while foraging (USACOE and California Natural Resources Agency 2011). Shrike are described as occasional (less than five individuals observed per season), year-round residents that are known to breed in the area, however, they are more numerous in winter, when numbers of breeding residents are augmented by migrants from other regions (Shuford and Gardali 2008).

Large-billed Savannah Sparrow (*Passerculus sandwichensis* spp. *rostratus*). This species is quite abundant around the Salton Sea during the nonbreeding season, where it can be found in habitat dominated by iodine bush, saltbush, and young tamarisk. It forages on barnacle beaches and rock outcrops at the shoreline of the Salton Sea. In 2010, it was observed at Obsidian Butte and near the mouth of New River (USACOE and California Natural Resources Agency 2011).

Redhead (*Aythya americana*). This diving duck is an uncommon to fairly common, year-round resident of the Salton Sea. Redheads, regularly breed at the Salton Sea, usually nesting in freshwater emergent wetlands where dense stands of cattails and tules (*Scirpus* spp.) are interspersed with areas of open water. The breeding season extends from April through August. The reproductive success of this duck is generally low and juvenile and adult mortality rates are relatively high, which makes this species particularly vulnerable to factors that may threaten its population viability (Shuford and Gardali 2008). Redheads are currently managed as a "Harvest" species in California, and two can be legally taken per licensed hunter per day during the hunting season. Redheads were observed during summer 2010 surveys at the mouth of the Alamo River and observed flying along the river channel (USACOE and California Natural Resources Agency 2011).

Northern Harrier (*Circus cyaneus*). The northern harrier is a common site on and near the Refuge in the winter and fall and is occasionally observed at other times of the year. Nesting, which is sporadic in this area, occurs on the ground in shrubby vegetation in emergent wetland, along rivers or lakes, in grasslands, or on sagebrush flats. Northern harriers feed on small rodents, birds, frogs, reptiles, crustaceans, and insects.

Lesser Sandhill Crane (*Grus canadensis* spp. *canadensis*). The lesser sandhill crane is a winter resident and migrant in California from mid-September to early April. Only a few individual lesser sandhill cranes were observed in the Imperial Valley in the 1970s, but since the 1990s, the numbers have increased (Shuford et al. 2008). A total of 30 wintering lesser sandhill cranes were observed during the winter of 1992/1993 and 45 were observed in winter 1993/1994. However, in the Imperial Valley, this subspecies is still far outnumbered by the greater sandhill crane. Each winter, the Refuge supports a small assemblage of sandhill cranes within the agricultural fields that are managed to provide forage for wintering geese. Here the cranes forage on grains and other seeds. According to Patten et al. (2003), the majority are lesser sandhill cranes, while Kruse et al. (2012) identifies the population of sandhill cranes that occur within the Lower Colorado River Valley as greater sandhill cranes. In 2009, a crane roost (not determined if it was the lesser or greater subspecies) was documented on Unit 1. Use of the Refuge's managed agricultural fields and roost locations vary, because sandhill cranes are nomadic and may randomly use any area that provides suitable habitat (USACOE and California Natural Resources Agency 2011).

Snowy Plover (Interior Population) (*Charadrius alexandrines*). The western snowy plovers present in the vicinity of the Refuge are part of the interior population of snowy plovers that are present in the area year-round (Shuford and Gardali 2008). In 1999, it was estimated that the breeding population at the Sea was approximately 220 (Shuford et al. 2002). This species was observed along the Salton Sea's shoreline adjacent to Bruchard Bay during surveys conducted in 2010 (USACOE and California Natural Resources Agency 2011).

Gull-billed Tern (*Gelochelidon nilotica* ssp. *vanrossemi*). In 2010, the western gull-billed tern population was estimated at 737 to 808 pairs, with breeding occurring in western Mexico and southern California. In southern California, this tern breeds very locally in southern California, including the Salton Sea and San Diego Bay (Molina et al. 2010). Although the primary wintering location for this species is in various locations in Mexico, a few western gull-billed terns have been observed at the Salton Sea in mid-winter (Molina et al. 2010).

The western gull-billed tern is commonly observed on the Refuge in spring and summer, foraging over fresh and saline emergent wetlands, mudflats, croplands, grasslands, and, on occasion brushlands. Unlike most other tern species present in California, the gull-billed tern is an opportunistic feeder with a broad diet that includes small fish, a variety of insects, side-blotched lizards, and crayfish (*Procambarus* spp.) (Shuford et al. 2002).

The Salton Sea is the only interior nesting site for gull-billed terns in western North America north of Mexico (Molina 2004). At present within the Refuge, the gull-billed tern nests in small subcolonies of 10 to 30 pairs (Molina et al. 2010) on unvegetated islands maintained by the Refuge within managed open water areas. There are also records from 1994 and 1998 of nesting near the mouth of the Alamo River (USACOE and California Natural Resources Agency 2011). Between 1992 and 2001 approximately 72 to 155 breeding pairs were present. In 2010, approximately 65 to 200 breeding pairs were present. Gull-billed terns generally have only one brood in a breeding season; however, this tern may re-nest if the initial clutch or brood is lost (Parnell et al. 1995). In 2011 and 2012, all nesting attempts were abandoned following disturbances from mammalian predators.

According to Molina et al. (2010), the available data indicates a decline in the number of breeding pairs of western gull-billed terns from the late 1930s through the late 1970s at the Salton Sea; however, the small number of breeding pairs in California seemed to remain stable from the early 1990s through 2005. Between 2005 and 2011, however, nesting success at the Salton Sea has declined as a result of nest predation by raccoons and coyotes, as well as impacts to nests, eggs, and chicks from overcrowding by other nesting species including Caspian terns, brown pelicans, and California gulls.

In about 2009, several thousand Caspian terns wintered at the Refuge and then stayed to nest on the islands that previously provided nesting habitat for gull-billed terns. Bird bands indicated that many of the Caspian terns came for the Columbia River basin, where their presence was being managed to reduce impacts to native salmon populations. The presence of the Caspian terns at the Salton Sea has adversely affected nesting success for both the gull-billed terns and black skimmers. California gulls, which tend to act aggressively towards nesting seabirds, can also be a management concern for gull-billed terns.

Refuge staff is attempting to address predation and overcrowding issues, and continues to maintain and manage nesting islands to support the western gull-billed tern.

Black skimmer (Mark Stewart/USFWS)

Black Skimmer (*Rynchops niger*). Black skimmers are commonly observed at the Salton Sea mid-April through September and occasionally into mid-October. The first recorded black skimmer nest in California occurred at the Salton Sea in 1972 (Shuford and Gardali 2008). This species is now observed annually on the Refuge including along the shallow waters at the edge of the Salton Sea, in the managed open water areas to the north of the Refuge headquarters, and along the New and Alamo rivers within and adjacent to the Refuge (USACOE and California Natural Resources Agency 2011).

Black skimmers have been observed nesting along both the northern and southern edges of the Salton Sea. On and adjacent to the Refuge, this ground-nesting seabird establishes breeding colonies primarily on small islands in the managed open water areas of the Refuge. These colonies can often include other species of terns. Generally, the first eggs are laid in early May and the last of the young are fledged by late September (Shuford and Gardali 2008).

Reproductive success at the Salton Sea varies from year to year. According to Shuford and Gardali (2008), although several hundred adults were present at the Salton Sea in both 2002 and 2003, only six pairs in 2002 and 99 pairs in 2003 attempted to nest. In 2004, nearly 400 pairs were present but almost all nesting attempts were unsuccessful, whereas in 2005 over 600 pairs nested, with high reproductive success. Black skimmers are considered sensitive to human disturbance, and have been known to abandon their nests following a major disturbance.

Skimmers are tactile feeders that catch small fish and crustaceans by flying along the water surface and skimming their lower mandibles along the water. Black skimmers are thought to be largely nocturnal feeders, and at the Salton Sea, foraging activity appears to peak at or near dusk. Feeding activity does however also occur throughout the day, particularly when adults are feeding chicks (Shuford and Gardali 2008).

Crissal Thrasher (*Toxostoma crissale*). The crissal thrasher is a rare, year-round resident of the Salton Basin, although its presence on the Refuge is limited. This species, which does nest in the area, prefers dense thickets of shrubs or low trees in desert riparian and desert wash habitats.

On the Refuge, it may be found in desert riparian and wash habitat that occurs along the New and Alamo rivers, and in some locations along irrigation and drainage channels. There are records from the last century of this species for the mouth of the Alamo River and in an upstream portion of the New River (Patten et al. 2003).

Lucy's Warbler (*Vermivora luciae*). Lucy's warbler is occasionally observed in the vicinity of the Salton Sea in all seasons but winter. Historically, this species was a frequent breeder in the area but today breeding is sporadic at best. The decline of this species is most likely related to loss of riparian habitat to support nesting. Breeding sites include thickets of

mesquite bosques, mainly honey mesquite but also screwbean mesquite, and willow and cottonwood areas along watercourses or near ponds. Lucy' warbler can also nest in sparser thorn-scrub of palo verde (*Parkinsonia* sp.), ironwood, and catsclaw acacia where such habitat borders stands of mesquite. Nesting has also been recorded in tamarisk (Otahal 2006).

Yellow-breasted Chat (*Icteria virens*). The yellow-breasted chat is a rare summer migrant to the Imperial Valley where it typically occupies early successional riparian habitats with a well-developed shrub layer and an open canopy. The species was formerly a common breeding bird in the area, but fewer numbers have been recorded in recent years (Shuford and Gardali 2008). The vegetation structure, rather than the vegetation type, appears to be the determining factor in nest-site selection. On the Refuge, suitable nesting habitat may include tamarisk scrub, screwbean mesquite bosque, and restored willow scrub habitat. This species was observed along the New River during surveys conducted on and adjacent to the Refuge in summer 2010 (USACOE and California Natural Resources Agency 2011).

Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*). The yellow-headed blackbird is an uncommon species that is known to breed in the area. This species, which breeds between mid-April to late July, began nesting in the Imperial and Coachella valleys in the early 1950s (Patten et al. 2003). Yellow-headed blackbirds breed almost exclusively in marshes with tall emergent vegetation, often along the edges of ponds or lakes. This species was observed on several occasions in marsh areas adjacent to the Alamo River during surveys conducted in the summer 2010 (USACOE and California Natural Resources Agency 2011).

Other Rarely Observed California Species of Concern

A number of bird species identified as California Species of Concern occur in very small numbers or have the potential to be observed on the Refuge. These include (in order of priority): summer tanager (*Piranga rubra*), tri-colored blackbird (*Agelaius tricolor*), Vaux's swift (*Chaetura vauxi*), olive-sided flycatcher (*Contopus cooperi*), purple martin (*Progne subis*), yellow warbler (*Dendroica petechia*), grasshopper sparrow (*Ammodramus savannarum*), long-eared owl (*Asio otus*), short-eared owl (*Asio flammeus*), black swift (*Cypseloides niger*), and Bendire's thrasher (*Toxostoma bendirei*). For the most part, the season of concern for these species is the breeding season. None of these species is known to breed in the vicinity of the Salton Sea, including on the Refuge; rather they are either migrant visitors or in some cases, they winter in the area in very small numbers.

American badger (*Taxidea taxus*). The potential for this species to be present on the Refuge is low due to the limited suitability of the habitats on the Refuge to support badgers. The badger is typically found in dry, open treeless areas, grasslands, and coastal sage scrub. It also occurs in drier open stages of most shrub, forest, and herbaceous habitat and especially requires friable soils for digging its burrows and foraging. Some suitable habitat may be present along the New and Alamo rivers, however, no recent observations of the species or signs of its foraging activity have been observed on the Refuge. There is a record of this species being present within the Alamo River delta in 1937 (USACOE and California Natural Resources Agency 2011).

Western Yellow Bat (*Lasiurus xanthinus*). This bat roosts in desert and montane riparian, desert succulent scrub, desert scrub, and pinyon-juniper woodland habitats, but can be observed foraging almost anywhere within its range. There is a low potential for this bat to roost in tamarisk scrub and tamarisk woodland along the New and Alamo rivers, but no recent sightings have been made in the vicinity of the Refuge.

4.5.5.2 Coachella Valley NWR

Federally Listed Species

The Coachella Valley NWR supports two federally listed species, the threatened Coachella Valley fringe-toed lizard and the endangered Coachella Valley milk-vetch. Approximately 2,500 acres of the Refuge have been designated as critical habitat for the fringe-toed lizard. Final rule was published in the Federal Register on February 13, 2013 (78 FR 10450) and became effective on March 15, 2013, designating all of the lands within the current Refuge boundary as critical habitat for Coachella Valley milk-vetch. Figure 4-23 depicts the boundaries of the critical habitat occurring on the Refuge.

A summary of the status and life history of these species is provided here.

Coachella Valley Fringe-toed Lizard (*Uma inornata*). The Coachella Valley fringe-toed lizard was listed by the Service (45 FR 63812) as a Federal threatened species and by the State of California as an endangered species in 1980. The primary reason for listing this species, as described in the Coachella Valley Fringe-toed Lizard Recovery Plan (USFWS 1985), was a significant decline in suitable habitat to support the species due to urban and agricultural development and associated windbreak structures. Off-road vehicle use in habitat areas was also identified as a threat to this species.

The Nature Conservancy in 1985 estimated that the acreage of "occupiable habitat" historically present in the Coachella Valley to support this species was 170,000 acres (68,796 hectares). At the time of listing (1980), only an estimated 63,000 acres (25,506 hectares) remained, and by 2000, only 27,000 acres (10,932 hectares) (16 percent of the habitat historically available to support this species) remained (USFWS 2010a).

The Coachella Valley fringe-toed lizard, a medium sized, whitish or sand-colored lizard that averages six to nine inches (15 to 23 centimeters) in total length, is restricted to wind-blown sand deposits on the floor of the Coachella Valley (USFWS 1985). The species has specific phenotypic adaptations to keep fine sand out of its eyes, mouth, nose, and ears.

The breeding season for these omnivorous lizards begins in the spring (April/May) following their winter dormancy. Their diet consists of plants and plant-dwelling arthropods. Hatchlings begin to appear from late June to early September. The non-breeding season begins in the summer (July/August), when the lizard's diet consists of plants and ground dwelling arthropods (USFWS 2010a). This lizard hibernates during the winter and is most active during daylight hours. To cope with the high temperatures of this desert environment, the lizard restricts its activities to the early morning and late afternoon hours. The loose sand also provides protection from the heat. When temperatures are high and the lizard's body temperature reaches about 95° Fahrenheit (35° Celsius), it escapes the heat by "swimming" or burrowing beneath the sand (USFWS 2010a).

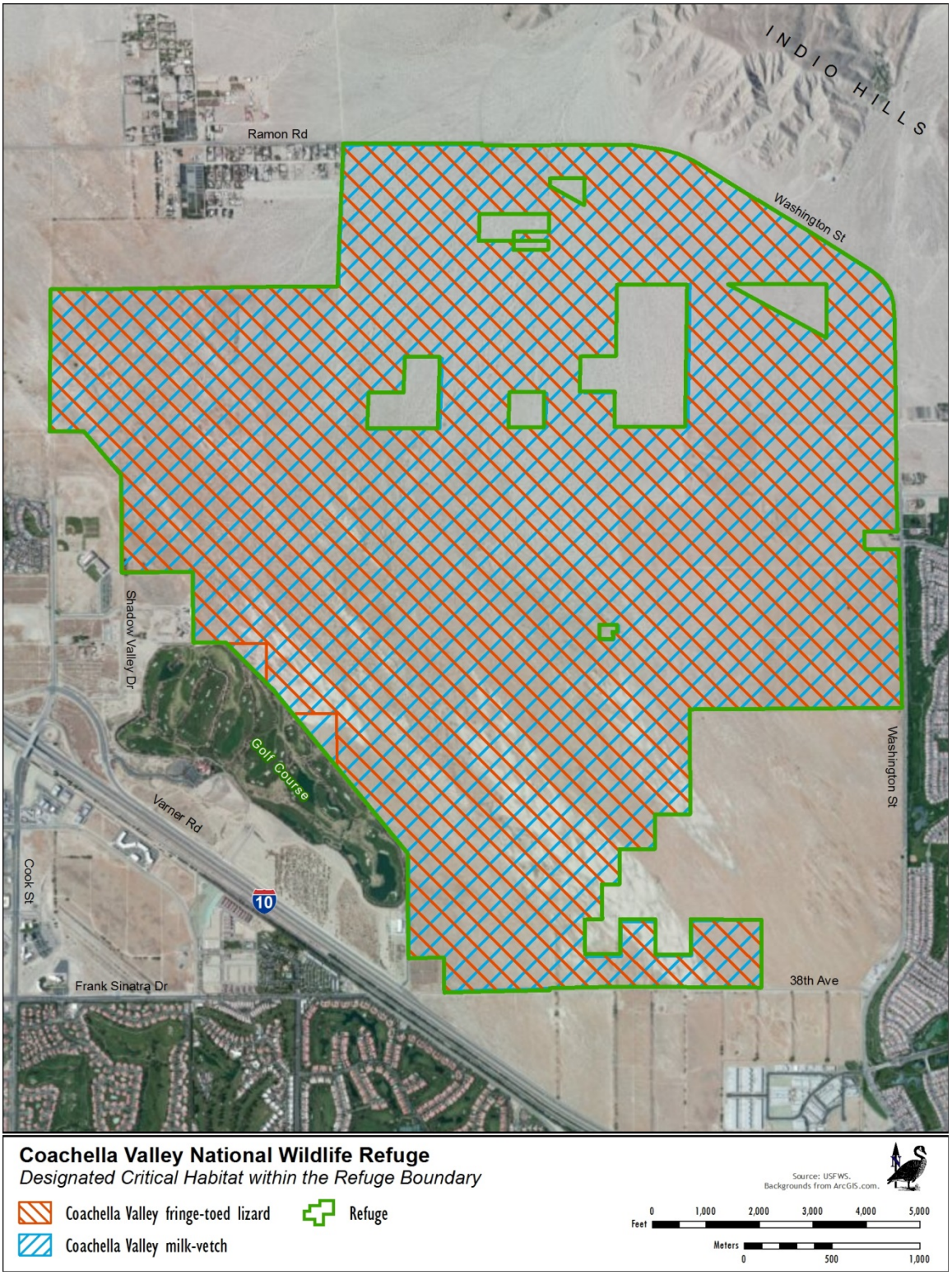


Figure 4-23. Designated Critical Habitat for the Coachella Valley Fringe-toed Lizard and Coachella Valley Milk-vetch on the Coachella Valley NWR

In 1986, the Service approved the Coachella Valley Fringe-toed Lizard Habitat Conservation Plan that called for the establishment of three preserves where this species could be protected. One of these preserves, the Thousand Palms Preserve, includes the Coachella Valley NWR. In 2008, the Coachella Valley MSHCP was approved, which resulted in the subsumation of the three existing preserves, including the Thousand Palms Preserve, and the creation of four conservation areas, including Thousand Palms (the boundaries of which still include the Refuge), Whitewater Floodplain, Willow Hole, and Edom Hill, all of which support Coachella Valley fringe-toed lizard habitat.

This lizard occurs in a dynamic system that is dependent on sandy (blowsand) habitat for its continued existence. The sand transport systems that maintain the existing blowsand habitat in the Thousand Palms Conservation Area has been substantially modified or disrupted by development. In addition to the obstruction of sand transport systems, threats to the Refuge's fringe-toed lizard population include non-native invasive plant species, human disturbance related to illegal entry on foot and in vehicles, climate change, and alteration of hydrology that is adversely affecting the growth of mesquite, which forms hummocks that act as anchors for the dune systems (USFWS 2010a). To address the loss of blowsand, sand fences have been erected on the Refuge and elsewhere in the Thousand Palms Conservation Area, but at present, the benefits of these fences are limited, as they are almost entirely covered by sand.

Coachella Valley Milk-vetch (*Astragalus lentiginosus var. coachellae*). This plant, with a distribution limited to the Coachella Valley, was listed as a federally endangered species in 1998 (63 FR 53596). At the time of listing, suitable habitat for this taxon was considered to be decreasing due to continuing direct and indirect impacts of development. Following its listing, development continued to replace occupied habitat in many portions of the Coachella Valley. This direst loss of habitat also has adverse effects on the sand transport system responsible for the creation and maintenance of this plant's habitat elsewhere in the Valley. As a result, suitable habitat for Coachella Valley milk-vetch has decreased since this taxon was listed (USFWS 2009b), leading to a recommendation in the five-year review of the status of this plant, that no change to its current status as endangered is warranted (USFWS 2009b).

Coachella Valley milk-vetch is an annual or short-lived perennial plant with ascending stems 4 to 12 inches (10 to 30 centimeters) tall, with pink-purple flowers arranged in 11 to 25-flowered racemes. The leaves, stems, and fruits are densely covered with short, appressed (pressed flat), white hairs. The date of first flowering may be as early as December in perennial plants, but usually not until January or February for plants in their first year. Blooming can continue into April (USFWS 2009b).

Coachella Valley milk-vetch (Ginny Short)

Coachella Valley milk-vetch is strongly associated with active, stabilized, and shielded sandy substrates and is found primarily on loose aeolian (i.e., wind transported) or alluvial (i.e., water transported) sands that are located on dunes or flats, but can also be found along disturbed margins of sandy washes. The Thousand Palms Conservation area, which includes the Refuge, contains over 4,300 acres of core habitat for this taxon.

Astragalus lentiginosus var. *coachellae* populations can survive prolonged drought periods as dormant seeds (seed bank) in the soil, so the numbers of above ground plants at any given time is only a limited and partial indication of population size (USFWS 2009b). Identifying changes in numbers of individuals present in an area and demographic trends over time is difficult because the number of seeds in a given area that germinate and produce standing plants can vary widely from year to year depending on environmental conditions.

A threat to Coachella Valley milk-vetch not identified in the listing rule (to date, no recovery plan has been prepared for this taxon) is degradation and loss of habitat due to invasive non-native plants, such as Sahara mustard, filaree (*Erodium* spp.), and Mediterranean grass (*Schismus barbatus*). Invasive, non-native plant species can potentially degrade existing habitat quality by stabilizing loose sediments in otherwise unsuitable locations and obstructing transport of sediment to occupied habitat downwind (USFWS 2009b). These invasive plants directly compete with Coachella Valley milk-vetch for water.

The Coachella Valley NWR protects a portion of the 4,292 acres of core habitat for the Coachella Valley milk-vetch included within the larger Thousand Palms Conservation Area. The MSHCP identifies the following actions needed to ensure the persistence and long-term viability of Coachella Valley milk-vetch: control and management of activities that degrade its core habitat, particularly activities that result in sand compaction and vegetation destruction; control of invasive plants; maintenance of the aeolian sand transport system; and development of models that can address the distribution, abundance, and ecological requirements of the species (CVAG 2007a).

State Listed Species

The Coachella Valley fringe-toed lizard is the only State listed species present on the Refuge.

Other Special Status Species

Birds of Conservation Concern. Birds of Conservation Concern (USFWS 2008a) in the Coachella Valley NWR are those bird species included in the BCR 33 (Sonoran and Mojave Deserts, U.S. portion only) List, USFWS Region 8 List, and the National List. Table 4-15 lists the Birds of Conservation Concern observed or expected to occur on the Coachella Valley NWR.

Table 4-15
Birds of Conservation Concern Observed on or Surrounding the Coachella Valley NWR

Common Name	Scientific Name	Abundance on SBSSNWR	Included on BCC List		
			BCR 33	Region 8	U.S.[1]
Swainson's hawk	*Buteo swainsoni*	Rare (migrant)	No	No	Yes
Prairie falcon	*Falco mexicanus*	Rare	Yes	No	No
Burrowing owl	*Athene cunicularia hypugaea*	Rare	Yes	Yes	No
Short-eared owl	*Asio flammeus*	Casual visitor	No	No	Yes
Costa's hummingbird	*Calypte costae*	Uncommon	Yes	Yes	Yes
Rufous hummingbird	*Selasphorus rufus*	Uncommon	No	No	Yes
Lewis's woodpecker	*Melanerpes lewis*	Irregular	No	Yes	Yes
Gilded flicker	*Colaptes chrysoides*	Fairly common	Yes	No	No

Table 4-15 Birds of Conservation Concern Observed on or Surrounding the Coachella Valley NWR					
Common Name	**Scientific Name**	**Abundance on SBSSNWR**	**Included on BCC List**		
			BCR 33	**Region 8**	**U.S.**[1]
Le Conte's Thrasher	*Toxostoma lecontei*	Rare	Yes	Yes	Yes
Olive-sided flycatcher	*Contopus cooperi*	Rare (migrant)	No	Yes	Yes
Willow flycatcher	*Empidonax traillii*	Uncommon (migrant)	No	Yes	Yes
Loggerhead shrike	*Lanius ludovicianus*	Fairly common	No	Yes	Yes
Horned lark	*Eremophila alpestris*	Uncommon	No	No	Yes
Cactus wren	*Campylorhynchus brunneicapillus*	Common	No	Yes	No
Bewick's wren	*Thryomanes bewickii*	Fairly common	No	No	Yes
Yellow warbler	*Dendroica petechial brewsteri*	Fairly common	Yes	Yes	No
Common yellowthroat	*Geothlypis trichas sinuosa*	Fairly common	Yes	Yes	No
Green-tailed towhee	*Pipilo chlorurus*	Rare	No	Yes	No
Spotted towhee	*Pipilo maculatus*	Uncommon	No	Yes	No
Brewer's sparrow	*Spizella breweri*	Uncommon	No	No	Yes
Sage sparrow	*Amphispiza belli*	Fairly common	No	Yes	No
Song sparrow	*Melospiza melodia*	Uncommon	No	Yes	No
Lawrence's goldfinch	*Spinus lawrencei*	Irregular visitor	Yes	Yes	Yes

[1] National List
Source: (USFWS 2008a)

California Species of Special Concern. Presented in Table 4-16 are those species, identified as Species of Special Concern by the State of California, that have been observed on the Coachella Valley NWR in the past or have the potential to occur on the Refuge based on their habitat needs and historic distribution. No plants occur or are expected on the Refuge that have been identified as Species of Special Concern by the State of California.

The species listed in Table 4-16, with the exception of short-eared owl, northern harrier, and loggerhead shrike, are species covered by the Coachella Valley MSHCP and will be addressed in that section, which follows.

Short-eared Owl (*Asio flammeus*). The short-eared owl is a casual winter visitor to the Coachella Valley. The total number of these owls in California varies significantly from year to year based on climate and prey cycles (Shuford and Gardali 2008). If present, this owl is likely to be observed between the months of late October and early March. Foraging almost exclusively on small mammals, the short-eared owl would likely occur in areas of open land and weedy fields. The primary threats to this species include habitat loss and degradation, aggravated by grazing, invasive non-native plants, water management, and disease (Shuford and Gardali 2008).

Table 4-16 California Species of Special Concern Observed or with the Potential to Occur on the Coachella Valley NWR	
Scientific Name	**Common Name**
INSECTS [1]	
Stenopelmatus cahuilaensis	Coachella Valley Jerusalem cricket
Macrobaenetes valgum	Coachella giant sand-treader cricket
REPTILES [2]	
Phrynosoma mcallii	flat-tailed horned lizard
BIRDS [3]	
First Priority	
Toxostoma lecontei	Le Conte's thrasher
Piranga rubra cooperi	summer tanager
Second Priority	
Athene cunicularia	burrowing owl
Lanius ludovicianus	loggerhead shrike
Dendroica petechia brewsteri	yellow warbler
Third Priority	
Circus cyaneus	northern harrier
Asio flammeus	short-eared owl
Toxostoma crissale	crissal thrasher
Icteria virens	yellow-breasted chat
MAMMALS [4]	
Xerospermophilus tereticaudus chlorus	Coachella Valley round- tailed ground squirrel
Perognathus longimembris bangsi	Palm Springs pocket mouse

[1] CDFG 2011, [2] Jennings and Hayes 1994, [3] CDFG 2008, [4] Woodbridge1986

Northern Harrier (*Circus cyaneus*). The northern harrier is considered a rare migrant within the Coachella Valley. It forages in a variety of open (treeless) habitats, including sagebrush flats, that provide adequate vegetative cover, suitable prey (small to medium-sized vertebrates, including rodents and passerines), and scattered perches such as shrubs or fence posts (Shuford and Gardali 2008). The primary threats to this species include loss and degradation of nesting and foraging habitat and nest failure due to a variety of human activities.

Loggerhead Shrike (*Lanius ludovicianus*). The loggerhead shrike is fairly common in the Coachella Valley Preserve and is known to nest in the region. In general, shrikes are considered more plentiful in the desert areas of California than on the coast. In the Salton Sink, they are fairly common during the breeding season and considered to be present in larger numbers during the winter months because of the presence of migrants from other regions (Shuford and Gardali 2008). The threats responsible for the decline of shrike numbers in California, which are particularly noticeable along the coast, are not well understood. These threats are likely a combination of habitat loss on breeding and wintering grounds, as well as along the shrike's migration routes (Shuford and Gardali 2008).

Species Covered by the Coachella Valley MSHCP

As discussed in previous sections, the Coachella Valley NWR is included within the Coachella Valley MSHCP. Of the species covered by this MSHCP, 13 species are known or have the potential to occur within the Coachella Valley NWR. These include Coachella Valley milk-vetch (described previously), Coachella Valley giant sand-treader cricket, Coachella Valley Jerusalem cricket, Coachella Valley fringe-toed lizard (described previously), flat-tailed horned lizard, burrowing owl, crissal thrasher, Le Conte's thrasher (*Toxostoma lecontei*), summer tanager (*Piranga rubra cooperi*), yellow warbler (*Dendroica petechia brewsteri*), yellow-breasted chat (*Icteria virens*), Coachella Valley round-tailed ground squirrel, and Palm Spring pocket mouse (*Perognathus longimembris bangsi*).

Coachella Valley Giant Sand Treader Cricket. This species depends on the active dunes and ephemeral sand fields at the west end of the Coachella Valley. The Refuge includes a significant portion of the 3,869 acres of core habitat identified for this species within the Thousand Palms Conservation Area.

The Coachella Valley giant sand-treader cricket, which is active primarily in the spring, is nocturnal, coming to the surface to forage on detritus blown over the dunes, or to look for mates (CVAG 2007a). They spend the day concealed in self-dug burrows that can extend from 16 to 65 feet (5 to 20 meters) into the sand. These burrows are often associated with the roots of perennial shrubs. Additional information about the life history of these insects is limited.

The most significant limiting factor for this species is the availability of the aeolian sand ecosystem and the sand sources and corridors that maintain it. Threats to this species include habitat loss and degradation, crushing as a result of pedestrian and vehicular activity, and sand compaction. Non-native species, including Sahara mustard and Russian thistle (*Salsola tragus*), can significantly stabilize active sand, and are therefore also considered a threat to this species.

Coachella Valley Jerusalem Cricket. The Coachella Valley Jerusalem cricket occurs in sandy to somewhat gravelly sandy soils and is considered an obligate sand species. This species does not necessarily require active blowsand habitat, however, it has been found in loose wind-blown drift sands, dunes, and sand in vacant lots where native vegetation exists. There is no core habitat for this species identified within the Thousand Palms Conservation Area and only a limited area (approximately 200 acres) of habitat occurs on the Refuge.

This species appears to require high humidity, with most observations made following winter and spring storms when the soil substrate is moist. Its distribution may be limited by temperature and moisture regimes. The easternmost known occurrence of this species in the Coachella Valley is a record from the Thousand Palms area in the vicinity of Bob Hope Drive and I-10. There are no recent sightings of this species in the vicinity of the Refuge, which may indicate that it no longer occurs in this area (CVAG 2007a).

Flat-tailed horned lizard. The flat-tailed horned lizard is found in extreme southwestern Arizona, southeastern California, and adjoining portions of Sonora and Baja California, Mexico. In California, this lizard occurs in portions of eastern San Diego County, central Riverside County, and Imperial County with the majority of the occupied habitat in Imperial County (Foreman 1997).

This lizard is often associated with sand flats, often hard-packed overlain with fine blowsand, and sand dunes. It is rare on more active dunes (CVAG 2007a). Most records for flat-tailed horned lizards come from the creosote-white bursage (*Ambrosia dumosa*) series of Sonoran desert scrub, and some studies indicate a preference for white bursage and indigo bush, presumably because of their ability to trap wind-blown sand and provide shade for thermal cover (Foreman 1997).

Flat-tailed horned lizard (Ginny Short)

Like related species, flat-tailed horned lizards are myrmecophageous – they eat ants, which comprise about 98 percent of their diet. Within the valley, the flat-tailed horned lizard occurs at low elevations. The Coachella Valley MSHCP (CVAG 2007a) identifies more than 4,000 acres of predicted habitat (i.e., areas where this species is known or expected to occur based on recent observations) within the Thousand Palms Conservation Area, with a significant portion of this acreage (approximately 2,500 acres) included within the Refuge boundary. Estimates of population density for this lizard within this core habitat area could range from 2,089 individuals per acre to 10,027 individuals per acre based on density estimates developed in association with the Coachella Valley MSHCP (CVAG 2007a).

The flat-tailed horned lizard populations in the Coachella Valley are isolated from all other flat-tailed horned lizard populations, and, as a group, the Coachella Valley population is viewed by some as a distinct vertebrate population pursuant to the Federal Endangered Species Act. Threats to habitat within the area include urban and agricultural development, expansion of utility corridors, and off-road vehicle use (CVAG 2007a).

The conservation goals presented for this species in the Coachella Valley MSHCP (CVAG 2007a) include:

- Protect core habitat areas to allow evolutionary processes and natural population fluctuations to occur;
- Minimize fragmentation, human-caused disturbance, and edge effects to core habitat by conserving contiguous habitat patches and effective linkages between patches of core habitat;
- Protect other conserved habitat to provide sufficient area and variety of habitat types to accommodate population fluctuations, allow for genetic diversity, and to conserve the range of environmental conditions within which this lizard is known to occur;
- Protect essential ecological processes, including sand source/transport systems, necessary to maintain core habitat and other conserved habitat for this species;
- Maintain biological corridors and linkages among all conserved populations; and
- Ensure conservation of the flat-tailed horned lizard by maintaining the long-term persistence of self-sustaining populations and conserving habitat quality through biological monitoring and adaptive management actions in the Plan Area.

The conservation objectives that specifically relate to the management of the Coachella Valley NWR involve implementing monitoring and adaptive management actions to ensure self-sustaining populations of this species, and, if feasible, implementing actions to reestablish self-sustaining populations of the flat-tailed horned lizard in previously occupied habitat on the Refuge. Similar goals and objectives are presented in the Flat-tailed Horned Lizard Rangewide Management Strategy 2003 Revision (Flat-tailed Horned Lizard Interagency Coordinating Committee 2003).

Burrowing Owl. The burrowing owl population has been significantly reduced throughout its range. The primary impact to this species is habitat loss, although predation by dogs and cats and destruction of nesting burrows also represents a threat to this species. Burrowing owls occupy a broad array of habitats, including sand dunes, open areas that support creosote bush, and agricultural areas. Within the Coachella Valley, burrowing owls are scattered in low numbers on open terrain throughout the lowlands, including open desert, fallow fields, and irrigation dikes, wherever burrows (generally dug by ground squirrels) are available.

Burrowing owls follow a crepuscular habit, being most active during the early morning and evening hours. They are opportunistic feeders, with a diet consisting predominantly of large insects and small rodents.

The number of burrowing owl pairs present within the Coachella Valley is not known. However, it is known that the relative population size and distribution of these owls is highly variable, and is dependent upon the availability of food and suitable burrow locations (CVAG 2007a).

Crissal Thrasher. The crissal thrasher, a ground-dwelling relative of the mockingbird, ranges from southeastern California to southern Nevada, southwestern Utah, and western Texas southward. Throughout its range, crissal thrasher is known as a resident of dense thickets and woodlands of shrubs or low trees in desert riparian and desert wash habitats. Within the Coachella Valley, where it is a year-round resident, the species occurs in areas dominated by mesquite hummocks, in thickets with acacias and arrowweed, and in desert saltbush scrub (CVAG 2007a).

Threats to the crissal thrashers within the Coachella Valley include habitat loss, groundwater overdraft that reduces available water for honey mesquite; water diversions that reduce water availability; tamarisk infestations which degrade desert saltbush scrub, mesquite bosque, and mesquite hummocks habitat; and significant fragmentation of available habitat (CVAG 2007a).

Le Conte's Thrasher. Le Conte's thrasher is a non-migratory bird that occurs in the southwestern U.S. and northwestern Mexico. Overall, the specific habitat needs and population numbers for the Le Conte's thrasher are poorly understood, and although the range in which it is found is fairly large, its distribution within these areas is patchy (CVAG 2007a).

Within the Coachella Valley, the habitat that supports the Le Conte's thrasher typically consists of sparsely vegetated desert flats, small arroyos, dunes, bare ground, alluvial fans, and gently rolling hills having a high proportion of one or more species of saltbush (*Atriplex* spp.) and/or cylindrical cholla cactus (*Opuntia* spp.) (CVAG 2007a). In these areas, shrubs are generally well scattered with closed cover and an accumulation of leaf litter. For nesting, Le Conte's thrasher prefers thick, dense, and thorny shrubs or cholla cactus (Weigand and Fitton 2008).

The Thousand Palms Conservation Area includes approximately 11,058 acres of Le Conte's thrasher habitat, including habitat that occurs within the Refuge. The primary threat to this species is habitat loss.

Summer Tanager. The North American breeding population of summer tanagers has remained generally stable since the mid-1970s, although some populations, including the population along the Colorado River, have declined. Considered common in the lower Colorado River Valley in the early 1900s, only 216 individuals were estimated to be present in 1976 (CVAG 2007a). Loss of nesting habitat as a result of water management projects is considered one of the primary reasons for the decline of the lower Colorado River Valley population.

Summer Tanagers are rare, but regular migrants and winter visitors throughout much of southern California (except the mountains). This species is known to nest in the riparian habitats within the Coachella Valley MSHCP Plan Area, as well as migrate through the area in the spring to reach breeding grounds to the north and in the fall to return south to its wintering grounds. These riparian nesters generally arrive in southern California in mid-April. No nesting habitat for this species occurs on the Refuge, but the habitats on the Refuge are available as cover and foraging areas for migrants passing through this area.

Yellow Warbler. Although the yellow warbler does not nest within the Refuge, it likely migrates through the Refuge en route to breeding or wintering areas. During migration, the yellow warbler uses a variety of habitats including desert fan palm oasis woodland, mesquite hummocks, mesquite bosque, arrowweed scrub, desert dry wash woodland, desert sink scrub, desert saltbush scrub, southern sycamore alder riparian woodland, Sonoran cottonwood-willow riparian forest, coastal and valley freshwater marsh, and cismontane alkali marsh (CVAG 2007a). Yellow warblers typically arrive from their wintering areas in Central and South America between late March and May. Peak fall migration, when these warblers return south, is during the month of September.

Yellow-breasted Chat. Like the yellow warbler, the yellow-breasted chat does not nest within the Refuge, but likely migrates through this area. In migration, the yellow-breasted chat may use desert fan palm oasis woodland, mesquite hummocks, mesquite bosque, arrowweed scrub, desert dry wash woodland, desert sink scrub, desert saltbush scrub, southern sycamore alder riparian woodland, Sonoran cottonwood-willow riparian forest, coastal and valley freshwater marsh, and cismontane alkali marsh habitat. It has been observed during migration within the Thousand Palms Conservation Area (CVAG 2007a). The yellow-breasted chat is in a general state of decline throughout its range. The primary threats to this species include loss of nesting habitat and cowbird parasitism.

Coachella Valley Round-tailed Ground Squirrel. The Coachella Valley round-tailed ground squirrel is a subspecies of the more widely distributed round-tailed ground squirrel that inhabits desert areas of the southwestern U.S. and northwestern Mexico. This subspecies is typically associated with sand fields and dune formations. It does not require active blowsand areas, and seems to prefer areas where hummocks of sand accumulate at the base of large shrubs that provide burrow sites and adequate cover (CVAG 2007a).

Threats to the squirrel include loss and deterioration of habitat as a result of urban and agricultural development and the lowering of the groundwater table, as well as impacts from off road vehicle activity, domestic pets, and invasive non-native plants such as Sahara mustard.

The Thousand Palms Conservation Area includes approximately 8,500 acres of core habitat for this ground squirrel subspecies, which are divided between two core habitat areas. One of these core habitat areas occurs within the Refuge boundary. Based on observations, this subspecies appears to occur in good numbers on the dunes of the Thousand Palms Preserve (CVAG 2007a).

Palm Springs Pocket Mouse. The Palm Springs pocket mouse is one of seven subspecies of *Perognathus longimembris*, the "silky pocket mice" occurring in southern California. The population of this subspecies has been greatly reduced within the Coachella Valley by habitat destruction, degradation, and fragmentation due to urban, agricultural, residential, and recreational development (CVAG 2007a).

Approximately 11,700 acres of core habitat for this subspecies have been identified within the Thousand Palms Conservation Area. This core habitat area includes the main dune system within the Refuge. Habitat to support the Palm Springs pocket mouse includes generally level to gently sloping topography, with sparse to moderate vegetative cover and loosely packed or sandy soils (CVAG 2007a).

4.5.6 Invasive Species

4.5.6.1 Introduction

Invasive species are organisms that are introduced into a non-native ecosystem and which cause, or are likely to cause, harm to the environment, economy, or human health. Invasive species can be plants, animals, and other organisms (e.g., microbes) and human actions are the primary means of invasive species introduction. Under favorable conditions, introduced exotic or alien (invasive) species can become established and out-compete a site's native species. In the case of plants, altered hydrologic, soil, and fire regimes are the primary factors contributing to invasive plant germination and establishment. The introduction of other non-native organisms such as birds, insects, or marine organisms can result in problems because there are no natural predators or parasites in the area, which allows the exotic species to multiply and out-compete the native species, often resulting in adverse effects to native species.

Since our Nation's founding, the U.S. has experienced the introduction of more than 30,000 species of plants, animals, fungi, viruses, most often introduced by man directly or indirectly. Some of these species have become serious pests resulting in economic damage in excess of $123 billion annually (http://www.scientificamerican.com/article.cfm?id=costly-interlopers).

4.5.6.2 Invasive Species Affecting Refuge Resources

Invasive species can spread in a number of ways, many times with unintended assistance from human actions. With respect to invasive plants, soil disturbance, excessive nutrients, native plant removal, and wildland fires all favor the spread of exotics. Many species have been either purposefully or accidentally introduced into the Salton Basin and human activity is facilitating the spread of these species. Each Refuge within the Sonny Bono Salton Sea NWRC has different issues related to non-native, invasive plants. Within the Imperial Valley, desert scrub habitat has been converted to agricultural land through heavily managed irrigation practices. Because of the high degree of human manipulation, the habitats in and around Sonny Bono Salton Sea NWR contain many invasive plants, as well as invasive aquatic fauna. The altered hydrology of the region permits many non-desert species to survive and thrive. Soil disturbance and the proliferation of weed seeds are the primary reason for invasive plants on the Coachella Valley NWR.

To assist land managers and others, the California Invasive Plant Council (Cal-IPC) tracks and documents the status of invasive plants throughout California. Cal-IPC's attempts to protect California's lands and waters from ecologically-damaging invasive plants through science, education and policy, and by working closely with agencies, industry and other nonprofit organizations to support research, restoration work, and public education. Cal-IPC, through its Calweed mapper program (http://www.cal-ipc.org/, accessed on 11/13/12), has identified 15 species of invasive plants in the vicinity of the Sonny Bono Salton Sea NWR and 18 species of invasive plants in the Sonoran/Coachella area, within the Thousand Palms Conservation Area. Not all of these species are currently present on refuge lands. Some of the more significant invasive plant infestations on the Sonny Bono Salton Sea and Coachella Valley NWRs are addressed below.

Sonny Bono Salton Sea NWR

Common Reed (*Phragmites australis*). This invasive wetland plant can grow up to 20 feet (6 meters) high in dense stands. This plant spreads primarily by means of rhizomes, although it can also reproduce by seed. In some areas, native wetland habitat has been replaced by large monocultures of common reed. On the Refuge, this species occurs along the edges of the managed cattail marsh habitat, as well as in irrigation and drainage ditches.

Tamarisk/Salt Cedar (*Tamarix ramosissima*). Tamarisk is a non-native shrub or tree invades a variety of wetland areas throughout California. It replaces willow and desert shrub habitats resulting in dramatic changes in geomorphology, soil chemistry, fire frequency, plant community composition, and native wildlife diversity. On the Refuge, tamarisk occurs along irrigation and drainage channels, along the floodway of the New and Alamo rivers, as well as within the river deltas, and along portions of the Salton Sea shoreline.

Colorado River Hemp/Sesbania (*Sesbania herbacea*). Although a native plant of the Sonoran Desert, this annual to perennial semi-woody herb has been identified as an invasive weed in some parts of the U.S. This species grows to heights ranging from three to ten feet and in its native habitat is found growing along streams and in other moist areas. When present within agricultural fields and areas managed for waterfowl, it can outcompete cultivated or other desirable plant species. Sesbania has limited, if any, forage value and its seeds are considered potentially poisonous. On the Refuge, this plant is a problem in seasonal wetland areas managed to provide winter forage for ducks and geese. When present, sesbania inhibits the growth of forage grasses, reducing the value of these managed lands for waterfowl.

Annual Weeds and Grasses. On the Refuge, non-native annual weeds and grasses, such as common mallow (*Malva neglecta*), cheeseweed *(Malva parviflora)*, goosefoot *(Chenopodium album*), puncture vine *(Tribulus terrestris)*, and wild radish *(Raphanus raphanistrum)* invade the managed agricultural fields, particularly following tilling.

Coachella Valley NWR

Sahara Mustard (*Brassica tournefortii*). Sahara mustard is a highly invasive erect non-native annual herb that can grow from four to forty inches tall. The basal rosette of leaves grows up to three feet in diameter in favorable environments. This species spreads through seed dispersal, often initially invading a disturbed area (e.g., roadsides, vacant lots, old agricultural fields) and then dispersing into native wildland areas. This species has the potential to be particularly damaging to native habitat, because it does not require soil disturbance to be invasive. There is much evidence of this in the Coachella Valley and other desert areas in southern California and Nevada.

Following the winter rains, Sahara mustard plants germinate earlier than the native annual wildflowers and as a result can inhibit native plant growth by dominating available soil moisture and potentially shading out native seedlings. Sahara mustard has infested large portions of the Refuge, including the sand dune habitat that supports the endangered plant, Coachella Valley milk-vetch.

Common Mediterranean Grass (*Schismus barbatus*). Common Mediterranean grass is an erect, to semi-prostrate and spreading, annual non-native grass. This grass can grow to eight inches (20 centimeters) tall or more and often forms large prostrate mats on the ground and extensive mats of fibrous root near the soil surface (Guertin 2003). It is most abundant on sandy soils on desert sand flats, in arroyos/washes, and roadsides. Like Sahara mustard, it germinates quickly following winter rains, which can inhibit native plant growth. In addition, this plant uses soil nitrogen at increased levels and at faster rates than the native plant species, which can inhibit the growth of native annuals (Guertin 2003). Adverse impacts to native vegetation may also occur as a result of other ecological changes associated with the presence of this species including increased fire size and frequency and alteration of soil ecology.

Common Mediterranean grass (USFWS)

Cal-IPC has identified more than 70 invasive species that occur within 50 miles of each Refuge but are not yet present in the region. These are identified as surveillance opportunities because infestations may be avoided through regular surveys, early detection, and immediate action to eradicate the new invasive plant from the area. High alert species for the Sonny Bono Salton Sea NWR include Uruguay and creeping water-primrose (*Ludwigia hexapetala* and *L. peploides*) and giant salvinia (*Salvinia molesta*). For the Coachella Valley NWR, the species with high potential for invasion based on the existing habitats present on the Refuge include cheatgrass (*Bromus tectorum*), iceplant (*Carpobrotus edulis*), spotted knapweed (*Centaurea stoebe ssp. micranthos*), and yellow starthistle (*Centaurea solstitialis*).

4.6 Cultural Resources

4.6.1 Introduction

Requirements for Federal agencies to identify, evaluate, and protect cultural resources are outlined in several Federal regulations (described in 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; requires Federal agencies to engage in government to government consultation with tribes where actions could affect tribal resources or culture; and requires Federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register of Historic Places (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 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 Sonny Bono Salton Sea NWR and the Coachella Valley NWR was prepared in 2009. This overview was prepared to assemble known information about the cultural resources located within and near the Refuges, to identify gaps in the existing database, 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.

Also in accordance with applicable cultural resource regulations, the federally recognized tribes in Imperial and Riverside Counties were formally contacted about the CCP process for the Sonny Bono Salton Sea NWR Complex, and comments regarding the CCP process and any concerns related to Tribal interests were solicited. A response was received from the Cocopah Indian Tribe in Somerton, Arizona that included a request to be involved in the planning process. Planning Updates and information related to the draft CCP were provided to the Cocopah Indian Tribe, as well as the other federally recognized tribes in the area, to keep them updated on the progress of the CCP.

4.6.2 Cultural Setting

A brief description of the cultural setting in and around the two refuges that constitute the Sonny Bono Salton Sea NWRC is presented here. A more detailed overview of the cultural setting is provided in Appendix L.

Both the Imperial Valley and the Coachella Valley contain rich archaeological records. Some portions of the Sonny Bono Salton Sea NWRC have previously been inventoried for cultural resources, while substantial additional areas have not yet been examined. Seventy-seven prehistoric and historic sites, features, or isolated finds have been documented on or within a 0.5-mile buffer around the Sonny Bono Salton Sea NWR and Coachella Valley NWR. The cultural resources associated with these Refuges may include archaeological and historic sites, buildings, structures, and/or objects.

4.6.3 Cultural History

Four successive periods, each with distinctive cultural patterns, may be defined for the prehistoric Colorado Desert, extending back in time over a period of at least 12,000 years. They include Early Man (Malpais), Paleoindian (San Dieguito), Archaic (Pinto and Amargosa), and Late Prehistoric (Patayan). The Malpais Pattern is represented by archaeological materials that have been hypothesized to date between 50,000 and 10,000 B.C. (Begole 1973, Begole 1976, Hayden 1976). Most of the aceramic lithic assemblages, rock features, and cleared circles in the Salton Basin were routinely assigned to the San Dieguito Phase III complex by many of the initial investigators. San Dieguito complex lithic technology was based on primary and secondary percussion flaking of cores and flakes. The San Dieguito III tools include pressure-flaked blades, leaf-shaped projectile points, scraper planes, plano-convex scrapers, crescentics, and elongated bifacial knives (Rogers 1939, Rogers 1958, Rogers 1966, Warren 1967, Warren and True 1961).

Site distributions within the Salton Basin suggest some of the basic elements of San Dieguito settlement patterns. Sites might be situated on any flat area, but the largest aggregations occurred on mesas and terraces overlooking major washes. Where lakes were present, sites are located

around the edges. These were areas where a variety of plant and animal resources could be found and where water would have been at least seasonally available.

The Pinto and Amargosa patterns were regional specializations within the general hunting and gathering adaptations that characterized the Archaic period. However, few Pinto or Amargosa (Elko series) projectile points have been identified on the desert pavements in the Colorado Desert, although that condition is beginning to change as the number of investigations increases. Some late Archaic sites are known, indicating occupations along the boundary between the low desert and Peninsular Range and at more favored habitats.

Radiocarbon dates of almost 1,000 B.C. and associated bird and fish bone confirm a Late Archaic period Lake Cahuilla occupational horizon. The emerging picture of late Archaic occupation in the Salton Basin is of mobile hunter and gatherer bands with atlatls (spear throwers) for hunting and milling stones for seed and nut processing, operating out of a limited number of base camps in optimal areas on the boundaries of the Salton Basin and on the shoreline of Lake Cahuilla. Sites dating to the Late Prehistoric period (A.D. 500 to 1700) are probably more numerous than any other in the Colorado Desert. Major innovations of this period include the production of pottery using the paddle-and-anvil technique and the introduction of floodplain agriculture on the Colorado River (Rogers 1945). Within the Colorado Desert, according to some investigators, ceramics first appear around A.D. 1000 (Love and Dahdul 2002). Exact dating for the presence of early domesticated plants is not available (Schroeder 1979).

Within the Late Prehistoric period, between A.D. 1000 and 1700, desert peoples of this region developed wide-spectrum and diversified resource procurement systems emphasizing a collector organization using residential bases and temporary logistical camps, scheduled according to the ripening seasons of staple plant resources. Mobility was an important element in this pattern, with frequent travel between the Colorado River and Lake Cahuilla, when the lake was present.

Archaeologically excavated house pits indicate that some have developed middens and diverse artifact types, suggestive of season-long temporary camps, while others have only sparse artifact associations suggestive of short-term fishing expeditions. Faunal assemblages vary from those largely limited to fish bone or the remains of migratory waterbirds, to others that contain more diverse resources, including rabbit and large mammal bone.

The numerous trail systems throughout the Colorado Desert attest to long-range travel to special resource collecting zones and ceremonial locales, trading expeditions, and possibly warfare. Pot drops, trailside shrines, and other evidence of transitory activities are associated with these trails (McCarthy 1993). Trade and travel is also seen in the distribution of localized resources such as Obsidian Butte obsidian.

4.6.4 Ethnohistory

Ethnography refers directly to cultural patterns that were observed during the historic period, primarily during the first half of the twentieth century, or to traditional culture as remembered during that period. However, used with proper caution, it also provides an invaluable source of analogies and inferences concerning earlier, prehistoric cultural patterns.

At the time of European contact, both the Salton Basin as a whole and the two major portions of the Sonny Bono Salton Sea NWRC were occupied by two distinct native ethnolinguistic groups. The Cahuilla occupied the northern half of the basin, including the lands within the Coachella Valley NWR, while the Kamia (also known as Kumeyaay, Tipai, and Diegueño) occupied the southern half, including the areas within the Sonny Bono Salton Sea NWR.

4.6.5 Historic Period

The lands within the Sonny Bono Salton Sea NWRC have generally been marginal to major historic period events in the Colorado Desert (Lawton 1976). The wider region first came to the attention of Europeans in 1539-1540, when Francisco de Ulloa reached the northern limit of the Gulf of California, Hernando de Alarcón sailed up the lower Colorado River at least as far as present-day Yuma, and Melchior Díaz traveled overland from Sonora to reach and cross the river. The portions of the desert west of the Colorado River were first visited only as late as the 1770s, when Juan Bautista de Anza and Francisco Garcés pioneered a route from the Colorado River to coastal southern California, passing to the south and west of the Refuge lands.

In 1853, Lieutenant K. S. Williamson of the U.S. Topographic Engineers and geologist William Blake surveyed the Salton Basin for railroad routes. In the process, Blake described the character of prehistoric Lake Cahuilla and recognized the fertility of the Salton Basin. Sporadic flooding occurred at least eight times from 1824 to 1904.

The possibility of diverting Colorado River water to irrigate the Imperial Valley was first raised in 1853. The first diversion canal and irrigation system was constructed by the California Development Company (CDC) (Dowd 1956, Starr 1990), and construction on the Alamo or Imperial canal, as it was known, began in August 1900. By January 1, 1905, over 80 miles of main canals and over 700 miles of distribution canals had been constructed in Imperial and Mexicali valleys (Dowd 1956).

Portions of the Sonny Bono Salton Sea NWR were formerly managed as the Salton Sea Test Base. Military use of the Salton Sea area began as early as 1939, when the U.S. Navy established a seaplane area for bombing practice and emergency landings. A larger seaplane base, the Naval Air Facility, was established on the southwestern shore in 1942. In 1944, the base was upgraded to a Naval Auxiliary Air Station (NAAS), with the construction of a larger airfield for land-based planes and a barracks. After the end of World War II, in 1946 the NAAS was disestablished, but it was maintained as an emergency seaplane facility and various new facilities were constructed. In the 1960s, the facility was taken over by Naval Air Facility El Centro (Apple et al. 1997, Osbourne 2002, Shettle 1997).

4.6.6 Existing Cultural Resources Investigations and Research

4.6.6.1 Overview

A total of 54 reports documenting cultural resource studies on and within a 0.5-mile radius of the Sonny Bono Salton Sea NWR and the Coachella Valley NWR are on file at the Information Centers of the California Historical Resources Information System. Thirteen of these reports concern studies in or near the Sonny Bono Salton Sea NWR, and 41 relate to the Coachella Valley NWR.

A review was also conducted of historic maps prepared for the areas that include the two Refuges. Maps created between 1854 through 1856 and 1908 offered a general overview of the area but did not show Euro-American settlements in the southern portion of the present-day Salton Sea or in the vicinity of the Coachella Valley NWR.

4.6.6.2 Sonny Bono Salton Sea NWR

The majority of the lands and waters within the Sonny Bono Salton Sea NWR have not been the subject of a comprehensive cultural resource survey. This includes the currently unsurveyable areas below the Salton Sea and all of lands and waters within Units 1 and 2. The small areas of upland located along the western edge of the Salton Sea that are included within the Refuge

boundary were surveyed in 1997 as part of the Archaeological Survey and Evaluation Program for the Salton Sea Test Base (Apple et al. 1997). Despite the limited survey work that has occurred here, several cultural sites have been recorded within the Refuge. Specifically, portions of nine sites (two prehistoric and seven historic), an archaeological district, and three isolates have been recorded within the boundaries of the Refuge. The Southwest Lake Cahuilla Recessional Shoreline Archeological District, listed on the National Register of Historic Places (NRHP), encompasses a portion of the Refuge, and two of the contributing sites are located within the Refuge boundary. The seven historic period sites identified during the record search conducted for the CCP include military features, as well as ponds and salt deposits. The isolates include lithic and ceramic artifacts or small scatters.

Of the structures present on the Refuge today, the Refuge House is more than 50 years old. This 2,068 square-foot, single-family residence was constructed in 1951 and has not been evaluated for listing on the NRHP.

Also not recorded or evaluated as historic sites are portions of a small number of agricultural drains, canals, and levees shown on USGS maps to be located within the Sonny Bono Salton Sea NWR at the south end of the Salton Sea. These irrigation features of probable significance include the Pumice Drain, Trifolium Drain and Lateral One, 13, 14, and 15, and Vail Drain and Lateral 4-A. The very northern portion of the Westside Main Canal is also located in the far western end of the Refuge where it enters the Salton Sea. These features represent but a small portion of the complex water delivery system in the Coachella and Imperial valleys that irrigate some of the most productive agricultural land in the United States. Although additional research is needed prior to evaluating these structures, it is likely that all these elements were put in place at the time of the early takeover of the mutual water companies after 1911 and the period of early upgrade and expansion of the irrigation network between 1923 and 1930.

The laterals, drains, and minor levees in the Refuge are among the hundreds of similar features that make up the IID water distribution system. They provide water to irrigate these lowest-lying areas of arable lands and also drain salt-laden run-off. The main canals, most notably the Eastside, Westside, and Central Main Canals, are primary components of the irrigation system, feeding water from the All-American Canal to all of the laterals. Water flow is controlled by means of checks and delivery gates throughout the system. From these laterals, farmers then divert water to specific fields by several methods, including small irrigation ditches fed by siphon tubes, area flooding, pumps, and sprinkler systems. The main canals retain integrity of location, setting, feeling, and association more than any other elements within the IID and represent major engineering components on a scale comparable to the All-American Canal. In their current form within the Refuge, the outflows of the New and Alamo rivers into the Salton Sea represent terminal but principal elements of the water distribution network associated with the All-American Canal, completed in 1942.

All of these elements likely have been maintained and upgraded in subsequent years, records for which can be found at the IID. However, they retain integrity of location, setting, feeling, materials, and association after more than 75 years. Any gates, checks, or other hardscape elements are likely to have been replaced and may no longer have integrity of materials, but this would need to be determined by field and archival investigations. This irrigation system has been pivotal to the development of agriculture and population within the Imperial Valley, without which extensive habitation in the region would not have been economically feasible (US Bureau of Reclamation 1955).

4.6.6.3 Coachella Valley NWR

Cultural resource surveys within the boundaries of the Coachella Valley NWR are generally limited to narrow strips of land along the perimeter of the Refuge boundary. These areas were most likely surveyed as part of adjacent development proposals. Surveys have also been conducted along the utility corridor that extends through the northeastern corner of the Refuge. Three historic sites and two isolates have been recorded within the limits of the Refuge. The historic period sites include a house site and two refuse scatters. The isolates are two prehistoric potsherds.

During 1855, surveyors determined the township and section lines for Township 4 South, Range 6 East, which includes land now designated as the Coachella Valley NWR. They indicated an "Indian Trail" that extended through the township in a southeasterly direction through Section 24, which appears to lie just inside the Refuge boundary. A series of resurveys occurred between December 1911 and March 1915, but these did not indicate historical resources within the current Refuge boundary. A 1942 survey also did not indicate historic resources within the Refuge. The only structures known to be present on the Refuge today include a shed and pump house, both of which were constructed around 1975, prior to acquisition of the land by the Service. These structures are not used for Refuge purposes.

4.6.7 Native American Sacred Sites

Within the Sonny Bono Salton Sea NWR, no sacred sites or known ceremonial locations are currently identified, although any archaeological sites, both known and to be discovered in the future, are likely to be of historical and cultural interest to people of Kamia, Tipai, and Quechan affiliation. Tribal members have expressed interest in the nearby obsidian source of Obsidian Butte, for example. Of particular ethnohistorical interest is an expedition by naturalist John L. LeConte in October of 1850 to the area where the New River emptied into the lower portion of the Salton Trough, then occupied by an ephemeral pan known as the "Salt Lake" (LeConte 1855). This location may be within or adjacent to the Refuge, possibly even submerged by the Salton Sea. The purpose of LeConte's visit was to examine the geothermal mud volcanoes (a.k.a. "mud pots"). Near the northern termination of the New River, probably at a location now drowned by the Salton Sea, he visited a Kamia village of some 50 people who provided gifts of musk melons, beans, and pumpkins that he observed they grew in abundance. Several Quechan from the Colorado River were visiting at the time.

Although the Thousand Palms Village (Cahuilla *Yum ich you*: "brushy") is not within or immediately adjacent the Coachella Valley NWR, the canyon in which it lies drains down to the Refuge and trails to the village evidently passed through the Refuge. The areas in and around the Thousand Palms Village continues to be particularly meaningful to Cahuilla Indians (Bean and Vane 1978).

4.7 Social and Economic Environment

Elements of the social and economic environment include land use, public safety, traffic circulation, public utilities/easements; public access and recreational opportunities, vectors and odors, economics/employment; and environmental justice.

4.7.1 Land Use

This section discusses existing land uses that occur within and adjacent to the Refuge. The relevant land use policies of surrounding municipalities, as well as applicable regional policies are discussed.

4.7.1.1 Sonny Bono Salton Sea NWR

Current Uses on the Refuge

The Sonny Bono Salton Sea NWR encompasses 37,658 acres of land, with the majority of the Refuge activities occurring along the south side of the Salton Sea in either Unit 1 or Unit 2 of the Refuge. The properties located in Units 1 and 2 include approximately 3,916 acres owned by IID and 615 acres owned by the State of California, all of which are leased to the Service for management as a national wildlife refuge, as well as 721 acres of land that is owned in fee title by the United States and under the jurisdiction of and managed by the Service.

Original Refuge Area (Circa 1930). With one minor exception, the area originally designated as the Salton Sea Wildlife Refuge in 1930 has long since been inundated by the waters of the Salton Sea. Uses in this area are limited to wildlife use and occasional boating activity. Some fishing activity may still occur in this area. Since 1995, water levels in the Salton Sea have been declining and more rapid declines are anticipated starting in 2017. As a result, at some point in the future areas of the Refuge that are currently inundated may once again be exposed.

Among the group of parcels located within the area originally established as the Refuge, there is one parcel that includes a portion of desert upland habitat at the western edge of the Sea. This area, located approximately six miles south of Salton City, supports relatively good quality desert scrub habitat and requires minimal management.

Unit 1. Unit 1 of the Refuge includes two areas: a larger 3,225-acre area, which includes Bruchard Bay, the mouth of the New River, and upland areas to the south; and a smaller area (555 acres) located to the north of the terminus of Bowles Road. Ownership in Unit 1 includes lands owned by the Service and lands leased from IID. The 555-acre portion of Unit 1 is not actively managed and is closed to public access, while the larger portion of Unit 1 supports a variety of managed habitats and provides opportunities for wildlife-dependent recreational uses.

Managed areas within the largest portion of Unit 1 include agricultural fields that provide winter forage for geese, impoundments that support seasonal wetlands, and impoundments that support freshwater cattail marsh habitat. A few nesting islands are located within the open water wetland areas at the north end of Unit 1.

Wildlife-dependent recreational uses in Unit 1 include wildlife observation, photography, and interpretation; all located in the southwestern portion of the Unit. Two observation platforms and a parking area are provided at the terminus of Vendel Road and just to the southwest, a 0.5-mile loop trail extends around a managed freshwater cattail marsh. Two photo blinds are accessible from this trail.

Unit 2, Salton Sea/Red Hill Bay Area. Approximately 940 acres of Unit 2 include areas that are currently or have recently been inundated by the Salton Sea.

Unit 2, Headquarters. Approximately 18 miles to the east of Unit 1, is Unit 2, which includes areas of the Refuge referred to as the Union Tract, Hazard Tract, and the headquarters site. As the name implies, the Refuge Complex headquarters is located on the headquarters site, which encompasses approximately 155 acres. The Refuge Complex headquarters is located along the south end of the Salton Sea at the northwest corner of the intersection of Gentry Road and W. Sinclair Road, approximately 5.5 miles west of Highway 111.

Uses include refuge offices, a visitor contact area, various facilities to support refuge operations and maintenance, and managed and natural habitat areas. A small public parking lot, picnic area, public restroom, and observation platform are provided at the front of the Refuge Complex headquarters to support public use, and a two-mile trail extends from the parking area to the top of Rock Hill where views of the Salton Sea and distance mountain ranges are quite spectacular.

Managed habitats in the Headquarters area include agricultural fields managed to support wintering geese, managed open water areas that include islands to support nesting seabirds, and an area of managed freshwater cattail marsh that supports Yuma Ridgway's rail and other marsh birds.

Unit 2, Union Tract. The Union Tract is located to the southwest of headquarters site. This area includes 265 acres, most of which are leased from IID. The majority of this area is managed to provide forage for wintering geese. In the northwest corner, adjacent to the existing seawall, is an area of managed freshwater marsh, and a relatively narrow area of managed seasonal wetland extends between the area's two large managed agricultural fields. Just to the west of the seasonal wetland is a drainage channel (part of the Vail lateral drain system) that extends north/south through the Union Tract. At West Sinclair Road, this channel turns east, following along the south side of West Sinclair Road. White geese and waterfowl hunting are permitted within a portion of this area and the hunting program is managed by CDFW.

Unit 2, Hazard Tract. The Hazard Tract, located to the east of Garst Road and the south of West Schrimpf Road, includes approximately 660 acres of land managed for waterfowl, shorebirds, and Yuma Ridgway's rail. This land is leased from CDFW. This area includes a portion of the Alamo River channel and associated unmanaged areas supporting oxbows, permanent open water ponds, and seasonal wetlands. The Hazard Tract is also one of the Refuge's designated waterfowl hunting areas, with the hunting program managed by CDFW. The details of the Refuge's hunting program are described under "Recreation."

Uses Surrounding the Refuge

The majority of the uses within the uplands surrounding the Refuge are agricultural uses or activities associated with agriculture, including private croplands, pastureland, and portions of the Imperial Valley's extensive network of agricultural drains and irrigation channels.

Geothermal development is also an important use in the area, with 10 geothermal plants currently located in the immediate vicinity of Unit 2. Under California's new Salton Sea Ecosystem Restoration Program, additional geothermal development is being considered near the Refuge (CDWR and CDFG 2007):

> *Field investigations have indicated that additional generation facilities could be successfully constructed in currently inundated areas of the Sea Bed after the water recedes. One of the areas that may include significant geothermal resources is located between the New and Alamo rivers along the southern shoreline. A portion of this area is located within the Sonny Bono Salton Sea National Wildlife Refuge, and most of the area is used extensively by many species of birds. Placement of Saline Habitat Complex and geothermal development in this area could require very specific mitigation measures to avoid conflicts with geothermal facilities, including power transmission lines and other facilities.*

Geothermal development will be extremely important in California and other southwestern states as part of a mosaic of energy sources to meet increasing energy demands. Therefore, the Preferred Alternative includes an area between the New and Alamo rivers without Saline Habitat Complex to reduce potential conflicts between geothermal development and habitat criteria. The geothermal development area would avoid the Sonny Bono Salton Sea National Wildlife Refuge lands and areas with pupfish connectivity in the drains.

Hunting (e.g., dove, waterfowl, quail) on adjacent and nearby private lands is a seasonal use occurring in the area. Private duck clubs also operate on nearby lands to the east and north of Unit 2 (The Redlands Institute 2002). Hunting also occurs within the Imperial Wildlife Area, which encompasses about 8,000 acres, located on three separate units to the south- and north-east of the Refuge. Hunting in this area is managed by CDFW. All of these sites are devoted to improving waterfowl production. To the west of Unit 1, beyond irrigated cropland, is the San Felipe delta, one of the best freshwater natural wetlands in the Salton Sea area (The Redlands Institute 2002).

Nearby Developed Areas

Areas developed for residential and commercial use in proximity to the Refuge include the cities of Calipatria (located seven miles to the southeast of the Refuge Complex headquarters) and Westmoreland (located about 9.5 miles south of the Refuge Complex headquarters), both with populations under 10,000; the small town of Niland (located seven miles to the northeast); and the city of Brawley (located about 14 miles south of the Refuge Complex headquarters), with a population of 22,000. Imperial County's population in 2008 was estimated at 176,158, an increase from 143,896 estimated in 2000 (CEDD 2008). The nearest metropolitan area is Mexicali, Mexico (across the border from Calexico), with a metropolitan population of about 900,000. To the north in Riverside County, small communities are scattered along the shoreline of the Salton Sea.

The U.S. Navy continues to own most of the lands at the southwest corner of the Salton Sea, the site of the now abandoned Salton Sea Test Base (CDWR and CDFG 2006). Once an active weapons testing and training ground, the Base's 36,600 acres of surface and submerged lands were designated for closure in 1989. In 2000, BLM received 5,840 acres of the U.S. Navy site.

Tribal lands owned and managed by the Torres Martinez Indian Reservation occur in a checkerboard ownership pattern at the northwest end of the Salton Sea and shoreline; of the Reservation's 24,000 acres, about half are currently inundated.

Local and Regional Planning

Land use planning is carried out by Imperial County for all unincorporated lands in the County (CDWR and CDFG 2006), including those located in proximity to the Refuge. In 2006, of the County's 4,600 square miles, 74 percent were undeveloped or publicly owned, 17 percent supported irrigated agriculture, municipalities occupied 1 percent, and the Salton Sea covered about 8 percent. The County's General Plan (Imperial County 1993) promotes the economic priority of agricultural production, expanding appropriate urban development centers, and preserving the unique cultural and natural resources of the Imperial Valley.

The Imperial County General Plan Land Use Map indicates that the lands within the Sonny Bono Salton Sea NWR have been designated as "Government/Special Public," "Recreation/Open Space," or "Agriculture" (Imperial County 2007). The lands located between Units 1 and 2 are designated Recreation/Open Space, while to the south the land is designated for agricultural uses.

The Southern California Association of Governments (SCAG) is responsible for regional planning in Imperial County, as well as five other counties in Southern California, including Los Angeles, Orange, San Bernardino, Riverside, and Ventura (SCAG 2008a). As the designated Metropolitan Planning Organization, SCAG is mandated by Federal and State law to research and draw up plans for transportation, growth management, hazardous waste management, and air quality. In 2008, SCAG updated its voluntary Regional Comprehensive Plan, which is a strategic plan for defining and solving the region's inter-related housing, traffic, water, air quality, and other issues (SCAG 2008b).

4.7.1.2 Coachella Valley NWR

Current Uses on the Refuge

Uses on the Coachella Valley NWR include an equestrian trail along the western and northern borders of the Refuge, limited habitat management, and occasional guided tours within the dune habitat. Vehicle travel on the Refuge is prohibited and no parking areas or buildings are present within the Refuge boundary.

Uses Surrounding the Refuge

The lands to the north and southeast of the Refuge consist primarily of conserved lands managed by BLM or CDFW, as indicated in Figure 4-24, or are currently vacant, privately held lands. To the east, south, and southwest of the Refuge, much of the area has been developed and supports moderate to low density residential development, limited commercial development, and a golf course. There is one small agricultural area located to the east of the Refuge, just to the north of existing residential development. The majority of the development in this portion of the Coachella Valley occurs south of I-10.

Local and Regional Planning

The Coachella Valley is located in the unincorporated eastern portion of Riverside County, about 100 miles east of Los Angeles. Riverside County covers over 4.7 million acres (7,310 square miles), while the Coachella Valley MSHCP planning area, which includes the valley and the surrounding mountains up to the ridgeline, encompasses approximately 1.2 million acres, (approximately 1,850 square miles). The Coachella Valley MSHCP area boundaries maximize inclusion of the Coachella Valley watershed, which largely represents the local and regional environment for the Refuge. It is estimated that 6 percent of the MSHCP area is currently urbanized, 1 percent is in rural development, 7.5 percent (84,852 acres) is in agriculture, and 0.5 percent supports wind energy development. Approximately 28 percent is vacant land under private or public non-conservation ownership (CVAG 2007b). Of the remaining land included within the Coachella Valley MSHCP, four percent is covered by the Salton Sea and 53 percent is public or private conservation land.

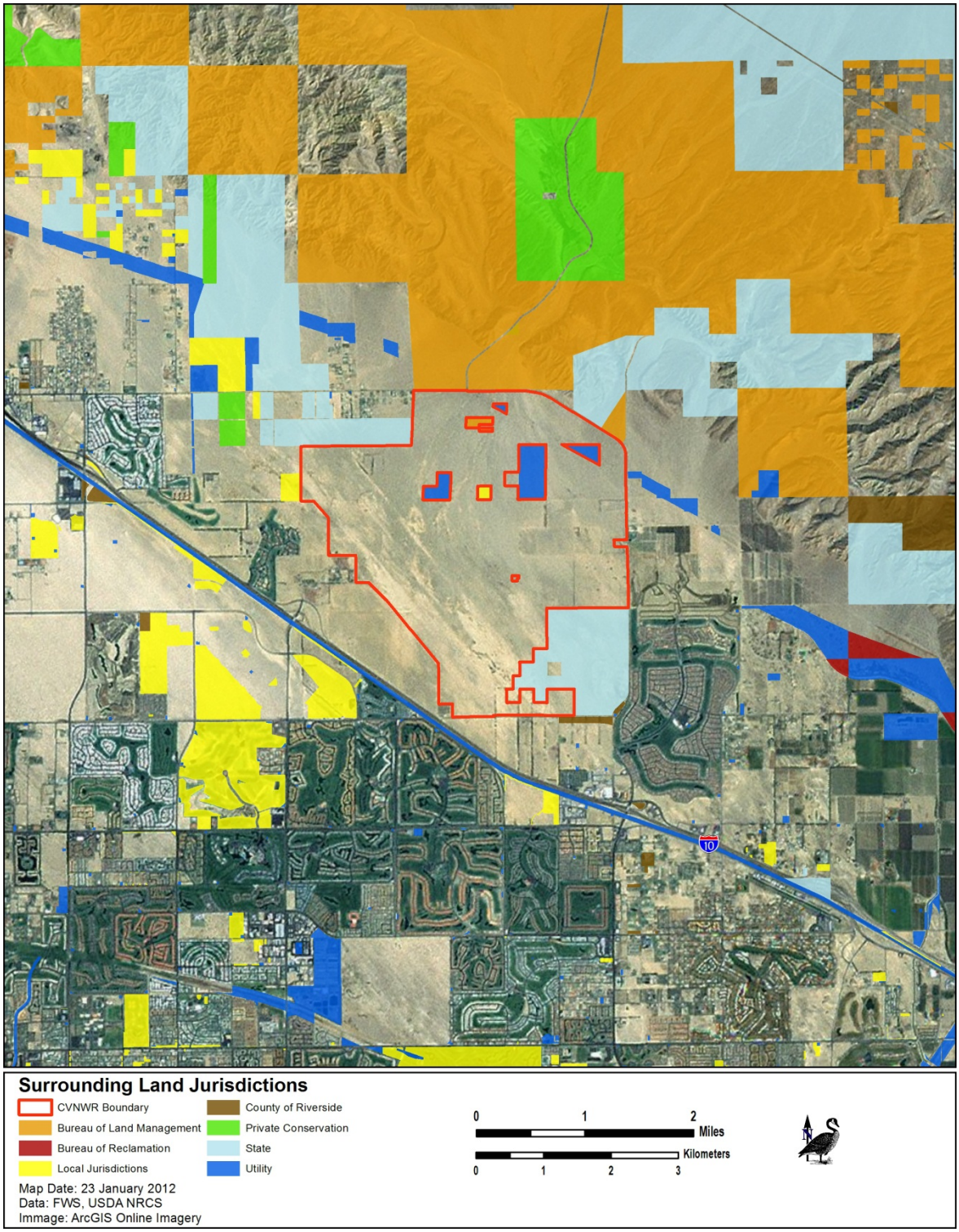


Figure 4-24. Developed and Conserved Lands in Proximity to the Coachella Valley NWR

4.7.2 Recreational Opportunities

4.7.2.1 Sonny Bono Salton Sea NWR

Recreation has historically been a popular use of land and water in and around the Salton Sea (CDWR and CDFG 2006). Private marinas, campgrounds, mineral spas, and recreational vehicle parks are found nearby. The Salton Sea State Recreation Area, managed by the California State Parks, contains 14,100 acres (2,460 acres under water) and is located along 15 miles of the northeastern shoreline of the Salton Sea. Federal lands of the California Desert Conservation Area (CDCA), mostly located on the surrounding mountains, are protected and managed primarily by BLM for wildlife, open-space, and recreation; the CDCA boundary also encompasses private, state, and other federally managed lands.

The major public hunting areas in the vicinity of the Refuge are part of the Imperial Wildlife Area, managed by CDFW. The Imperial Wildlife Area includes the Wister Unit and the Finney-Ramer Unit. The Wister Unit is located on the east side of the Salton Sea along Highway 111, five miles northwest of Niland. This area, managed by CDFW, provides opportunities for fishing, wildlife observation, and waterfowl, quail, dove, and pheasant hunting. The Finney-Ramer Unit, located along the Alamo River south of Calipatria, provides opportunities for waterfowl hunting from boats. Opportunities for hunting also exist on some private lands in the vicinity of the Refuge.

Two areas are open seasonally for waterfowl hunting on Unit 2 of the Refuge, including approximately 350 acres on the Hazard Tract and 130 acres on the Union Tract. Within the Union Tract, the primary target is white geese (snow geese and Ross' geese), while a wider range of waterfowl are present within Hazard Tract. The hunting program generally accommodates about 1,000 hunter visits per year. With this level of use, about half of the blinds are not filled during most of the season on the Hazard Tract. The Union Tract hunting blinds are filled more frequently, reaching 100 percent capacity on all open hunt days late in the season.

Hunting is permitted on Saturdays, Sundays, and Wednesdays during the open season, and ducks, geese, brant, American coots (*Fulica americana*), and common gallinules (formally common moorhens) may be hunted. Hunters must comply with the State of California's "Waterfowl and Upland Game Hunting & Department Lands Public Use Regulations," which are updated annually, including the specific regulations addressed in the section entitled, National Wildlife Refuges with DFG Hunting Programs.

Fishing from boats is permitted in the Salton Sea, but increasing salinity levels have eliminated most of the once abundant sport fish species in the Sea. Tilapia is now the most abundant sport fishing species remaining in the Sea.

Red Hill Marina Park, operated by Imperial County, is a 10-acre park on the southeastern shores of the Salton Sea, northwest of Calipatria. The park, which is accessed from Garst Road, provides recreational vehicle hookups, a designated camping area, restrooms, ramadas, picnic tables, and opportunities for shoreline fishing. The boat launches at this site are not currently operational due to receding water levels in the Salton Sea.

The majority of the visitors to the Refuge participate in wildlife observation. Situated along the Pacific Flyway, the Salton Sea provides year round opportunities for observing birds. The area supports significant numbers of migratory shorebirds, waterfowl, and other waterbirds, and provides nesting areas for summer visitors including terns and gulls and foraging areas for winter visitors such as snow geese and sandhill cranes. In addition, upland areas support a variety of resident and migratory land birds. Over 400 species of birds have been observed at the Sea and

surrounding area, making the Sea and its environs a birding area of year-round international importance. To support wildlife observation and photography, the Refuge provides two elevated observation platforms, an interpretive loop trail, and two photo blinds in Unit 1, and an elevated observation platform and interpretive trail in Unit 2. Table 4-17 provides estimated annual visitation numbers for various years between 2005 and 2011.

Table 4-17
Annual Visitation to Sonny Bono Salton Sea NWR

Year	Number of Visitors
2005	27,616
2007	29,500
2009	28,000
2011	27,000

4.7.2.2 Coachella Valley NWR

Recreational opportunities in the vicinity of the Coachella Valley NWR are available at a range of sites, including developed community parks, golf courses, riding and hiking trails, and natural open space areas. The closest developed park to the Refuge is the Thousand Palms Community Center and Park is located to the northwest, to the north of East Ramon Road and east of I-10. Other developed parks in the general vicinity include the Palm Desert Community Center and Gymnasium and the Bermuda Dunes Community Center.

Recreational opportunities that focus on wildlife and natural open space can be found at the Coachella Valley Preserve, located to the northeast along Thousand Palms Canyon Road. Here the public has access to interpretive trails and a visitor center. Opportunities for observing wildlife and native desert and desert oasis habitats are also provided. Public lands in the area managed by BLM, California State Parks, and CDFW also provide opportunities for hiking, equestrian trail riding, and wildlife observation. No opportunities for hunting occur in the vicinity of the Refuge.

4.7.3 Transportation/Traffic Circulation

4.7.3.1 Sonny Bono Salton Sea NWR

The primary transportation routes to the Refuge include:

1) From the northeast and southeast, access to the Complex headquarters is available via Highway 111, then west on West Sinclair Road to its terminus at Gentry Road;
2) From the northwest, access is available to the Complex headquarters and Unit 1 from State Route 86, then east on West Bannister Road from there, Unit 1 is accessed via Vendel Road north and the Complex headquarters can be accessed by a variety of county maintained two-lane roads; and
3) From the southwest, access is also available from State Route 86, Highway 111, and a variety of county maintained two-lane roads.

The routes available to access the Refuge have adequate capacity to handle the trips generated by visitors, staff, and vendors traveling to and from the two units of the Refuge.

According to the Imperial County Bicycle Master Plan (Imperial County 2003), a Class II bike route is proposed that when completed will provide bicycle access to the Refuge headquarters site. A Class II bikeway, often referred to as bike lanes, incorporates a bicycle trail into existing travel

lanes by providing striping, stenciling, and signage to demarcate the bicycle travel lane along the edge of the roadway. The proposed bike lanes, which are designated in the Bicycle Master Plan as Route 7 (Sinclair/Gentry/Rutherford/Highway 111), is a loop route that will extend north from Calipatria to Sinclair Road, then west to Gentry Road (the entrance to the Refuge headquarters), south to Westmorland, east to Highway 111, and north back to Calipatria. This route is also proposed to connect to other routes, including those that provide access to Brawley, Imperial, and El Centro.

4.7.3.2 Coachella Valley NWR

The unique geography and linear distribution of communities in the Coachella Valley are the primary influences and constraints that have shaped the regional roadway network. The valley is a northwest-southeast trending geologic basin, bounded by mountains on the north, west, and south, which impose significant physical restrictions on roadway planning and construction opportunities. The communities of the Coachella Valley (with the exception of Desert Hot Springs) are largely distributed in a continuous and linear pattern across the southerly portion of the valley. They are connected by state and interstate highways, most notably I-10 and Highway 111, and a web of arterial roadways built on a north-south/east-west grid pattern (CVAG 2007b). Portions of this transportation network are subject to high traffic volumes and peak hour congestion.

The Refuge is bounded on the east and northeast by Washington Street, a four-lane, county maintained road, and on the north by East Ramon Road, a two-lane, county maintained road. Access to I-10 is available either directly or indirectly from these roads and both roads provide access to Thousand Palms Canyon Road, which extends to the northeast. A less traveled, two-lane local street (38th Avenue) extends along a portion of the Refuge's southern boundary. The motorized transportation routes available to access the Refuge have adequate capacity to handle the limited trips generated by occasional visitors, staff, and biological monitors to the site.

There is also a non-motorized transportation plan for the Coachella Valley that designates alignments for bikeways and trails throughout the area. This plan was completed in 2001 and updated in 2010 (CVAG 2010). The plan designates a Class II bikeway route for the segments of East Ramon Road and Washington Street that border the Refuge. The non-motorized transportation plan also addresses equestrian and hiking trails and includes a proposed trail along the western and northern portions of the Refuge. This trail alignment was evaluated and approved in 1990 by BLM (1989) and Service (USFWS 1990) for use by equestrians and is considered an existing equestrian trail within the Refuge boundary.

4.7.4 Public Utilities/Easements

4.7.4.1 Sonny Bono Salton Sea NWR

Water. As described by the Imperial County General Plan (Imperial County 2008b), "Since its inception, the history of Imperial County has been tied to the availability of water from the Colorado River for agriculture. Agriculture is the County's main economic activity and for the foreseeable future will remain its dominant activity . . . The availability of water will play an important role in determining the population and economic growth of Imperial County." The future availability of water for Refuge operations was described previously; therefore, this section addresses water distribution.

Today, IID provides raw Colorado River water for irrigation and also for non-potable residential and industrial use. Agriculture accounts for most of the water consumed in Imperial County, with a history of more than 2,500,000 acre-feet of water supplied annually for agricultural purposes.

This represents approximately 98 percent of the water diverted to Imperial County by the IID (Imperial County 2008b). Potable water delivered for residential and commercial uses is treated and distributed by the individual cities and unincorporated areas within the County.

Power. Electrical power is supplied to the Refuge by the IID. The IID provides service to residential, commercial, and industrial users in most of the Imperial County from conventional fuel sources, as well as hydroelectric, steam, geothermal, and nuclear sources. In 2006, more than 30 percent of IID's power was derived from its own local power generation facilities (Imperial County 2008a). As of 2010, when nine photovoltaic arrays were installed on Refuge headquarters buildings, the Refuge has also been generating a portion of its own electrical power. The Refuge also purchases propane to fuel the on-site incinerators and the north bunkhouse.

Natural gas is delivered by the Southern California Gas Company via twin ten-inch lines which generally run south through the County in Range 14 East. These lines serve Niland, Calipatria, Brawley, Imperial, El Centro, Heber, and Calexico; and branch lines serve Holtville, Westmorland, Seeley, NAF, and Plaster City. Rural residents are served by laterals from the branch lines. The lateral lines typically do not exceed a quarter mile in length.

Solid Waste. The Resource Conservation and Recovery Act of 1976 is the principle Federal law governing the disposal of solid waste and hazardous waste (Title 40, Code of Federal Regulations, Part 14 260). This law establishes state responsibility for regulating nonhazardous wastes. It also addresses the generation, transportation, storage, and disposal of hazardous waste through a comprehensive "cradle-to-grave" system of hazardous waste management techniques and requirements. Although the USEPA is responsible for implementing the law, this task has been delegated to the California Department of Toxic Substances Control in California.

The California Integrated Waste Management Act of 1989 (Assembly Bill [AB] 939) regulates nonhazardous solid waste and requires that solid waste generated in the State be reduced, recycled, and reused to the maximum extent feasible in an efficient and cost-effective manner to conserve natural resources, protect the environment, and improve landfill safety. Under this bill, cities and counties in California were required to reduce 50 percent of their waste stream by 2000.

Landfills accepting solid waste are classified as Class I, Class II, and Class III. Class I landfills are designated specifically for the dumping of hazardous wastes, while Class II landfills are used for designated and/or special waste, including biosolids. A Class III landfill is designated for the dumping of nonhazardous wastes, such as municipal waste. Imperial County currently operates ten Class III landfills (Imperial County 2008a). Trash collection and recycling services in the area are supplied by Allied Waste Management. Two Class I landfills are located in California: Safety Kleen's Buttonwillow Landfill in Kern County and Chemical Waste Management's Kettleman Hills Landfill in Kings County. If the Refuge were to have some future need to disposal of hazardous materials, the material would be properly transported to one of these two facilities.

4.7.4.2 Coachella Valley NWR

Water. Public water services and facilities in the Coachella Valley are provided by a number of public and quasi-public agencies that ensure a coordinated system of services for valley residents and businesses, although scattered development in outlying areas of the Coachella Valley relies upon privately owned, deep well and reservoir delivery systems (e.g., Desert Hot Springs, Sky Valley, Indio Hills). The CVWD is the principal domestic water provider serving the Coachella Valley, and other water purveyors serve the remainder of the valley. Since the late 1940s, the CVWD has provided imported Colorado River water for irrigation purposes to agricultural lands in the eastern valley via the Coachella Branch of the All-American Canal. Colorado River water is

imported via the Colorado River Aqueduct (which extends across the northerly portion of the valley) to artificially recharge the regional groundwater basin (CVAG 2007b).

There are two old agricultural wells on the Refuge that were used to irrigate farm fields prior to acquisition of the property. The wells are not currently being used and will be dismantled, covered, and possibly used for monitoring water table levels in the future.

Sewage. Sewage collection and treatment services are provided throughout the Coachella Valley by several agencies such as the CVWD, Desert Water Agency, and Mission Spring Water District. The long-term use of on-lot septic systems has been associated with groundwater contamination in isolated areas of the Coachella Valley, including the Cathedral City Cove. The greatest potential impacts on groundwater quality are expected to occur where poorly maintained septic systems serve relatively large populations in high densities (CVAG 2007b).

Power. Southern California Edison (SCE) is the primary electric service provider for the upper Coachella Valley. SCE derives its power from cogeneration, geothermal, hydroelectric, solar, and wind sources. SCE's largest transmission lines pass through the Coachella Valley along an east-west trending utility corridor, which is roughly parallel to I-10. This transmission corridor cuts through the northeast corner of the Refuge within a dedicated easement. Although the lines and associated facilities pass directly through high wind hazard zones and natural blowsand corridors, these facilities have not been shown to significantly obstruct blowing sand (CVAG 2007b).

Natural gas is used for space heating, domestic and commercial hot water, cooking, air conditioning, and various industrial applications. The Gas Company (Sempra Energy) provides natural gas services and facilities to much of the Coachella Valley.

Solid Waste. The largest provider of solid waste management services in the Coachella Valley is Waste Management of the Desert. Most cities in the valley have implemented a comprehensive recycling program, which has proven beneficial in the preservation of landfill space (CVAG 2007b).

4.7.5 Health/Safety

This section addresses issues related to human and wildlife health.

4.7.5.1 Sonny Bono Salton Sea NWR

Fish Advisories. The California Office of Environmental Health Hazard Assessment (OEHHA) has issued safe eating guidelines for fish from the Salton Sea. OEHHA recommends the consumption of no more than two servings of fish from the Salton Sea per week. The 2012-2013 Freshwater Sport Fishing Regulations issued by CDFW includes the same recommendation, citing the levels of selenium detected in the fish present within the Salton Sea as the reason for this advisory (nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=41442).

Air and Dust-Borne Diseases. Two airborne diseases and public health risks potentially exist within the study area – valley fever (or coccidiomycosis) and Hantavirus cardiopulmonary syndrome (HCPS). Valley fever is a fungal infection caused by coccidioides organisms. It can cause fever, chest pain and coughing, among other signs and symptoms. The coccidioides species of fungi that cause valley fever are commonly found in the soil in certain areas. Coccidiodes organisms can grow under environmental extremes of temperature, salinity, and alkaline conditions. These fungi can be stirred into the air by anything that disrupts the soil, such as farming, construction, and wind. Airborne spores can be inhaled into the lungs, where they multiply and grow. Most people who breathe the spores (about 60 percent) develop no symptoms

at all. The rest develop flu-like symptoms. Without treatment, valley fever can lead to severe pneumonia, meningitis, and even death. However, when properly treated at the first sign of symptoms, most people will recover without problems. Once infected, the body usually establishes lifetime immunity against future infections. The disease is not contagious, so it cannot spread from one person to another.

HCPS, identified by the Vector-Borne Disease Section of the California Department of Public Health (CDPH) as the most important rodent-borne disease in California, is a rare, but often fatal, disease of the lungs. HCPS was first recognized in 1993 in the southwestern United States. HCPS infections are associated with domestic, occupational, or recreational activities that bring humans into contact with rodents and their excreta, usually in rural settings in poorly ventilated buildings. Between 2001 and 2010, there were no reported HCPS cases in Imperial County (CDPH 2010).

Diseases Affecting Avian Species at the Salton Sea. Avian disease outbreaks were quite frequent between 1992 and 2004 at the Salton Sea, with the bird (and fish) die-offs between 1992 and 1999 described as "catastrophic" by the State of California (CRWB 2003). According to the Salton Sea Authority, bird diseases were first reported in the 1920s (SSA 2008). Bird diseases most commonly seen and with greatest mortality are botulism type C and avian cholera, followed by Newcastle Disease virus. Occasional instances of the bacterial infection salmonellosis (*Riemerella anatipestifer*) and botulism type E, as well as unknown diagnoses, have also occurred in the past 14 years (USGS 1995-2008). The role of contaminants in bird die-offs is also being investigated (Roberts 1997b, Audet et al. 1999).

The National Wildlife Health Center tracks avian mortality reports from around the U.S. and indicates the date, location, species, mortality number, and diagnosis in its quarterly annual records (USGS 1995-2008). For the Salton Sea area and the Sonny Bono Salton Sea NWR, Table 4-18 lists the major (greater than 100) bird mortality events between 1992 and 2008.

The frequency and size of major avian disease mortalities declined after 2005. No theories for this apparent decline have been proposed. As observed by the Salton Sea Authority, the numbers of bird deaths due to disease began increasing after 1987, sharing a pattern observed worldwide (SSA 2008). Of the identified causes, type C botulism has killed the greatest number of birds. However, the 1992 eared grebe die-off, which resulted in the estimated loss of 150,000 eared grebes, remains the single largest mortality in recent decades. Some of the grebes collected later in that event showed signs of avian cholera, but birds that died early did not display the typical lesions. Although this does not rule out avian cholera as the cause of this die-off, as with most eared grebe mortalities, the diagnosis cannot be confirmed (Audet et al. 1999, USGS 1995-2008).

Avian botulism is a disease known to paralyze birds and often be fatal after they ingest toxin produced by the bacterium, *Clostridium botulinum* (USGS 1999). Die-offs of waterfowl are most often caused by type C toxin, though occasional die-offs among fish-eating birds (such as gulls and common loons [*Gavia immer*]) have been caused by type E. Type C botulism bacterial spores are broadly distributed in wetland sediments and in the tissues of most wetland wildlife (invertebrates and vertebrates). Production of toxin occurs when the spores germinate.

Table 4-18
Avian Disease Mortality Events at the Salton Sea or Sonny Bono Salton Sea NWR, 1992-2008[1]

Year	Bird Species	Estimated #	Diagnosis
1992[2]	Eared grebe	150,000	Uncertain
1993-1994	(No records)		
1995	Eared grebe	2,000	Open
1996	American white pelican, brown pelican, great egret (*Ardea alba*), ring-billed gull (*Larus delawarensis*), unidentified gull	14,109	Botulism type C
	Ruddy duck (*Oxyura jamaicensis*), northern shoveler, black-necked stilt, green-winged teal (*Anas crecca*), unidentified gull	1,000	Avian cholera
1997	Eared grebe	4,980	Open
	Ruddy duck, northern shoveler, snow goose, American coot (*Fulica americana*), green-winged teal	957	Avian cholera
	Ring-billed gull, American white pelican, brown pelican, western sandpiper, California gull (*Larus californicus*)	2,264	Botulism type C
	American white pelican, Clark's grebe (*Aechmophorus clarkii*), surf scoter (*Melanitta perspicillata*), unidentified gull	870	Botulism type C
	Double-crested cormorant	1,800	Newcastle Disease
1998	Eared grebe, ruddy duck, northern shoveler, ring-billed gull, herring gull (*Larus argentatus*)	1,500	Avian cholera
	California gull, brown pelican, herring gull, ring-billed gull, Caspian tern (*Hydroprogne caspia*)	835	Botulism type C
	Double-crested cormorant	1,000	Newcastle Disease
	Brown pelican, American white pelican, unidentified dowitcher	7,123	Botulism type C, suspected
1999	Ruddy duck, northern shoveler	5,500	Avian cholera
	Eared grebe	1,383	Open
	Double-crested cormorant, brown pelican, American white pelican, white-faced ibis (*Plegadis chihi*), marbled godwit (*Limosa fedoa*)	685	Botulism type C
2000	America white pelican, California brown pelican	1,025	Botulism type C
	Cattle egret (*Bubulcus ibis*)	800	Salmonellosis
2001	Ruddy duck, ring-billed gull, American white pelican, American wigeon, northern shoveler	442	Avian cholera
2002	California brown pelican, ring-billed gull, California gull, Caspian tern, eared grebe	241	Botulism type C
2003	None		
2004	Ruddy duck, ring-billed gull, American coot, eared grebe, herring gull	4,272	Avian cholera

Table 4-18 Avian Disease Mortality Events at the Salton Sea or Sonny Bono Salton Sea NWR, 1992-2008[1]			
Year	**Bird Species**	**Estimated #**	**Diagnosis**
2005	None		
2006	Cattle egret	100	Open
2007	None		
2008	American white pelican, California brown pelican, northern shoveler, unidentified gull & teal	Less than 400	Botulism type C

[1] USGS 1995-2008. National Wildlife Health Center, Quarterly Wildlife Mortality Report.
[2] Audet et al. 1999.

Botulism outbreaks are largely controlled by various ecological factors: pH, salinity, temperature, and others. Decaying organic matter (including decomposing carcasses) provide locations for toxin production. Outbreaks tend to peak in late summer and early fall, when warm temperatures dominate. All waterbirds are vulnerable, but filter-feeding and dabbling waterfowl and probing shorebirds are likely most at risk of acquiring the toxin. It is the disease of most concern for migratory birds worldwide. To reduce the likelihood of outbreaks, certain management actions can mitigate environmental conditions at wetlands (e.g., reducing organic inputs and decaying matter, especially dead fish and birds).

Avian cholera is also a contagious bacterial disease that results from the bacterium *Pasteurella multicoda* (USGS 1999). Contamination from diseased and dead birds is the primary source of infection; high concentrations of the bacteria can remain for weeks in wetlands and on the surface of waters where waterfowl die. The patterns of avian cholera outbreaks have suggested disease carriers among migratory species of wild birds, but only evidence has been found in snow goose breeding colonies. Waterfowl (especially ducks, geese and swans) and coots suffer the greatest magnitude of wild bird losses from avian cholera. Species that scavenge, such as crows and gulls, are also frequently diagnosed with this disease. Avian cholera outbreaks appear to be increasing in frequency and geographic distribution throughout North America, since being recognized as a major disease in 1970. The disease can kill waterfowl during all stages of their life cycle; California's seasonal peak is usually in the winter months. Prompt and careful bird carcass removal is one management action that can reduce the rate of infection.

Newcastle disease is a viral infection once thought confined to domestic poultry but now has spread to at least wild double-crested cormorants (USGS 1999). Before 1990, it had rarely been reported as a mortality cause in free-living native birds in the U.S. or Canada. Double-crested cormorants have died in large numbers since then, including about 2,800 at the Salton Sea in 1997 and 1998, as noted in Table 4-18. Mostly nestlings and other young of the year have died in cormorant colonies during the months of March through September. Tremors or incomplete paralysis are common symptoms. The virus is readily spread by air and water. Disease control specialists need to be involved immediately with an outbreak of Newcastle disease.

In 1999 through a partnership with the Salton Sea Authority, CDFW, and Sonny Bono Salton Sea NWR, regular disease monitoring was initiated to provide early detection of avian disease and remove any infected birds from the environment to help minimize the spread of disease on the Salton Sea. Various Refuge staff members conduct the majority of disease monitoring effort and maintain the necessary equipment for disease response. This includes a fleet of seven airboats, two incinerators, laboratory facilities, a necropsy room, and two bunkhouses that are made available to researchers studying the incidence and cause of bird deaths. Although the summer months are

occupied with regular disease patrols of the entire shoreline looking for sick or dead pelicans, as well as other birds, Refuge staff continues to conduct disease surveillance throughout the year. When located, sick and dead birds are retrieved and taken out of the environment. Sick birds are taken in for treatment, and protocols refined through years of experience and guidance from veterinarians and bird rehabilitators always are followed. Birds are typically only held a day before being taken to local wildlife rehabilitation centers where they are treated further and, if possible, released back into the wild when recovered.

Mosquito and Other Vectors. A vector is any arthropod, insect, rodent or other animal of public health significance capable of harboring or transmitting the causative agents of human disease (e.g. malaria, plague) to humans. Mosquitoes are the primary insect vector of concern in and around the Refuge, because mosquitoes are known carriers of human and animal diseases, particularly West Nile Virus (WNV) and Saint Louis encephalitis virus. WNV is spread by mosquitoes that feed on the blood of infected birds and other animals and then transmit the virus to humans when they bite. While most people infected with WNV exhibit mild or no symptoms, severe infections can lead to encephalitis and can be fatal. WNV first appeared in California in 2002. In 2004, 58 counties detected WNV activity in dead birds, mosquito pools, and sentinel chickens (CDPH 2009).

The Imperial County Public Health Department's Vector Control District's (VCD) mission is to detect and reduce the spread of mosquitoes and other disease carrying animals. Searching for new mosquito breeding areas, inspecting and treating known mosquito sources, as well as conducting mosquito trapping and testing programs that target mosquito-borne disease agents such as WNV, St. Louis encephalitis, and Western Equine encephalitis are all the responsibility of the Imperial County VCD. The Imperial County VCD also responds to problem bee infestations and provides public outreach concerning mosquito control, prevention of rodent infestations, and other vector related health issues. Imperial County VCD historically conducted mosquito trapping on the Refuge, but stopped this effort in order to focus on mosquito issues occurring closer to urban centers. No mosquito control is currently occurring on or proposed for the Refuge.

The CDPH considers *Culex tarsalis* a potential vector of WNV in California; it is not known if this mosquito species is found on the Refuge. It is CDPH's responsibility to compile information on the occurrence of WNV in California. No infected wild birds or humans were recorded in Imperial County in 2008, but three humans tested positive in 2007. Sentinel chickens, some of which were kept on the Refuge by the Coachella Valley Mosquito and Vector Control District (CVMVCD), did show positive results in 2007 and 2008 (CVMVCD 2012). Monitoring of sentinel chickens on the Refuge ended in about 2010.

Between January 1 and August 7, 2012, 13 cases of human WNV were detected in California, including one death; however, no cases were documented in Imperial County. In fact, no cases of human infection have been recorded in Imperial County since 2007. However, WNV activity has been documented in the County in 2012, with several cases of infected sentinel chickens and detection of the disease in one mosquito breeding pool.

Wild birds are the hosts of Saint Louis encephalitis virus, which is transmitted among birds and to humans by mosquitoes. Human infection with Saint Louis encephalitis virus can result in mild to severe illness, with case-fatality rates ranging from 3 percent to 30 percent. Since 1945, 597 human cases of Saint Louis encephalitis virus have been reported in California. The most recent outbreaks occurred in 1984 in the Los Angeles Basin (26 cases) and in 1989 in the southern San Joaquin Valley (29 cases). The last human case reported was in 1997.

Certain avian diseases, discussed above, can possibly be transmitted to humans (USGS 1999). Newcastle disease virus is capable of causing mild symptoms in humans through aerosol contamination. In rare cases, avian cholera can cause human infections from a bite, scratch or respiratory tract exposure. Personnel disposing of diseased carcasses must use caution. However, avian botulism type C is not known to cause disease in humans.

Bird Strikes. The potential for collisions between birds and aircraft are also considered a potential threat to human safety. Bird strikes are a concern, both for civilian and military aircraft, and can result in the loss of aircraft and personnel or lead to costly repairs. The Federal Aviation Administrative (FAA) Wildlife Strike Database contains records of reported wildlife strikes since 1990. Strike reporting is voluntary; therefore, this database only represents the information the FAA has received from airlines, airports, pilots, and other sources.

Birds are most frequently found at low altitudes; consequently, the risk of a bird strike is greatest near airfields. Seventy-five to 90 percent of birdstrikes involving civil aircraft occurred near airports, primarily during takeoff and landing. Large birds, such as geese and pelicans, have resulted in the greatest damage to aircraft. Military aircraft face additional risks because they often engage in low altitude, high speed, and training flights (USACOE and California Natural Resources Agency 2011).

Civilian airports closest to the Salton Sea include the Imperial County Airport, Brawley Municipal Airport, Cliff Hatfield Memorial Airport in Calipatria, and Salton Sea Airport in Salton City. The nearest military installation is Naval Air Facility (NAF) El Centro, located approximately 17 miles south of the Salton Sea. Every month, 7 to 12 squadrons and up to 1,600 personnel train at NAF El Centro, which also provides base support to Naval Aviation Squadrons and is associated with R-2510 and R-2512 Restricted Airspace Ranges that provide for critical military operations for weapons and air combat training (USACOE and California Natural Resources Agency 2011). No airstrikes with civilian aircraft were reported in Imperial County during this time; however, NAF El Centro lost an F-18 jet to a bird strike in October 1995.

Two military training routes (Visual route [VR 296] and VR 1211), flown at low altitudes by military aircraft, are present in the vicinity of the Refuge. No evidence of bird strikes has been reported on these two routes for the past year, and they are used infrequently (three to four times per year on average) (USACOE and California Natural Resources Agency 2011). However, the time of year in which these routes are flown is during the winter when the Refuge experiences the greatest bird use. The larger snow geese present on the Refuge at that time are very sensitive to the over flights and are likely to take flight when disturbed by low flying aircraft. Refuge staff has notified the NAF El Centro staff of the potential risks to personnel conducting these flights from geese that may become airborne in an attempt to avoid approaching aircraft.

4.7.5.2 Coachella Valley NWR

CVMVCD is responsible for vector control in the areas in and around the Coachella Valley NWR. The District implements mosquito surveillance in representative sites of all habitats in the Coachella Valley. Surveillance includes monitoring of immature and adult mosquito abundance and detecting virus activity by testing adult female mosquitoes, sentinel chickens and wild birds, horses, and humans for infection.

CVMCVCD also monitors for all known mosquito-borne viruses in California, as well as for any newly introduced viruses that may be present in the area (CVMVCD 2012). Surveillance of immature and adult mosquito abundance occurs throughout the year in the Coachella Valley. Adult mosquito abundance is a key factor when evaluating the risk of disease transmission.

Mosquito adult surveillance in the Coachella Valley is conducted by setting 76 CO2 baited traps on a biweekly basis, and 27 gravid traps on a weekly basis. A gravid trap and CO2 baited trap are maintained at a site on La Canada Way in Thousand Palms located approximately four miles northwest of the Refuge. No mosquitoes have tested positive for arboviruses at this site between January 1 and August 6, 2012. Positive tests have been confirmed in various locations to the south of the Refuge, particularly in the vicinity of the Salton Sea. The closest site to the Refuge that tested positive for arboviruses during this period was located in Indio, about eight miles to the south of the Refuge (http://www.cvmvcd.org/wnvmap.htm accessed on August 10, 2012). No mosquito control is currently occurring on or proposed for the Refuge.

4.7.6 Population/Employment

4.7.6.1 Sonny Bono Salton Sea NWR

Population and Demographics. The population estimate for the Imperial Valley in 2011 was 177,057, less than one percent of the estimated population for California (U.S. Census Bureau, http://quickfacts.census.gov). Table 4-19 provides additional information regarding the populations and demographics for the cities located near the Refuge, as well as for the County and State.

Table 4-19
Population and Demographics for Areas in Proximity to the Sonny Bono Salton Sea NWR

Census Data	Calipatria	Brawley	El Centro	Imperial	Imperial County	State of California
Estimated Population	*7,705 (2010)*	*24,953 (2010)*	*42,598 (2010)*	*14,758 (2010)*	*177,057 (2011)*	*37,691,912 (2011)*
White[1]	41.7% (2010)	54.4% (2010)	59.6% (2010)	63% (2010)	89.3%	74.0%
Hispanic or Latino[2], 2011	64.1% (2010)	81.5% (2010)	81.6% (2010)	74.8% (2010)	80.6%	38.1%
Asian[1], 2011	1.2% (2010)	1.4% (2010)	2.3% (2010)	2.5% (2010)	2.4%	13.6%
African American[1], 2011	20.9% (2010)	2.0% (2010)	2.5% (2010)	2.2% (2010)	3.8%	6.6%
American Indian or Alaska Native[1], 2011	1.0% (2010)	1.0% (2010)	1.3% (2010)	1.0% (2010)	2.6%	1.7%
Hawaiian or other Pacific Islander[1], 2011	0.3% (2010)	0.1% (2010)	0.1% (2010)	0.1% (2010)	0.2%	0.5%
White, Not Hispanic	12.5% (2010)	14.9% (2010)	13.5% (2010)	20.2% (2010)	13.5%	39.7%

Table 4-19 Population and Demographics for Areas in Proximity to the Sonny Bono Salton Sea NWR						
Census Data	**Calipatria**	**Brawley**	**El Centro**	**Imperial**	**Imperial County**	**State of California**
Persons reporting two or more races, 2000	2.9% (2010)	4.0% (2010)	5.2% (2010)	5.5% (2010)	1.8%	3.6%
Living below the poverty line, percent, 2006-2010	17.2%	6.6%	20.9%	12.6%	21.4%	13.7%

Source: (U.S. Census Bureau: State and County QuickFacts, Revised June 6, 2012)
[1] Includes persons reporting only one race
[2] Hispanics may be of any race, so also are included in applicable race categories.

Economy/Employment. Agriculture and its related industries have provided the backbone to Imperial County's economy for many years. The total value in 2007 of all farm commodities was $1.37 billion (ICAC 2008). Significant contributors to the local economy also include government, retail trade, and services. With the passage of NAFTA in the 1990s, manufacturers have increasingly settled on both sides of the border. Industrial and commercial developments have been encouraged at the Calexico-Mexicali "Gateway of America" international border crossing.

Of 64,200 employed workers in Imperial County in 2006, agricultural employment accounted for 21.3 percent, government 31.0 percent, trade-transportation-utilities 19.7 percent, leisure and hospitality 5.6 percent, educational and health services 5.1 percent, manufacturing 4.4 percent, professional and business services 4.7 percent, and others 8.6 percent (CEDD 2008). The labor force increased 11.7 percent between 2002 and 2006. Three industries led this job growth: agriculture, trade-transportation-utilities, and government (local).

In 2006, the annual unemployment rate for Imperial County was 15.3 percent compared to 4.9 percent for the State. In October 2008, however, the monthly unemployment rate was 27.6 percent out of a labor force of 78,400, and in 2011, the annual unemployment rate (not seasonally adjusted) was 29.7 percent out of a labor force of 77,600. This high rate, possibly the highest in the State, compares to 13.6 percent in Riverside County and 11.7 percent statewide. Average per capita income in 2010 was $27,342 for Imperial County compared to a State average of $42,514.

In California, a disadvantaged community is defined as a community with an annual median household income less than 80 percent of the statewide median household income, which for the period 2006 - 2010 was $60,883. Therefore, communities with a median household income of less than $48,706 would be considered disadvantaged. The median household income of $38,685 for Imperial County as a whole meets the definition of disadvantaged. In addition, the cities of El Centro ($38,481), Calipatria ($38,586), and Brawley ($39,676) all meet the definition of a disadvantaged community. The exception in the City of Imperial with a median household income of $54,617 (U.S. Census Bureau: State and County QuickFacts, Revised June 6, 2012).

Refuge Revenue Sharing Act. Land in the Refuge is not on the local tax rolls. The Refuge Revenue Sharing Act (16 U.S.C. §715s) offsets the loss of local tax revenues from federal land ownership through payments to local taxing authorities. In California, payments are directed to counties. The annual payments are calculated on the appraised value for tax purposes, and are proportionally adjusted based on the amount of receipts received by the Service and funds directly appropriated annually by Congress. Recent payments have been less than the fully funded revenue sharing formula. Service receipt contributions generally come from such programs as mineral and facility leases, timber harvest and grazing permits. Refuge revenue sharing payments are made annually to Imperial County, but the amounts vary, with $9,076 paid for FY 2006, $8,123 for FY 2007, $7,289 for FY 2009, and $5,136 for FY 2010.

4.7.6.2 Coachella Valley NWR

Population and Demographics. Table 4-20 shows the population estimates and trend for the regional area and communities near the Refuge over the past decade (2000-2010). Riverside County accounts for nearly 6 percent of the State population and makes up 4.6 percent of California's land mass. Summary data for 2000-2010 indicate that while major cities are experiencing minimal growth (Los Angeles +2.6 percent and San Francisco +3.7 percent), California continues to grow, including some of the principal cities in the Coachella Valley (U.S. Census Bureau, http://quickfacts.census.gov/).

Table 4-20
Population Data for California, Riverside County, and Coachella Valley Area Cities

Area	2010 Residents	2000 Residents	Percent Population Change	Percent Land Area of State	2010 Residents per Square Mile
California	37,253,956	33,871,648	+10.0%	100%	239.1
Riverside County	2,189,641	1,545,387	+41.7%	4.6%	303.8
Palm Springs	44,552	42,807	+4.1%	<0.001	473.4
Palm Desert	48,445	41,155	+17.7%	<0.001	1,807.0
Indio	76,036	49,116	+54.8%	<0.001	2,605.7

Source: (U.S. Census Bureau, http://quickfacts.census.gov/)

In 2007, the Coachella Valley population was estimated to be 421,676. This represents a 95.6 percent increase since 1990. In the same time period, the Riverside County population increased by 73.6 percent, and the State of California population increased by 26.5 percent. By 2010, the estimated population was 477,900 residents, with about 75 percent of the residents living in one of the nine incorporated cities and 25 percent living in the unincorporated areas of the Valley. It is estimated that the population in the Coachella Valley increases to about 500,000 during winter months, due to the influx of seasonal and part-year residents. SCAG estimates that the valley's permanent population is will increase to 540,901 by year 2020 (SCAG 2007).

The valley's population is diverse, and includes students, families, professionals, retirees and seniors. Based on 2000 U.S. Census data, the median age of residents in the Coachella Valley ranged from 22.8 years in Coachella to 63.4 years in Indian Wells. Approximately 68.6 percent of residents in the incorporated cities classify themselves as white, and approximately 44.3 percent identify themselves as Hispanic or Latino (CVAG 2007b). More population and demographic data for the area is provided in Table 4-21.

Table 4-21 Population and Demographics for Areas in Proximity to the Coachella Valley NWR					
Census Data	**Thousand Palms**	**Palm Desert**	**Indio**	**Riverside County**	**State of California**
Estimated Population	*7,715 (2010)*	*48,445 (2010)*	*76,036*	*2,239,620 (2011)*	*37,691,912 (2011)*
White[1]	74.7% (2010)	82.5% (2010)	61.5% (2010)	81%	74.0%
Hispanic or Latino[2], 2011	52.5% (2010)	22.8% (2010)	67.8% (2010)	46.1%	38.1%
Asian[1], 2011	1.7% (2010)	3.4% (2010)	2.2% (2010)	6.5%	13.6%
African American[1], 2011	1.4% (2010)	1.8% (2010)	2.4% (2010)	7.0%	6.6%
American Indian or Alaska Native[1], 2011	1.0% (2010)	0.5% (2010)	1.0% (2010)	1.9%	1.7%
Hawaiian or other Pacific Islander[1], 2011	0.1% (2010)	0.1% (2010)	0.1% (2010)	0.4%	0.5%
White, Not Hispanic	43.1% (2010)	70.4% (2010)	27% (2010)	39.1%	39.7%
Persons reporting two or more races, 2000	2.7% (2010)	2.5% (2010)	3.4% (2010)	3.3%	3.6%
Living below the poverty line, percent, 2006-2010	11.7%	8.8%	19.7%	13.4%	13.7%

[1] Includes persons reporting only one race,
[2] Hispanics may be of any race, so also are included in applicable race categories.
Source: (U.S. Census Bureau: State and County QuickFacts, Revised June 6, 2012)

Economy/Employment. Between 2000 and 2007, employment in the Coachella Valley grew by 32.6 percent (4.1 percent annually), as compared to 4.4 percent (0.6 percent annually) nationwide. As a result of the economic downturn that began in 2008, the Valley's employment growth has stalled (Coachella Valley Regional Water Management Group 2010). Retail trade is the region's largest employment sector, followed by the hotel and amusement industry. Agriculture, previously the second largest employment sector, now ranks third. The construction industry was the fastest growing jobs sector in the valley during the period from 1991 to 1999, increasing 103.6 percent over that period (CVAG 2007b). A smaller portion of the region's employment base includes manufacturing, finance, and professional services.

The growth of the valley's resort and tourism industry began in the 1920s and 1930s, primarily in the western portion of the valley. Today, the entire urbanized portion of the valley, from Palm

Springs southeastward, is considered a world-class tourist destination. The valley attracts approximately 3 million overnight visitors annually, generating approximately $1.5 billion in annual revenues to the region (CVAG 2007b).

The economic profile of Coachella Valley varies throughout the Region, with the annual median household income of some communities in ranges similar to statewide estimates, while other communities meet the definition of a disadvantaged community. The Coachella Valley has a wide range of disadvantaged communities from different demographics, including migrant and seasonal farm workers, very low-income families, urban residents, and low-income seniors (Coachella Valley Regional Water Management Group 2010). According to the 2010 Nielsen Update Demographics model, the statewide median household income for 2010 was $62,401; therefore, disadvantaged communities would be those communities with a median household income of less than $49,921. Based on this information, all nine cities and a number of unincorporated communities within the Coachella Valley, including Thousand Palms, contain pockets of communities that would qualify as disadvantaged (Coachella Valley Regional Water Management Group 2010).

Refuge Revenue Sharing Act. Refuge revenue sharing payments are distributed to Riverside County annually for fee title lands within the Coachella Valley NWR. The payment amounts vary: $68,424 was paid for FY 2006, $38,722 for FY 2009, and $27,284 for FY 2010.

4.7.7 Environmental Justice

Environmental justice is defined by the USEPA 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." The goal of environmental justice in the U.S. is to afford the same degree of protection from environmental and health hazards to all individuals and communities throughout the nation. 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.

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (February 11, 1994), requires that federal agencies consider as part of their action, any disproportionately high and adverse human health or environmental effects to minority and low income populations. Agencies are required to ensure that these potential effects are identified and addressed. The USEPA defines environmental justice 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." In this context, fair treatment means that no group of people should bear a disproportionate share of negative environmental consequences resulting from the action.

Both the Imperial Valley and Coachella Valley populations are composed of different ethnicities and races. Minority populations are generally well-integrated and dispersed geographically throughout these areas, and there are few isolated minority neighborhoods or districts in the region. However, larger percentages of minorities reside in certain regions of both areas.

5. Plan Implementation

5.1 Introduction

Presented here are the details of how we will manage the Sonny Bono Salton Sea NWR and Coachella Valley NWR over the next 15 years. Implementation of the selected alternatives, which began with the approval of the CCP, will occur with assistance from existing and new partners, including public agencies, tribes, non-governmental organizations, and the public. Consistent public outreach and continued coordination with Refuge constituents are essential components of this implementation process.

This CCP serves as the primary management reference document for Refuge operations, management, and step-down planning until the CCP is formally revised or amended. The timing and achievement of the management strategies are contingent upon several factors, including funding and staffing, completion of step-down plans, accomplishing compliance requirements, and monitoring outcomes.

CCPs provide long-term guidance for management decisions and identify the Service's best estimate of future needs. These plans detail programs that in some cases require funding that is substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. Accordingly, the plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

In addition to providing long-term guidance for Refuge management decisions, the CCP also addresses the role these Refuges and the management undertaken on these Refuges plays in the larger conservation landscape. The Sonny Bono Salton Sea NWR is just one component of the much larger Salton Sea landscape and as that landscape changes, the role of the Refuge may need to adapt. The same is true for the role that preservation of the habitats within the Coachella Valley NWR plays in the long-term preservation of the habitats and species covered by the Coachella Valley MSHCP.

5.2 Refuge Vision, Goals, Objectives, and Strategies

This CCP sets forth the vision, goals, objectives, and strategies needed to accomplish the purposes for which each of the refuges within the Sonny Bono Salton Sea NWRC were established. Goals and objectives are the unifying elements of Refuge management, intended to identify and focus management priorities and provide a link between management actions, Refuge purposes, and the National Wildlife Refuge System mission and goals.

The vision, goals, objectives, and strategies for the Sonny Bono Salton Sea NWR and Coachella Valley NWR are presented in Chapter 3. Although it is our intent to implement the proposed projects by the dates presented in this chapter, the timing of implementation may vary depending upon a variety of factors, including funding, staffing, compliance with Federal regulations, partnerships, and the results of monitoring and evaluation.

5.3 Funding and Personnel

5.3.1 Project Funding

For fiscal year (FY) 2012, the general operating costs (excluding staff costs, which are discussed below) for the Sonny Bono Salton Sea NWRC were approximately $827,160. Base funding available to Refuges varies annually. In addition, specific funding may be provided in a given year to address deferred maintenance needs, to fund a specific Refuge construction project, or to address specific management actions. For instance, in FY 2012, $10,000 in additional funding was provided to the Complex for avian disease monitoring on the Salton Sea. Special funding may be available from time to time through a competitive process initiated to fund special projects, such as visitor services projects that implement the Service's initiative for connecting people with nature. The annual budget for the Refuge System is not always adequate to address the replacement and maintenance needs on individual Refuges; therefore, a database of deferred maintenance projects is retained as part of an the Service Asset Maintenance Management System (SAMMS). (As of 2012, SAMMS was the database of record for documented real property deferred maintenance needs, existing equipment replacement requests, and project proposals that will result in the construction of additional new real property assets or the expansion/alteration of existing assets.)

New construction projects proposed for inclusion in the SAMMS database for the Sonny Bono Salton Sea NWRC address a range of Refuge responsibilities including wildlife and habitat management, visitor service, and general Refuge operations. With the completion of the CCP, the existing SAMMS database will be updated to reflect the proposals included in the preferred management alternative for the Sonny Bono Salton Sea NWR and Coachella Valley NWR.

Table 5-1 outlines the SAMMS projects for the Sonny Bono Salton Sea NWR and Table 5-2 includes the SAMMS project proposed for the Coachella Valley NWR. These lists include both new projects and projects that meet the definition of a deferred maintenance project. The projects are listed for each Refuge in order of priority. In addition, visitor services projects on both Refuges are prioritized for the complex. The ranking of the visitor services projects for the Complex are provided at the end of the construction project description and are identified by the "VS" Priority number.

Table 5-1
Proposed SAMMS Database - Sonny Bono Salton Sea NWR

Construction Project (presented in order of priority)	Corresponding CCP Objective(s)	Estimated Project Cost
Restore Salton Sea Wetlands at Red Hill Bay – To address the effects of a receding Salton Sea, implement the phased restoration of Red Hill Bay by creating 420 acres of shallow saline wetland habitat to support shorebirds and other waterbirds and reduce the potential for dust. Berms, waters pumps, and other components of a water delivery system would be maintained for the life of the project. The project's eastern berm would include a new birding trail and two interpretative signs to address project purposes and species' benefits.	Sonny Bono Salton Sea NWR – 1.4, 2.3, 2.4, 4.1, 4.2, 5.2, 5.3, 5.5, 5.6	$3,500,000
Install Shaded Visitor Parking – Design, purchase, and install a shade structure to cover five visitor parking spaces, improving visitor comfort and safety at the Refuge headquarters' parking lot where the average high summer temperature is 100°F or greater. (VS Priority 1)	Sonny Bono Salton Sea NWR – 5.2, 5.3	$50,000

Table 5-1 Proposed SAMMS Database - Sonny Bono Salton Sea NWR		
Construction Project (presented in order of priority)	**Corresponding CCP Objective(s)**	**Estimated Project Cost**
Replace Existing Carport – Replace the existing carport located behind the Complex headquarters to improve protection for station vehicles from high winds, direct sunlight, and extreme temperatures.	Sonny Bono Salton Sea NWR – 2.4, 4.5	$225,000
Expand and Refurbish Existing Public Restroom – Remodel or replace the existing unisex bathroom to provide two restrooms that can better accommodate visitors. The design should improve accessibility and reduce water use. (VS Priority 2)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4	$20,000
Replace/Repair Existing Concrete Sidewalk Around the Visitor Contact Area of the Complex Headquarters – Replace or repair approximately 2,265 square feet of damaged and degraded sidewalk to protect visitor safety and ensure continued accessibility to the visitor contact desk and public restroom. (VS Priority 3)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4	$26,600
Improve the Surface of the Interpretive Trail at the Complex Headquarters – Resurface the existing interpretive trail that leads from the Complex headquarters to the base of Rock Hill (approximately 3,800 linear feet) to provide a firm and stable surface to improve access for all members of the public. (VS Priority 4)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.5	$40,000
Update Interpretive Signage in Unit 1 – Design, fabricate, and install, where appropriate, six interpretive panels and two bird identification signs along the existing trail and on the new observation deck in Unit 1 to interpret topics such as the habitat needs of the Yuma Ridgway's rail, the need to provide a sanctuary for wildlife (i.e., why you can't walk out to the Salton Sea), different birds for different seasons, what attracts birds to this area, and how the Refuge's farming practices support wildlife. (VS Priority 5)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.5, 5.6	$29,500
Improve Interpretive Trail Accessibility – In Unit 1, upgrade 4,000 linear feet of an existing trail, as well as the access routes to and from the parking lot and observation deck to provide a year-round firm and stable trail surface that can accommodate all users. (VS Priority 6)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.6	$25,000
Construct a Parking Area for Birdwatchers in Unit 1 – Design and construct a four-car parking area in Unit 1 along Vendel Road to support birdwatching and photography near three acres of restored willow scrub habitat. (VS Priority 8)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.5, 5.6	$75,000
Construct New Photoblind in Unit 1 – Design and construct an accessible photo/observation blind adjacent to restored willow scrub habitat to support photographing and viewing birds utilizing the willow habitat, as well as wintering geese and sandhill cranes that foraging in the adjacent farm fields.(VS Priority 9)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.5, 5.6	$10,000
Construct a Seasonal Birding Trail, Kiosk, and Parking Area in the Hazard Tract – Design and construct a 1.5-mile-long loop trail and four to six-car parking area and design, fabricate, and install a two-panel kiosk with site information and interpretation, in the northwest corner of the Hazard Tract to accommodate seasonal (March 1 through September 30) opportunities for wildlife observation, photography, environmental education, and interpretation. (VS Priority 10)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.6	$60,000

Table 5-1 Proposed SAMMS Database - Sonny Bono Salton Sea NWR		
Construction Project (presented in order of priority)	**Corresponding CCP Objective(s)**	**Estimated Project Cost**
Control Public Access to Protect Sensitive Habitats – Install six new gates and associated signage at various locations within the Refuge where elimination of unauthorized public access is necessary to protect sensitive species and habitat.	Sonny Bono Salton Sea NWR – 2.4	$10,000
New Chemical and Flammable Liquid Storage Buildings – Purchase and install new prefabricated, stand-alone, steel chemical and flammable liquids storage buildings, replacing the existing old buildings, where products such as herbicides, oils, paints, and fuel cans are currently stored. The new structures will improve storage conditions and ensure continued compliance with health, safety, and environmental regulations.	Sonny Bono Salton Sea NWR – 3.3, 4.5	$40,000 ($20,000 per building)
Update Interpretive Signage in Unit 2 – Design, fabricate, and install six to eight interpretive panels along the Red Hill Trail. The interpretive messages should be coordinated with the curriculum and lesson plans used by teachers in association with the Refuge's environmental education program. (VS Priority 11)	Sonny Bono Salton Sea NWR – 5.2, 5.3, 5.4, 5.5, 5.6	$28,000
Develop and Publish a Naturalist Activity Guide – In partnership with others, develop and publish an activity pamphlet that will enable students and their families, teachers, and other visitors, to conduct and enjoy self-guided walks on the Refuge. Design the pamphlet to improve the field trip experience by providing new activities that explore the Refuges' natural history, conservation values and challenges, and stewardship opportunities. (VS Priority 12)	Sonny Bono Salton Sea NWR – 5.4, 5.5, 5.6	$10,000
Total Estimated Cost for the Refuge		**$ 4,149,100**

Table 5-2 Proposed SAMMS Database – Coachella Valley NWR		
Construction Project	**Corresponding CCP Objective(s)**	**Estimated Project Cost**
Interpretive Elements for Off-Site Display – In partnership with others, develop a concept for, design, and fabricate both a permanent interpretive display to be placed at an appropriate off-site location and a traveling interpretive display to be used at schools, libraries, and other locations, to interpret the rare and unique resources of the Coachella Valley NWR. (VS Priority 7)	Coachella Valley NWR – 2.1, 3.1	$25,000
Total Estimated Cost for the Refuge		**$ 25,000**

Another database relevant to Refuge operations is the Refuge Operating Needs System (RONS), a database that houses a Refuge's desired habitat improvement projects, studies, and new equipment needs, as well as the place where staffing needs (predicated on the nationally agreed upon staffing model) are expressed.

Data within RONS are used regularly in budget justifications presented to the Department of the Interior, the Office of Management and Budget, and Congress. All of the RONS projects within the Sonny Bono Salton Sea NWRC are prioritized to identify the most important projects within the Complex. Each year RONS projects are submitted for consideration and compete with similar projects throughout the nation for Refuge funds.

The RONS database is updated when a CCP is completed to reflect the proposals included in the selected management alternative. The projects described in the selected alternatives for the Sonny Bono Salton Sea NWR and Coachella Valley NWR are presented in Table 5-3, with the projects listed in order of priority (from highest to lowest) within the Refuge. The implementation of these actions will assist in achieving Refuge purposes, goals, and objectives. For each project, the corresponding CCP objective, as described in Section 3.3, is provided.

Table 5-3
Updates for Inclusion in the RONS Database for the Sonny Bono Salton Sea NWRC

Proposed Action	Complex Ranking	Corresponding CCP Objective	Operating Costs	
			First Year Cost	Recurring Annual Cost
Sonny Bono Salton Sea NWR Projects (presented in order of priority for the Refuge)				
Laser-level Agricultural Fields – Enter into a contract to laser-level approximately 360 acres of managed agricultural fields to provide more uniform irrigation coverage. Better coverage will improve plant forage production to support 30,000 wintering snow geese and other waterfowl, result in better utilization of water, and lower annual water costs.	5	1.1, 3.3, 4.5	$100,000	$15,000
Increase Irrigation Efficiency – Purchase and install a new sprinkler irrigation pipe in the Flammang fields to more efficiently distribute water across the site, and install a water storage container and pipe to collect and distribute tail water to other fields.	8	1.1, 1.2, 4.5	$100,000	$15,000
Sonny Bono Salton Sea NWR Staffing Needs (presented in order of priority for the Refuge)				
Improve Water Delivery to Managed Fields and Wetland Areas – Hire a full-time Irrigator (GS 5/6) to operate and maintain the Refuge's water delivery and distribution system, including at new restoration sites.	1	1.1, 1.2, 4.5	$45,000	$45,000
Expand Interpretive, Volunteer, and Public Outreach Programs – Hire a full-time Outdoor Recreation Planner (GS 7/9/11) to oversee these programs.	3	4.5, 5.3, 5.5, 5.6, 5.7 ,5.8	$95,000	$95,000
Management of Refuge Facilities – Hire a full time Facilities Manager (GS 7/9/11) who would be responsible for upkeep of Refuge structures and facilities organization.	4	2.4, 4.1, 4.5	$95,000	$95,000

Table 5-3
Updates for Inclusion in the RONS Database for the Sonny Bono Salton Sea NWRC

Proposed Action	Complex Ranking	Corresponding CCP Objective	Operating Costs	
			First Year Cost	Recurring Annual Cost
Implement Biological Activities – Hire a Fish and Wildlife Biological Technician (GS 5/7/9) to monitor and respond to Salton Sea wildlife disease outbreaks; assist in bird surveys; and conduct invasive plant control.	6	2.4, 4.1, 4.4	$37,500	$37,500
Sonny Bono Salton Sea NWR Subtotal for Projects and Staffing			**$472,500**	**$302,500**
Coachella Valley NWR Projects (presented in order of priority for the Refuge)				
Control Invasive Plants to Protect Listed Dune Species – Design and implement a multi-year enhancement plan for about 200 acres of previously cultivated land that will focus on invasive plant control followed by seeding of appropriate native plant species.	7	1.1, 1.2, 1.3, 2.1	$200,000	$5,000
Reestablish Mesquite Hummocks to Benefit Listed and Sensitive Species – To retain sand on the Refuge, install and irrigate honey mesquite along the downwind end of the Refuge. Once established, the loss of blowsand from the Refuge will be slowed and accumulated sand will be available for redistribution onto the site. Actions include purchasing and planting honey mesquite, and providing irrigation or an alternative form of water.	9	1.1, 1.2, 1.3, 2.1	$150,000	$10,000
Coachella Valley NWR Staffing Needs (presented in order of priority for the Refuge)				
Protect and Manage Refuge Resources – Hire a dual function refuge manager/Federal wildlife officer (GS 7/9/11), who would dedicate a minimum of 25 percent of the time to law enforcement on both the Coachella Valley and Sonny Bono Salton Sea NWRs and spend the remaining time managing the Coachella Valley NWR (e.g., habitat and species management, species monitoring, general site maintenance, managing partnerships, and coordinating with the Valley Floor RMC and Coachella Valley Conservation Commission).	2 (Complex position)	1.1, 1.2, 1.3, 2.1, 3.2	$150,000	$95,000
Coachella Valley NWR Subtotal for Projects and Staffing			**$500,000**	**$110,000**
Total Estimated Cost for the Refuge Complex			**$972,500**	**$412,500**

The costs presented in Table 5-3 are rough estimates and will be refined as more details are available. To fully implement the proposed actions and achieve the goals and objectives of the CCP, additional staff position will be required as reflected in Table 5-4. The estimated cost for implementing the proposals in the SAMMS and RONS database, as outlined in Tables 5-1, 5-2, and 5-3 is $5,146,600 and the anticipated reoccurring annual cost for these new proposals is estimated at $412,500.

5.3.2. Current and Future Staffing Needs

The current staffing levels for the Refuge Complex, per the approved (4/30/12) organization chart, are presented in Table 5-4, along with those positions that are identified in the CCP as necessary to achieve Refuge purposes. Based on the actions presented in the CCP, there is a need to add and fill three new permanent full time staff positions and fill, as permanent full time, two currently unfilled term full time positions. If all of these positions were to be filled, and funding was available for project implementation, the Refuge would be able to carry out all aspects of CCP to a reasonable standard. If one or more positions are not filled, some aspects of the Plan may not be completed within the timeframe presented in the CCP. The estimated cost of providing the staff needed to maintain and operate the Sonny Bono Salton Sea NWRC per the direction provided in the CCP is approximately $1,350,000, which includes all current and proposed positions at their full performance level plus benefits.

Table 5-4
Current and Proposed Future Staff Positions for the Sonny Bono Salton Sea NWRC

Position (grade)	Quantity	Current Unit	Proposed Unit
Project Leader (GS-13/14)	1.0[1*]	PFT[2]	PFT
Deputy Project Leader (GS-12/13)	1.0[1*]	PFT	PFT
Senior Wildlife Biologist (GS-11/12)	1.0[1*]	PFT	PFT
Wildlife Refuge Specialist (GS 7/9/11)	1.0[1*]	PFT	PFT
Administrative Support Assistant (GS-6/7)	1.0[1*]	PFT	PFT
Biological Technician (GS-5/7)	1.0[1#,6]	TFT[3]	PFT
Biological Technician (GS-5)	2.0[1*]	TFT	TFT
Biological Technician (GS-4/5)	1.0[1*]	STEP[4]	STEP
YCC Youth Leader (GS-5)	1.0[1#]	Temp[5]	Temp
Computer Assistant (GS-4/5)	1.0[1*]	PFT	PFT
Park Ranger (GS-5/7)	1.0[1#]	TFT	TFT
Engineering Equipment Operator (WG-10)	1.0[1*]	PFT	PFT
Mobile Equipment Mechanic (WG-10)	1.0[1*]	PFT	PFT
Tractor Operator (WG-6)	2.0[1*]	PFT	PFT
Tractor Operator (WG-6)	1.0[1#]	TFT	TFT
Maintenance Worker (WG-6)	1.0[1*]	PFT	PFT
Irrigation System Operator (GS-5/6)	1.0[1#,6]	TFT	PFT
Dual Function Refuge Manager/Federal Wildlife Officer (7/9/11)	1.0[7]	PFT	PFT
Outdoor Recreation Planner/Interpretive Specialist (GS 7/9/11)	1.0[7]	PFT	PFT
Facilities Manager (GS 7/9/11)	1.0[7]	PFT	PFT

[1]Position currently included on the Complex organization chart ([1*] filled position, [1#] unfilled position), [2]PTE = Permanent Full Time, [3]TFT = Term Full Time, [4]STEP = Student Temporary Employment Program, [5]Temp = Seasonal, [6]Identified in the CCP as a position that should be filled as PFT to meet Refuge purposes, [7]Identified in the CCP as a new position that should be filled to meet Refuge purposes.

5.3.3 Potential Funding Sources for Implementing CCP Projects

Some of the projects included in the CCP may be implemented in full or in part by sources other than the Refuge annual budget. These projects could be funded through partnerships with other local, State, or Federal agencies, special legislative appropriations, or grants (e.g., North American Wetlands Conservation Act Grant, National Fish and Wildlife Foundation, Service Cost Share Grants, Federal Highway Administration Refuge Roads Program, Salton Sea Financial Assistance Program). Other potential sources of funding for species monitoring, habitat restoration, listed species conservation and recovery, and research include: the Cooperative Endangered Species Conservation Fund, funds available for implementing the Coachella Valley MSHCP, and grants that support community-based restoration through partnerships with land management agencies.

5.4 Land Tenure

Approximately 2,500 acres located to the south of the Salton Sea were originally leased to the Service by the IID in the 1940s and 1950s. The original leases expired some time ago with IID electing to lease the lands on a year-to-year basis rather than entering into any new long-term leases with the Service.

The Service is currently working with the IID to establish longer term leases for lands needed to meet Refuge purposes into the future. Factors such as the receding Salton Sea and changes in land use to support geothermal development could result in modifications to the configuration of the IID lands currently being utilized for Refuge purposes. IID lands needed to accommodate geothermal development (e.g., plants, transmission and pipeline corridors, access roads) would no longer be leased to the Service, as such uses would likely not be considered compatible with Refuge purposes. There is, however, the potential that IID lands may be available elsewhere in the vicinity of the Refuge that could be leased to the Service to ensure that adequate acreage is available to meet the habitat needs of the species currently supported on the Refuge. Such changes to the current configuration of the Refuge would be implemented to ensure that the Refuge purposes, goals, and objectives outlined in the CCP would continue to be met and activities occurring within the lands managed by the Refuge would be compatible with those purposes.

The changing conditions within the Salton Sea may also influence future land tenure. As the Salton Sea continues to recede, it will be necessary to evaluate how the current configuration of lands managed by the Service are or are not assisting in the achievement of Refuge purposes. When deemed appropriate, a step-down plan would be prepared to evaluate the status of the lands managed as a part of the Refuge. This step-down plan may identify opportunities to exchange areas under the jurisdiction and management of the Service for areas owned by other entities. Coordination with the Palm Springs Fish and Wildlife Office would be initiated during step-down planning if changes in land tenure could adversely affect listed species.

5.5 Step-down Plans

In some cases, achieving the management objectives presented in the CCP for public use and wildlife and habitat management will require more in-depth planning than is currently provided in the CCP. For these projects, the Service prepares step-down plans. Step-down plans provide additional planning and design details necessary to implement the strategies (projects or programs) identified in the CCP. Three step-down plans were been prepared in association with this CCP, an Integrated Pest Management Plan for the Refuge Complex (Appendix G) and a Predator Management Plan (Appendix H) and a Hunt Plan (Appendix I) for the Sonny Bono

Salton Sea NWR. The environmental consequences of implementing these plans were addressed in Chapter 5 of the EA (Appendix F).

5.5.1 Step-Down Plans Accompanying the CCP

Integrated Pest Management Plan

An Integrated Pest Management (IPM) Plan has been prepared for the Sonny Bono Salton Sea NWR Complex in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. 136r-1) and Part 517 DM 1 of the Department of the Interior's Departmental Manual. The complete document is provided in Appendix G.

The purpose of preparing an IPM Plan is to provide a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. The Service is mandated to manage pests and use IPM principles in a manner that reduces risks from both the pests and associated pest management activities. IPM is a science-based, decision-making process that incorporates management goals, consensus building, research, pest biology, environmental factors, pest detection, monitoring, and the selection of the best available technology to prevent unacceptable levels of pest damage. In developing the IPM Plan, full consideration has been given to the safety and protection of humans and other non-target organisms and resources.

Along with a detailed discussion of IPM techniques, the IPM Plan for the Sonny Bono Salton Sea NWR Complex describes the selective use of pesticides, primarily herbicides, on the Refuge. Various herbicides are proposed for use in combination with other pest management activities to ensure the availability of quality habitat to support migratory and resident birds and other wildlife. The IPM Plan also addresses application techniques, including aerial application of herbicides within the Refuge's managed agricultural fields and areas of the Refuge that currently support extensive monocultures of salt cedar.

The IPM Plan describes the approval process to be followed when pesticides are proposed for use within the Complex. Depending on the product, Pesticide Use Proposals (PUPs) are submitted for review and approval at the Project Leader, Regional Office, or Washington Office level. Unless an IPM Plan is in place, all PUPs must be submitted for review and approval at the appropriate level on an annual basis. With an approved IPM Plan in place, a Chemical Profile is developed for the proposed pesticide and a PUP is then reviewed at the appropriate level. If approved, for the next four years following approval, the PUP need only be reviewed and approved at the field level. If however the Refuge were to propose a substantial change in the use pattern of an approved PUP, review by the Regional or Washington Office, depending upon the product, would be required before this change could be implemented on the Refuge.

The primary focus of the IPM Plan for the Sonny Bono Salton Sea NWR Complex is on controlling invasive plants. The approved IPM Plan will continue to be reviewed and updated as needed throughout the life of the CCP to address new information and policy changes.

Predator Management Plan

A Predator Management Plan, provided in Appendix H, has been prepared for the Sonny Bono Salton Sea NWR to reduce the effects of mammalian predation on nesting gull-billed terns and black skimmers, both identified as Birds of Conservation Concern by the Service. Predator management along with proposals to expand and improve nesting opportunities for these ground nesting seabirds is intended to restore conditions that support the successful reproduction of these species on the Refuge. Predator management on the Refuge will involve the use of both lethal and

nonlethal control methods, with the use of lethal control limited to those individual predators that pose a threat to gull-billed tern and black skimmer chicks, eggs, and adults.

Hunt Plan

A hunt plan (Appendix I) for the Sonny Bono Salton Sea NWR has been prepared in accordance with 605 FW2 (Hunting) of the Service Manual and Title 50, Part 32 of the Code of Federal Regulations. The hunt plan describes the details of the Refuge's hunting program, which is managed by CDFW. The hunt plan does not include any changes to how the hunting program was implemented prior to the development of the CCP.

5.5.2 Future Step-Down Plans

Several additional step-down plans are proposed for completion in the future. Table 5-5 lists these step-down plans along with target dates for completion.

Table 5-5
Future Step-down Plans Proposed
for the Sonny Bono Salton Sea National Wildlife Refuge Complex

Plan	*Description*	*Target for Completion*
Habitat Management Plan (HMP), Coachella Valley NWR	Consistent with Service Manual Section 620 FW 1 (Habitat Management Plans), the HMP will include an inventory and description of the habitats on the Coachella Valley NWR, as well as identification and discussion of refuge resources of concern, habitat goals and objectives, and habitat management strategies. This HMP will likely be a subset of the larger Reserve Management Unit Plan adopted for Unit 1 of the Coachella Valley MSHCP in 2012.	FY2016
Inventory and Monitoring Plan (IMP), Coachella Valley NWR	Consistent with the Inventory and Monitoring Initiative, the IMP, to be prepared in a concise, user-friendly format, will prioritize surveys based on input provided in the HMP and Reserve Management Unit Plan and provide guidance for improving the quality, consistency, utility, and long-term storage of monitoring data. Consistent with the Reserve Management Unit Plan, data collected for this effort will also be submitted for entry into the GIS database for the Reserve Management Unit and the Coachella Valley MSHCP area.	FY 2017
Yuma Ridgway's Rail Management Plan, Sonny Bono Salton Sea NWR	Per the draft revised Yuma Clapper Rail Recovery Plan (USFWS 2010c), this plan will address: the long-term protection and management of Refuge core rail habitat areas; long-term monitoring requirements; rail population goals; measures to ensure successful maintenance of rails and their habitats; an evaluation of potential movement within and to and from the Refuge; the need to secure a long-term water source of a quantity and quality sufficient to manage the Refuge's rail habitat; and management actions needed to control the threat to rails associated with current and future selenium levels.	FY2016
Visitor Services Plan, Sonny Bono Salton Sea NWR	This plan will provide an integrated analysis of all applicable aspects of the visitor service programs on the Refuges within the Sonny Bono Salton Sea NWR Complex. Specific strategies needed to achieve the visitor services goals and objectives included in the CCP will be addressed, and detailed information and future plans for compatible wildlife-dependent recreational uses and their supporting recreational activities and facilities will be provided.	FY2017

Table 5-5 Future Step-down Plans Proposed for the Sonny Bono Salton Sea National Wildlife Refuge Complex		
Plan	***Description***	***Target for Completion***
HMP, Sonny Bono Salton Sea NWR	The HMP will include an inventory and description of the habitats on the Sonny Bono Salton Sea NWR, as well as identification and discussion of refuge resources of concern, habitat goals and objectives, and habitat management strategies.	FY2018
Visitor Services Plan, Coachella Valley NWR	This plan will focus on providing appropriate public outreach and interpretation of the resources protected on the Refuge by working in partnerships with others to provide this information primarily at off-refuge locations.	FY2018
IMP, Sonny Bono Salton Sea NWR	The IMP will prioritize surveys based on input provided in the HMP, and provide guidance for improving the quality, consistency, utility, and long-term storage of monitoring data.	FY 2019
Land Status Review, Sonny Bono Salton Sea NWR	This step-down plan will evaluate the status of the lands currently being managed as part of the Refuge in light of the changing circumstances at the Salton Sea, determine if changes in land tenure may be necessary in order for the Refuge to continue to meet its Refuge purposes and goals, and if necessary, make recommendations for changes to the Refuge's current land status.	FY 2022

5.6 Fire Management Plan

Per the Department of the Interior fire management policy, all refuges with vegetation that can sustain fire must have a Fire Management Plan (FMP) that details fire management guidelines for operational procedures and values to be protected and enhanced. Fire management plans outline the fire management objectives for a Refuge, including as appropriate, suppression and prescribed fire strategies.

Values considered in a FMP include protection of Refuge resources and neighboring private properties, effects of burning on refuge habitats/biota, and firefighter safety. Refuge resources include properties, structures, cultural resources, trust species including endangered, threatened, and species of special concern, and their associated habitats. FMPs are reviewed periodically to ensure that the fire program is conducted in accordance and evolves with the Service mission and the goals and objectives of the Refuges covered by the plan.

The currently approved FMP for the Sonny Bono Salton Sea NWR (USFWS 2001) addresses fire management strategies that focus on preparedness, wildland fire operations, prevention, detection, and full suppression. Prescribed fire is also included as a strategy for achieving management objectives within the Sonny Bono Salton Sea NWR.

In 2003, the Coachella Valley NWR was determined to be exempt from developing a FMP because the Refuge contained essentially no burnable vegetation due to weather and fuels conditions that prevent ignition and fire spread. In addition, there were no plans to conduct prescribed burning. If conditions change in the future, a FMP would be prepared for the Coachella Valley NWR.

5.7 Cultural Resource Management

To avoid adverse effects to cultural resources, the following procedures will be implemented for all proposals that require subsurface disturbance in previously undisturbed areas or require ground disturbance at depths that extend beyond the depths of previous ground disturbing activities within the proposed project area:

a. Prepare and submit a Request for Cultural Resource Compliance (Appendix D) to the Regional Cultural Resources Program as early in the planning process as possible, and include a map, indicating the full extent of the area of potential effect along with a detailed project description;
b. Implement any measures deemed necessary by the Cultural Resource staff to protect cultural resources (in an area of sensitivity for an archaeological resource, measures may include having an archaeological monitor present during activities affecting subsurface materials), or if the action falls under the terms of the Service's Programmatic Agreements with SHPO and the Advisory Council for Historic Preservation, retain this documentation in the project file;
c. If during the course of ground disturbing activities, any cultural resources are discovered, all earthwork on the site would be stopped and the Service's Regional Historic Preservation Officer would be contacted to review the materials and recommend a treatment that is consistent with applicable laws and policies, the site would be recorded and evaluated for eligibility to the NRHP, and all measures required to protect or otherwise mitigate impacts to the site would be implemented (if the site is determined to be eligible to the NRHP, the Service, through the Regional Historic Preservation Officer, would consult with SHPO, federally recognized tribes, and interested parties); and
d. Proper care for any federally owned and administered archaeological collections would be provided in accordance with all applicable Federal regulations, including ensuring that significant prehistoric and historic artifacts and associated records are deposited in an institution with adequate long-term curatorial capabilities (i.e., providing professional, systematic, and accountable curatorial services on a long-term basis).

To identify and preserve traditional cultural properties and sacred sites on the Refuge and to determine the level of confidentiality necessary to protect them, the Refuge will work with interested tribal groups to establish government-to-government relationships that will ensure meaningful consultation with tribal governments during the planning phase of projects. The Refuge Complex will initiate discussions with interested tribal groups to create a MOU to implement the inadvertent discovery clause of NAGPRA. Development of this MOU will involve identifying the Native American tribes, groups, and direct lineal descendants that may be affiliated with these Refuge lands, initiating consultation with the affiliated parties, developing procedures to follow for intentional and inadvertent discoveries, and identifying the persons to contact for the purposes of NAGPRA.

5.8 Compatibility and Appropriate Use Determinations

The Improvement Act requires that all uses permitted on a NWR be compatible with Refuge purposes and the mission of the NWRS; further, they shall not be inconsistent with public safety. Before activities or uses are allowed on a Refuge, uses must be found to be both appropriate and compatible. A compatible use is defined as a proposed or existing wildlife-dependent recreational use or any other use of a Refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes for

which a Refuge was established. A determination of whether or not a use is appropriate is required for all but wildlife-dependent recreational uses, which are identified in the Improvement Act as hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

Compatibility determinations prepared for the Sonny Bono Salton Sea NWR include waterfowl hunting; recreational fishing; wildlife observation, photography, and interpretation; environmental education; and research. For the Coachella Valley NWR, compatibility determinations were prepared for Environmental Education, Research, and Equestrian/Hiking Trail. An appropriate use evaluation was prepared for research and equestrian/hiking trail. All documents are provided in Appendix E.

5.9 Inventory, Monitoring, and Evaluation

The core mission of the Refuge System is to conserve, manage and restore fish, wildlife and plant resources and their habitats. To evaluate progress toward meeting the Refuge System's conservation, management and restoration objectives, Refuges are tasked with monitoring the status and trends of their priority biological resources. Accomplishing this requires that all phases of the data management cycle be addressed, including identifying priority resources of concern and appropriate monitoring attributes, developing appropriate study designs, selecting protocols, collecting data, entering and analyzing data, reporting results, and archiving significant documents and data for future generations. Additionally, effective stewardship of Refuge System lands depends on the availability of relevant and accurate data to guide management decision making. This information will be developed for the Refuge Complex as part of future step-down plans, including habitat management plans (HMPs) and inventory and monitoring plans (IMPs).

In 2012, Inventory and Monitoring Initiative staff (I&M staff) from Region 8 conducted an Inventory and Monitoring Needs Assessment at various refuges throughout the region, including the Sonny Bono Salton Sea NWR. This assessment was conducted to identify and summarize inventory and monitoring needs of individual stations. As part of the assessment, I&M staff populated the Planning and Review of Inventory and Monitoring on Refuges (PRIMR) Access database of natural resource surveys with available current, historical and planned surveys of abiotic features, biological resources and natural resource stressors on stations. Details such as survey type, timing, duration, lead organization, and protocol were included. Collection of baseline data will continue at both Refuges. These data will be used to update existing species lists, wildlife habitat requirements, and seasonal use patterns, and will be utilized and expanded upon during the development of HMPs and IMPs for the Sonny Bono Salton Sea and Coachella Valley NWRs.

Monitoring the effects of management actions on Refuge trust resources is an important component of the CCP, as is the documentation of Refuge baseline conditions. By completing baseline inventories and monitoring specific management actions, Refuge staff can better understand the species, habitats, and physical processes that occur on the Refuge and the ecological interactions that occur between species. With this information, Refuge staff can also identify changes in populations or population trends that may be occurring on the Refuge as a result of factors including, but certainly not limited to disturbance, competition from invasive species, changes in water quality and quantity, and climate change.

Monitoring of federally listed species and other special status species is an ongoing management activity within the Refuge Complex. As described in Chapter 3, monitoring is implemented by Refuge staff, other public, private, academic, and nonprofit partners, and researchers and is

expected to be funded through a variety of funding sources from both within and outside the Service. These monitoring programs will provide valuable information needed to assess the quality of the habitats, as well as to provide Refuge-specific data needed to evaluate the effectiveness of the various wildlife and habitat management strategies proposed and to determine if changes in management are necessary to achieve Refuge purposes and goals.

Monitoring of public use programs will involve the continued collection of visitor use statistics and an assessment of how public use activities are affecting wildlife and habitat quality. The data obtained will then be used to evaluate the overall effects of public use on Refuge resources, as well as to determine if the public use opportunities provided by the Refuge Complex are achieving proposed objectives for improving visitor understanding of Refuge resources, connecting people with nature, and providing a positive visitor experience.

5.10 Adaptive Management

The Service acknowledges that much remains to be learned about the species, habitats, and physical processes that occur on refuge lands, and about the ecological interactions between them. Developing a better understanding of these processes and interactions is further complicated by ongoing changes associated with climate change, receding water levels in the Salton Sea, increased fire frequency in the Coachella Valley, and presence of non-native species within native habitats. Uncertainty is an unavoidable component of managing natural systems because of their complexity, inherent variability, and gaps in our knowledge of their functions. Adaptive management involves sequential decision making, integrating project design, management, and monitoring to systematically test assumptions. It strives to reduce some of that uncertainty and improve management over time by allowing us to evaluate and refine management based on the results of management activities and the status of the managed resource. The Service has been practicing adaptive management on the Refuge since its establishment and plans to continue the practice. Accordingly, the proposed management scenarios for the two refuges within the Sonny Bono Salton Sea NWRC provide for ongoing adaptive management.

In designing and implementing an adaptive management strategy, it may be necessary at some point during the next 15 years to amend the CCP in response to changing conditions. Adequate baseline data, clearly defined and measurable project objectives, a monitoring plan focused on measurable results, and a process for refining and improving current and future management actions are all essential components of a successful adaptive management approach. For proposed restoration projects, the details of the adaptive management approach would be integrated into final restoration plans.

The adaptive management process would be used to evaluate our success in achieving our public use goals and objectives. These periodic evaluations would be used over time to adapt both our public use objectives and strategies to better achieve our goals. Such a system embraces uncertainty, reduces option foreclosure, and provides new information for future decision-making.

5.11 Partnership Opportunities

Partnerships will continue to play an important role in implementing the various strategies presented in the CCP. Achieving many of the objectives presented above will require various degrees of interaction and support from outside partners (e.g., other public and private land managers, USGS, IID, Valley Floor Reserve Unit Management Committee, CVCC). Through ongoing partnerships with other land managers in the region, staff and funding can be leveraged to

implement management and monitoring strategies that benefit multiple ownerships. Such an example is active participation in the Valley Floor Reserve Unit Management Committee and coordination of activities on the Coachella Valley NWR with the recommended actions within the RMU Plan for Unit 1 (CVCC 2012a). Implementing public use programs and public outreach will also require the continuation of existing partnerships, as well as the development of new partnerships.

Restoration efforts will also involve partnerships with other Federal, State, and/or local agencies, researchers, and non-governmental organizations. Protection of cultural resources will require partnerships with the region's Native American community on issues such as resource protection, interpretation, and repatriation.

The needs and opportunities for research within the Refuge Complex are vast and it is only through partnerships that these needs can even begin to be met. For example, expanded partnerships with academic institutions, USGS, and others could provide valuable data related to the life history of little-known species protected on the Coachella Valley NWR, while other research could answer questions related to the threats to waterbirds from rising selenium levels in the Salton Sea, as well as how best to manage limited sand resources to protect endemic dune species.

5.12 Compliance Requirements

5.12.1 Federal Regulations, Executive Orders, and Legislative Acts

All projects and step-down plans described in the CCP are required to comply with NEPA and the Improvement Act, as well as a variety of other Federal regulations, executive orders, and legislative acts. Such requirements address issues such as human rights, cultural resources, biological resources, land and water use, Tribal coordination, and wilderness. Federal regulations, executive orders, or legislative acts applicable to projects proposed for implementation on the Sonny Bono Salton Sea NWR and Coachella Valley NWR are presented in Appendix J along with a summary of how the CCP will comply with these requirements. With respect to wilderness, the lands within both the Sonny Bono Salton Sea NWR and the Coachella Valley NWR have been inventoried and no areas were found that meet the eligibility criteria for a Wilderness Study Area as defined by the Wilderness Act. Therefore, potential wilderness designation of lands within the Sonny Bono Salton Sea NWR Complex is not analyzed further in the CCP. The results of the wilderness inventory are documented in Appendix M.

5.12.2 Potential Future Permit, Approval, and/or Review Requirements

The implementation of some actions described in this CCP may require additional analysis and review under NEPA, and potentially under the California Environmental Quality Act (CEQA) should the project include State partners or State funding. Prior to implementing some management actions, the Service may be required to obtain local, State, or Federal permits or approvals. Permits, approvals, or reviews that may be required for projects within the Sonny Bono Salton Sea NWR Complex include, but are not limited to the following:

- **U.S. Fish and Wildlife Service, Refuges** - Project level internal Section 7 consultation, as appropriate under the authorities of the Endangered Species Act, prior to implementing any actions that may affect federally listed endangered or threatened species.

- **U.S. Fish and Wildlife Service, Regional Cultural Resources Team** - Project level internal review of actions that could have an adverse effect on cultural resources pursuant to the National Historic Preservation Act and/or other regulations related to the protection of cultural resources. Compliance involves submitting a Request for Cultural Resource Compliance Form (Appendix D) to the Regional Cultural Resources Team, which will assist in notification to the Tribes and determine if consultation with the California State Historic Preservation Officer is required.

- **U.S. Army Corps of Engineers** - Clean Water Act Section 404 for projects, including restoration projects, that could discharge dredged or fill material into waters of the U.S.

- **California State Water Resources Control Board** - Clean Water Act Section 401 certification for discharges into waters of the U.S. and/or a General Permit for Discharges of Storm Water Associated with Construction Activity.

- **California State Historic Preservation Office** - Section 106 consultations under the authorities of the National Historic Preservation Act for any actions that may affect historic properties or cultural resources associated with listed properties (or those eligible for listing) on the National Register of Historic Places.

5.13 Conservation Measures to be incorporated into Future Projects

To ensure that proposed projects and other actions described in this CCP do not result in significant adverse effects to the environment, conservation measures will be implemented, as appropriate, in association with the development and/or carrying out of proposed projects and/or actions. Project specific measures were provided in Chapter 5 of the EA (Appendix F), and stipulations necessary to ensure compatibility are outlined in the Compatibility Determinations provided in Appendix E. An overview of the conservation measures to be considered is provided below.

General Conservation Measures for all Project Categories

- Consult with the appropriate departments at IID prior to implementing refuge projects located adjacent to IID facilities or easements.
- Follow all terms and conditions provided in regulatory permits and other official project authorizations or approvals.

Habitat and Species Protection Conservation Measures

- Avoid any disturbance within and provide adequate no disturbance buffers around habitat that supports sensitive nesting bird species during the breeding season;
- Minimize disturbance (e.g., noise, lighting, human presence) in sensitive habitat areas year round;
- Implement appropriate BMPs to minimize the potential for impacts to air and water quality related to soil exposure and erosion.
- To the extent feasible, use existing roadways or travel paths for access related to both project implementation and ongoing refuge activities;
- Adhere to the specific BMPs included on pesticide product Chemical Profiles to avoid impacts to Refuge trust species (refer to Appendix G for more details);
- Routinely evaluate the results of on-going species and habitat monitoring to determine if modifications in Refuge operations and/or management practices are necessary to address changes in population trends or habitat quality; and

- Survey proposed construction sites to identify and map the locations of all listed or sensitive species and/or sensitive habitats that could be affected by a project and then design the proposed facility to avoid to the extent practicable any impacts to these resources; where impacts cannot be avoided, implement measures to mitigate these impacts to below a level of significance (e.g., habitat restoration).

Water Quality Conservation Measures

- Obtain a Construction General Permit (2009-0009-DWQ) from the California State Water Resources Control Board and prepare a Storm Water Pollution Prevention Plan for construction activities involving grading and/or major brush removal;
- Implement appropriate erosion control measures (e.g., fiber rolls, filter fabric, silt fencing) during and after land disturbance to minimize short and long-term erosion into wetlands;
- Carry out the appropriate BMPs, including those outlined in the IPM Plan, when applying pesticides on the Refuge; and
- Implement the following BMPs when construction vehicles or equipment are being used to implement a project:
    - Specify and follow vehicle and equipment fueling procedures and practices that are designed to minimize or eliminate the discharge of fuel spills and leaks, particularly when operating in or around wetlands;
    - To the extent practicable, do not allow vehicle/equipment fueling within 50 feet of a wetland or downstream drainage facility and use berms and/or dikes around fueling areas to prevent run-on, runoff, and to contain spills;
    - Inspect construction vehicles and equipment for leaks prior to each day of use and if a leak is discovered, immediately implement repairs; and
    - Maintain a spill kit on the construction site at all times when construction equipment is present.

Air Quality Conservation Measures

- Effectively stabilize graded or disturbed areas during construction to minimize dust generation by:
    - watering prior to and during any earth movement, when necessary;
    - installing wind fencing, if deemed necessary; and
    - stopping work during high wind conditions;
- Cover temporary stockpiles of excavated material with a suitable cover such as a tarp when dry, windy conditions are predicted in the area;
- Cover the load of all haul vehicles during the transport of dirt or other dust generating materials;
- Wash or sweep all construction vehicles and equipment prior to leaving the project site to avoid tracking dirt and dust onto public roads;
- Ensure that all construction equipment meets APCD air quality standards; and
- Carry out the appropriate BMPs, as outlined in the IPM Plan (Appendix G), when applying herbicides.

Cultural and Paleontological Resource Protection Measures

- To protect cultural resources, follow the measures outlined in section 5.7.
- To protect paleontological resources,
    - identify the paleontological sensitivity of the project area (i.e., the potential for a stratigraphic or bed unit to yield significant paleontological resources); and

  - in areas of high paleontological sensitivity, work with the Regional Cultural Resources Program to determine if a paleontological monitoring plan is required based on a review of the proposed project.

- If the preparation of a paleontological monitoring plan is deemed necessary, develop the plan in consultation with the Regional Cultural Resources Program and enter into a formal agreement with a recognized museum repository for the curation of any fossils that may be uncovered.
- Prior to commencing construction activity in an area of high paleontological sensitivity, retain a certified paleontologist to supervise the monitoring of construction excavations (involving inspection of exposed rock units and microscopic examination of matrix to determine if fossils are present), and to produce a Paleontological Resource Management Recovery Plan, should one be required.
- For construction activities to be implemented in an area of high paleontological sensitivity, the construction supervisors and crew would receive training from a certified paleontologist on the procedures for identifying and protecting paleontological resources, as well as the procedures to be implemented in the event fossil remains are encountered during ground-disturbing activities.
- The paleontological monitor, who would have authority to temporarily divert grading away from exposed fossils to recover the fossil specimens, would document the results of the construction monitoring program.
- Should fossils be encountered, field data forms would be completed for each fossil locality. The locality would be recorded, the stratigraphic columns measured, and appropriate scientific samples submitted for analysis.

5.14 Plan Amendment and Revision

CCPs are intended to evolve with each Refuge, and the Improvement Act specifically requires that these plans be formally revised and updated at least every 15 years. The formal revision process will follow the same steps as those implemented for the initial CCP development process, with a major emphasis placed on public involvement. Until a formal revision is initiated, the Service will periodically review and update the CCP (at least as often as every five years) to address needs identified as a result of monitoring or in response to adaptive management procedures. This CCP will also be informally reviewed by Refuge staff while preparing annual work plans and updating the Refuge databases. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the plan. The goals described in this CCP will not change until they are reevaluated as part of the formal CCP revision process. However, the objectives and strategies may be revised to better address changing circumstances or to take advantage of increased knowledge of Refuge resources. If revisions to the CCP are required prior to the initiation of formal revisions, the level of public involvement and associated NEPA documentation will be determined by the Refuge Manager.

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Appendices

Appendix A. List of Preparers, Planning Team Members, and Persons/Agencies Consulted

Appendix B. Glossary of Terms

Appendix C. Species Lists

Appendix D. Request for Cultural Resource Compliance Form

Appendix A

List of Preparers, Planning Team Members, and Persons/Agencies Consulted

Appendix A: List of Preparers, Planning Team Members, and Persons/Agencies Consulted

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Appendix B

Glossary of Terms

Appendix B: Glossary of Terms

1. Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
Action Plan	California's Wildlife Action Plan
ADA	Americans with Disabilities Act
ADT	average daily traffic volumes
AHPA	Archaeological and Historic Preservation Act
APCD	air pollution control district
APE	Area of Potential Effect
ARB	California Air Resources Board
ARPA	Archaeological Resources Protection Act
ATV	all-terrain vehicle
Basin Plan	Water Quality Control Plan for the Colorado River Basin Region
BCR	Bird Conservation Regions
BEST	Biomonitoring of Environmental Status and Trends Program
BLM	Bureau of Land Management, Department of the Interior
BMPs	Best Management Practices
CAAQS	California Ambient Air Quality Standards
Caltrans	California Department of Transportation
CAP	Contaminants Assessment Process
CAPCOA	California Air Pollution Officers Association
CARB	California Air Resources Board
CCP	Comprehensive Conservation Plan
CDCA	California Desert Conservation Area
CDFW	California Department of Fish and Wildlife, formerly Department of Fish and Game (CDFG)
CDPH	California Department of Public
CEQ	President's Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm	centimeter
CO	Carbon monoxide
CO_2	carbon dioxide
CH_4	methane
CNDDB	California Natural Diversity Database Code
Complex	Sonny Bono Salton Sea National Wildlife Refuge Complex
CRWB	California Regional Water Quality Control Board, Colorado River Basin Region
CVAG	Coachella Valley Association of Governments
CVMVCD	Coachella Valley Mosquito and Vector Control District

CVWD	Coachella Valley Water District
CWA	Clean Water Act
DDT	dichlorodiphenyltrichloroethane
DDE	dichlorodiphenyldichloroethylene
DOI	Department of the Interior
DOT	Department of Transportation
EA	environmental assessment
EC	Environmental Contaminants Program of the USFWS
ECC	emergency command center
EIS	Environmental Impact Statement
EIR	Environmental Impact Report
EO	Executive order
ES	Ecological Services, USFWS
ESA	Federal Endangered Species Act
FAA	Federal Aviation Administrative
FDA	U.S. Food and Drug Administration
FEMA	Federal Emergency Management Agency
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FMMP	Farmland Mapping and Monitoring Program
FMO	fire management officer
FPPA	Farmland Protection Policy Act
FR	Federal Register
FTE	full-time equivalent
FY	Fiscal Year
GHGs	greenhouse gases
GPS	Global Positioning System
GS	General Service
HCP	Habitat Conservation Plan
HCPS	Hantavirus cardiopulmonary syndrome
HMP	habitat management plan
HSWA	Hazardous and Solid Waste Amendments
HUD	U.S. Department of Housing and Urban Development
H_2S	hydrogen sulfide
IA	Implementing Agreement
IBP	Institute for Bird Populations
ICAPCD	Imperial County Air Pollution Control District
IID	Imperial Irrigation District
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
IPCC	Intergovernmental Panel on Climate Change
IPM	integrated pest management
kV	kilovolt
LCC	Landscape Conservation Cooperative
LOS	level of service
LPP	Land Protection Plan
m^2	square meter
maf	million acre-feet
MBTA	Migratory Bird Treaty Act
MCLs	maximum contaminant levels
mg/kg	milligrams per kilogram
$\mu g/m^3$	micrograms per cubic meter
MOA	Memorandum of Agreement

MOU	Memorandum of Understanding
mph	miles per hour
MRZ	Mineral Resource Zone
MSDS	Material Safety Data Sheet
MSHCP	Multiple Species Habitat Conservation Program
MSL	mean sea level
Municipal Permit	Municipal Storm Water NPDES Permit
MWD	Metropolitan Water District of Southern California
NAAQS	National Ambient Air Quality Standards
NAF	Naval Air Facility
NAGPRA	Native American Graves Protection and Repatriation Act
NCCP	Natural Community Conservation Planning
NEPA	National Environmental Policy Act
ng/g	nanograms per gram
NGOs	non-government organizations
NHPA	National Historic Preservation Act
NIWQP	National Irrigation Water Quality Program
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOx	oxides of nitrogen
N_2O	nitrous oxide
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NVCS	National Vegetation Classification Standards
NWR	National Wildlife Refuge
NWRC	National Wildlife Refuge Complex
NWRS	National Wildlife Refuge System
O_3	ozone
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polycyclic aromatic hydrocarbons
Pb	lead
PCC	Portland cement concrete-grade aggregate
PC Region	production/consumption region
PCBs	polychlorinated biphenyls
PFRG	Pesticide Fate Research Group, U.S. Geological Survey
Plan Committee	North American Waterfowl Management Plan Committee
PM	particulate matter
PM_{10}	fugitive dust emissions or "inhalable particles" that are 10 microns (millionths of a meter) or less in diameter
$PM_{2..5}$	fine inhalable particles that are 2.5 microns and smaller
Ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
PUPS	Pesticide Use Proposal System
PUPs	Pesticide Use Proposals
PVC	polyvinyl chloride
QSA	Quantification Settlement Agreement
RCRA	Resource Conservation and Recovery Act of 1976
Reclamation	U.S. Bureau of Reclamation

ROD	Record of Decision
RONS	Refuge Operating Needs System
RV	recreational vehicle
RWQCB	Regional Water Quality Control Board
SAMMS	Service Asset Maintenance Management System
SCAG	Southern California Association of Governments
SCAQMD	South Coast Air Quality Management District
SCE	Southern California Edison
SCH Project	Salton Sea Species Habitat Conservation (SCH) Project
SE	State endangered
Service	U.S. Fish and Wildlife Service (also, USFWS)
SHPO	State Historic Preservation Office
SJV	Sonoran Joint Venture
SJVBCP	Sonoran Joint Venture Bird Conservation Plan
SLVBH	sediment bioaccumulation screening levels
SMCL-CA	California Department of Public Health secondary maximum contaminant level
SO_2	sulfur dioxide
SO_4	sulfates
SUP	Special Use Permit
SWRCB	California State Water Resources Control Board
SWPPP	Storm Water Pollution Prevention Plan
TBT	tributyltin
TDS	total dissolved solids
TMDLs	Total Maximum Daily Loads
TNC	The Nature Conservancy
TRPH	total recoverable petroleum hydrocarbons
UCR	University of California, Riverside
US	United States
USC	United States Code
USACOE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USDA APHIS	U.S. Department of Agriculture, Animal Plant Health Inspection Service
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service (also, Service)
USGS	U. S. Geological Survey
VCD	Vector Control District
VOCs	volatile organic compounds
WERC	Western Ecological Research Center, U. S. Geological Survey
WG	wage grade
WMP	Coachella Valley Integrated Regional Watershed Management Plan
WNV	West Nile Virus
°F	degrees Fahrenheit

2. Glossary of Terms

Accessibility. The state or quality of being easily approached or entered, particularly as it relates to complying with the Americans with Disabilities Act.

Accumulation. The build-up of a chemical in an organism due to repeated exposure.

Adaptive Management. The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Alternative. A reasonable way to fix an identified problem or satisfy a stated need, or a different set of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the refuge system mission, and resolving issues.

Aquatic. Pertaining to water, in contrast to land.

Artifact. An object used or made by humans, usually in reference to projectile points, tools, utensils, art, food remains, and other products of human activity.

Benthic. Refers to organisms associated with the bottom of the ocean, bay, lake, or river.

Biodiversity (Biological Diversity). Refers to the full range of variability within and among biological communities, including genetic diversity, and the variety of living organisms, assemblages of living organisms, and biological processes. Diversity can be measured in terms of the number of different items (species, communities) and their relative abundance.

Biological Integrity. Biotic composition, structure, and functioning at the genetic, organism, and community levels consistent with natural conditions, including the natural biological processes that shape genomes, organisms, and communities.

Biota. The plant and animal life of a region.

Categorical Exclusion. A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act.

Compatibility Determination. A written determination that a proposed or existing use of a National Wildlife Refuge is a compatible use or is not a compatible use.

Compatible Use. A proposed or existing wildlife-dependent recreational use or any other use of a National Wildlife Refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System Mission or the purposes of the Refuge on which the use would occur.

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of the refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge, helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates.

C**oncern**. See issue.

Contaminant. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

Critical Habitat. According to U.S. Federal law, the ecosystems upon which endangered and threatened species depend.

Cultural Resource. The physical remains of human activity (artifacts, ruins, petroglyphs, etc.) and conceptual content or context of an area such as a traditional sacred site. It includes historically, archaeologically and architecturally significant resources.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4.

Cultural Resource Review. A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved.

Disturbance. Significant alteration of habitat structure or composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft overflight). Also see wildlife disturbance.

Easement. A privilege or right that is held by one person or other entity in land owned by another.

Ecological Integrity. The integration of biological integrity, natural biological diversity, and environmental health; the replication of natural conditions.

Ecoregion. A territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.

Ecosystem. A dynamic and interrelating complex of plant and animal communities and their associated non-living environment.

Ecosystem Approach. Protecting or restoring the natural function (processes), structure (physical and biological patterns), and species composition of an ecosystem, recognizing that all components are interrelated.

Ecosystem Management. Management of natural resources using system-wide concepts to ensure that all plants and animals in ecosystems are maintained at viable levels in native habitats and basic ecosystem processes are perpetuated indefinitely.

Effect. A change in a resource, caused by a variety of events including project attributes acting on a resource attribute (direct), not directly acting on a resource attribute (indirect), another project attributes acting on a resource attribute (cumulative), and those caused by natural events (e.g., seasonal change).

Endangered Species (Federal). A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species (State). A plant or animal species in danger of becoming extinct or extirpated in California within the near future if factors contributing to its decline continue.

Environment. The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

Environmental Assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an Environmental Impact Statement or Finding of No Significant Impact.

Environmental Education. A process designed to develop a citizenry that has the awareness, concern, knowledge, attitudes, skills, motivation, and commitment to work toward solutions of current environmental problems and the prevention of new ones. Environmental education within the National Wildlife Refuge System incorporates materials, activities, programs, and products that address the citizen's course of study goals, the objectives of the refuge or unit, and the mission of the Refuge System.

Environmental Health. Abiotic composition, structure, and functioning of the environment consistent with natural conditions, including the natural abiotic processes that shape the environment.

Environmental Impact Report (EIR). A public disclosure document, required by the California Environmental Quality Act for all discretionary actions proposed by a State, local, or regional agency in the State of California, when a proposed action could result in significant adverse effects on the environment.

Environmental Impact Statement (EIS). A detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Federal Trust Resources. A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States of America as a result of Federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by the Migratory Bird Treaty Act and other international treaties, and native plant or wildlife species found on the Refuge System.

Finding of No Significant Impact (FONSI). A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Floodplain. The relatively flat area along the sides of a river which is naturally subjected to flooding.

Fluvial. Pertaining to a river.

Flyway. A route taken by migratory birds between their breeding grounds and their wintering grounds. Four primary migration routes have been identified for birds breeding in North America: the Pacific, Central, Mississippi, and Atlantic Flyways.

Foraging. The act of feeding; another word for feeding.

Forb. A broad-leaved, herbaceous plant.

Fragmentation. The process of reducing the size and connectivity of habitat patches.

Gastropod. Any of a large class of mollusks, usually with a univalve shell or no shell and a distinct head bearing sensory organs, such as snails and slugs.

Goal. Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units.

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Habitat Fragmentation. The breaking up of a specific habitat into smaller, unconnected areas.

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Habitat Type. See Vegetation Type.

Hydrologic Regime. The local pattern and magnitude of water flow influenced by season.

Hydrology. The science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere. The distribution and cycling of water in an area.

Impact. Refer to Effect.

Integrated Pest Management (IPM). Methods of managing undesirable species, such as weeds, including education; prevention, physical or mechanical methods or control; biological control; responsible chemical use; and cultural methods.

Interpretation. Interpretation can be an educational and recreational activity that is aimed at revealing relationships, examining systems, and exploring how the natural world and human activities are interconnected.

Invasive Species. Species that have been intentionally introduced to or have inadvertently infiltrated an area in which they are not naturally found. Invasive, non-native species compete with native species for food or habitat.

Inversion. A state in which the temperature of the air increases with increasing altitude and keeps the surface air and pollutants down.

Invertebrate. Animals that do not have backbones. Included are insects, spiders, mollusks (clams, snails, etc.), and crustaceans (shrimp, crayfish, etc.).

Issue. Any unsettled matter that requires a management decision (e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition).

Landbird. A category of birds that obtains at least part of their food from the land and nest in mainland areas (though some can also be found on islands). Landbirds include raptors and songbirds among others.

Landform. The physical shape of the land reflecting geologic structure and processes of geomorphology that have sculpted the structure.

Landowner. A person or entity indicated as the owner of property on the various ownership maps maintained by the Office of the County Assessor.

Lease. A legal contract by which rights to use land or water are acquired for a specified period of time for a specified rent or compensation.

Management Alternative. A set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4].

Management Concern. Refer to Issue.

Marsh Habitat. Habitat that is characterized by shallow water and emergent vegetation; unless otherwise specified, this term does not apply to similar habitat found in rivers, drains, or canals.

Migration. The seasonal movement from one area to another and back.

Migratory Bird. A bird that seasonally moves between geographic areas.

Mitigation. To avoid or minimize impacts of an action by limiting the degree or magnitude of the action; to rectify the impact by repairing, rehabilitating, or restoring the affected environment; to reduce or eliminate the impact by preservation and maintenance operations during the life of the action.

Model. A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Monitoring. The process of collecting information to track changes of selected parameters over time. Monitoring is necessary to identify, track and analyze results of management actions at the Refuge so that future management actions may be adapted to obtain the best benefits to wildlife and habitat. See also Adaptive Management.

National Environmental Policy Act (NEPA). An act which encourages productive and enjoyable harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and atmosphere, to stimulate the health and welfare of humans. The act also established the Council on Environmental Quality. The Act requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making.

National Wildlife Refuge (Refuge or NWR). A designated area of land or water or an interest in land or water within the Refuge System, including National Wildlife Refuges, Wildlife Ranges, Wildlife Management Areas, Waterfowl Production Areas, and other areas (except Coordination Areas) under Service jurisdiction for the protection and conservation of fish and wildlife.

National Wildlife Refuge System. Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; games ranges; wildlife management areas; or waterfowl production areas.

National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Under the Refuge Improvement Act, the Service is required to develop 15-year Comprehensive Conservation Plans for all National Wildlife Refuges outside Alaska. The Act also describes the six public uses given priority status within the NWRS (i.e., hunting, fishing, wildlife observation, photography, environmental education, and interpretation).

National Wildlife Refuge System Mission. "The mission of the system is to administer a National network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

Native Species. Species that normally live and thrive in a particular ecosystem.

Natural Recruitment. Plant establishment through natural processes.

Neotropical Migratory Birds. Migratory birds that breed in North American and winter in Central and South America.

No Action Alternative. An alternative under which existing management would be continued.

Notice of Intent (NOI). A notice that is published in the Federal Register announcing that an Environmental Impact Statement will be prepared and considered for a specific action.

Objective. An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively.

One-Hundred-Year Floodplain. The relatively flat portion of the river channel that has a one percent chance of being inundated by flood water in any given year.

Opportunities. Potential solutions to issues.

Outreach. Two-way communication between the Service and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with goal of improving joint stewardship of our natural resources.

Flooding. River flows that exceed the boundaries of the existing river channel and/or levees and flood adjacent areas.

Paleontological Resource. Any fossilized remains, traces, or imprints of organisms, preserved in or on the earth's crust, that are of paleontological interest and that provide information about the history of life on earth.

Passerine Bird. A songbird or other perching bird that is in the order Passeriformes (blackbirds, crows, warblers, sparrows, and wrens for example).

Peak Flow. The maximum discharge of a stream or river during a specified period of time.

Perennial. In reference to a body of water, one that contains water year-to-year and that rarely goes dry.

Permeability. The property or capacity of porous rock, sediment, or soil to transmit water.

Phenology. The life cycle of particular species.

Planning Area. The area upon which a planning effort is focused.

Planning Team. A team or group of persons working together to prepare a document. Planning teams are interdisciplinary in membership and function and generally consist of a planning team leader, refuge manager and staff biologists, a state natural resource agency representative, and other appropriate program specialists (e.g., social scientist, ecologist, recreation specialist).

Planning Unit or Unit. A single refuge, an ecologically or administratively related refuge complex, or distinct unit of a refuge. The planning unit also may include lands currently outside refuge boundaries.

Plant Association. A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community.

Plant Community. An assemblage of plant species of a particular composition. The term can also be used in reference to a group of one or more populations of plants in a particular area at a particular point in time; the plant community of an area can change over time due to disturbance (e.g., fire) and succession.

Population. All the members of a single species coexisting in one ecosystem at a given time.

Preferred Alternative. This is the alternative determined by the decision maker to best achieve the Refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management.

Prescribed Fire. The skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that allows confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

Prime Farmland. Farmland in an area or region that is considered to be the most ideal farmland based on several criteria; usually soil types and land productivity of the land are two of the most important criteria.

Priority Public Uses. Compatible wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

Proposed Action. The Service's proposed action for Comprehensive Conservation Plans.

Public. Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Public Involvement. A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

Public Scoping. See Public Involvement.

Purpose(s) of the Refuge. The purpose of a refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorization, or expanding a refuge, refuge unit, or refuge subunit.

Raptor. A category of carnivorous birds, most of which have heavy, sharp beaks, strong talons, and take live prey (e.g., peregrine falcon, northern harrier). Also referred to as a bird of prey.

Record of Decision (ROD). A concise public record of decision prepared by the Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation.

Recruitment. The annual increase in a population as determined by the proportion of surviving offspring produced during a specific period (usually expressed per year).

Refuge Goal. Refer to Goal.

Refuge Operating Needs System (RONS). A national database that contains the unfunded operational needs of each refuge. The Service includes projects required to implement approved plans and meet goals, objectives, and legal mandates.

Refuge Purposes. Refer to Purposes of a Refuge.

Refuge Use. Any activity on a refuge, except administrative or law enforcement activity carried out by or under the direction of an authorized service employee.

Refuge Vision. A succinct statement of the unit's purpose and reason for being.

Restoration. The return of an ecosystem to an approximation of its former unimpaired condition.

Revetment. A facing of stone, concrete, or other material placed on a riverbank to protect it from erosion.

Rhizomes. Rootlike stem growing horizontally below the surface. The rhizome is used for food storage and can produce roots and shoots.

Riparian. Refers to an area or habitat that is transitional from terrestrial to aquatic ecosystems; including streams, lakes wet areas, and adjacent plant communities and their associated soils which have free water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, "riparian" describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes any and all plant life growing on the land adjoining a stream and directly influenced by the stream.

Riparian Habitat. Gravel bars, sand dunes, non-vegetated riverbanks, herbaceous, scrub and forested vegetation, which provides habitat for plants, macro-invertebrates, fish and wildlife.

Riverine. Freshwater wetlands and deepwater habitats within a channel containing periodically or continuously moving water. It includes wetlands with primarily or mostly submerged vegetation but does not include those wetlands with mostly emergent vegetation or shrubs and trees. This habitat encompasses a river or stream, its channel, and the associated aquatic vegetation. Can also pertain to rivers and floodplains.

Seiche. A sudden fluctuation of water levels on a lake or inland sea, potentially the result of an earthquake.

Sediment. Any material, carried in suspension by water, which ultimately settles to the bottom of water courses. Sediments may also settle on stream banks or flood plains during high water flow.

Soil Erosion. The wearing away of the land's surface by water, wind, ice, or other physical process.

Songbirds. A category of birds that includes medium to small, perching landbirds. Most are territorial singers and migratory. (Refer also to Passerines.)

Sound Professional Judgment. A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act of 1966 (16 U.S.C. 668dd-668ee), and other applicable laws. Included in the finding, determination, or decision is a refuge manager's field experience and knowledge of the particular refuge's resources.

Species. A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.

Species Composition. A group of species that inhabit a specific habitat type in its healthy state.

Species Diversity. Usually synonymous with "species richness," but may also include the proportional distribution of species.

Step-down Management Plan. A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives.

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives.

Study Area. The area reviewed in detail for wildlife, habitat, and public use potential. For purposes of this CCP/EIS the study area includes the land and water within the approved Refuge boundary.

Subsidence. Movement to a lower level or elevation.

Surface Water. A body of water that has its upper surface exposed to the atmosphere.

Terminus. In reference to a stream or river, its end point; where it flows into a lake or other basin.

Threatened Species (Federal). Species listed under the Endangered Species Act that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

Tiering. The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues.

Trace Elements. Metallic elements generally occurring in trace amounts in water, including iron, manganese, copper, chromium, arsenic, mercury, and vanadium.

Turbidity. Cloudiness of a water body caused by suspended silt, mud, pollutants, or algae.

U.S. Fish and Wildlife Service Mission. "Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

Upland. An area where water normally does not collect and where water does not flow on an extended basis. Uplands are non-wetland areas.

Vegetation. The composition of plant species, their frequency of occurrence, density, and age classes at a specified scale.

Vegetation Community. Refer to Plant Community.

Vegetation Type or Habitat Type. A land classification system based upon the concept of distinct plant associations.

Waterfowl. A group of birds that include ducks, geese, and swans (belonging to the order Anseriformes).

Watershed. The entire land area that collects and drains water into a river or river system.

Wetland. Land that is transitional between upland (terrestrial) and aquatic systems (greater than about 6-feet deep) where the water table is usually at or near the surface or the land is covered by shallow water.

Wetland Habitat. Habitat provided by shallow or deep water (but less than 6-feet deep), with or without emergent and aquatic vegetation in wetlands. Wetland habitat only exists when and where a wetland or portion of a wetland is covered with water (visible surface water). Consequently, the size and shape of "wetland habitat" will fluctuate from season to season and year to ear while the size and shape of the "wetland" within which wetland habitat occurs will remain constant from season to season and from year to year.

Wildfire or Wildland Fire. A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands.

Wildlife. All non-domesticated animal life; included are vertebrates and invertebrates.

Wildlife Corridor. A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic, including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival of reproduction of its migrants.

Wildlife-dependent Recreational Use. "A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation." These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended.

Appendix C

Species Lists

Appendix C: Species Lists

SONNY BONO SALTON SEA NATIONAL WILDLIFE REFUGE

Bird Species List

The following list includes bird species that have been observed within the Sonny Bono Salton Sea NWR and nearby habitats. The birds' common and scientific names are provided in accordance with the 7th edition (1998), 12th Supplement (2012) of the A.O.U. Checklist of North American Birds.

Common Name	Scientific Name
Black-bellied Whistling-duck	*Dendrocygna autumnalis*
Fulvous Whistling-duck	*Dendrocygna bicolor*
Taiga Bean-Goose	*Anser fabalis*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Ross's Goose	*Chen rossii*
Brant	*Branta bernicla*
Cackling Goose	*Branta hutchinsii*
Canada Goose	*Branta canadensis*
Trumpeter Swan	*Cygnus buccinator*
Tundra Swan	*Cygnus columbianus*
Wood Duck	*Aix sponsa*
Gadwall	*Anas strepera*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acute*
Green-winged teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Black Scoter	*Melanitta americana*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*

Common Name	**Scientific Name**
Gambel's Quail	*Callipepla gambelii*
Ring-necked Pheasant	*Phasianus colchicus*
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Least Grebe	*Tachybaptus dominicus*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
Laysan Albatross	*Phoebastria immutabilis*
Cook's Petrel	*Pterodroma cookii*
Wedge-tailed Shearwater	*Puffinus pacificus*
Buller's Shearwater	*Puffinus bulleri*
Sooty Shearwater	*Puffinus griseus*
Leach's Storm-Petrel	*Oceanodroma leucorhoa*
Black Storm	*Oceanodroma melania*
Least Storm-Petrel	*Oceanodroma microsoma*
Wood Stork	*Mycteria americana*
Magnificent Frigatebird	*Fregata magnificens*
Blue-footed Booby	*Sula nebouxii*
Brown Booby	*Sula leucogaster*
Brandt's Cormorant	*Phalacrocorax penicillatus*
Neotropic Cormorant	*Phalacrocorax brasilianus*
Double-crested Cormorant	*Phalacrocorax auritus*
Anhinga	*Anhinga anhinga*
American White Pelican	*Pelecanus erythrorhynchos*
Brown Pelican	*Pelecanus occidentalis*
American Bittern	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great Blue Heron	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Tricolored Heron	*Egretta tricolor*
Reddish Egret	*Egretta rufescens*
Cattle Egret	*Bubulcus ibis*
Green Heron	*Butorides virescens*
Black-crowned Night-heron	*Nycticorax nycticorax*
Yellow-crowned Night-heron	*Nyctanassa violacea*
Glossy Ibis	*Plegadis falcinellus*
White-faced Ibis	*Plegadis chihi*
Roseate Spoonbill	*Platalea ajaja*
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
White-tailed Kite	*Elanus leucurus*
Bald Eagle	*Haliaeetus leucocephalus*

Common Name	Scientific Name
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Harris's Hawk	*Parabuteo unicinctus*
Red-shouldered Hawk	*Buteo lineatus*
Broad-winged Hawk	*Buteo platypterus*
Swainson's Hawk	*Buteo swainsoni*
Zone-tailed Hawk	*Buteo albonotatus*
Red-tailed Hawk	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquila chrysaetos*
Black Rail	*Laterallus jamaicensis*
Yuma Ridgway's Rail	*Rallus obsoletus yumanensis*
Virginia Rail	*Rallus limicola*
Sora	*Porzana carolina*
Common Gallinule	*Gallinula galeata*
American Coot	*Fulica americana*
Sandhill Crane	*Grus canadensis*
Black-bellied Plover	*Pluvialis squatarola*
American Golden-plover	*Pluvialis dominica*
Pacific Golden-plover	*Pluvialis fulva*
Snowy Plover	*Charadrius nivosus*
Wilson's Plover	*Charadrius wilsonia*
Semipalmated Plover	*Charadrius semipalmatus*
Piping Plover	*Charadrius melodus*
Killdeer	*Charadrius vociferus*
Mountain Plover	*Charadrius montanus*
Black-necked Stilt	*Himantopus mexicanus*
American Avocet	*Recurvirostra americana*
Spotted Sandpiper	*Actitis macularius*
Solitary Sandpiper	*Tringa solitaria*
Wandering Tattler	*Tringa incana*
Spotted Redshank	*Tringa erythropus*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmata*
Lesser Yellowlegs	*Tringa flavipes*
Whimbrel	*Numenius phaeopus*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Ruddy Turnstone	*Arenaria interpres*
Black Turnstone	*Arenaria melanocephala*
Surfbird	*Aphriza virgata*
Red Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Semipalmated Sandpiper	*Calidris pusilla*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris bairdii*

Common Name	**Scientific Name**
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpina*
Stilt Sandpiper	*Calidris himantopus*
Ruff	*Philomachus pugnax*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Snipe	*Gallinago delicata*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicarius*
Black-legged Kittiwake	*Rissa tridactyla*
Sabine's Gull	*Xema sabini*
Bonaparte's Gull	*Chroicocephalus philadelphia*
Little Gull	*Hydrocoloeus minutus*
Laughing Gull	*Leucophaeus atricilla*
Franklin's Gull	*Leucophaeus pipixcan*
Heermann's Gull	*Larus heermanni*
Mew Gull	*Larus canus*
Ring-billed Gull	*Larus delawarensis*
Western Gull	*Larus occidentalis*
Yellow-footed Gull	*Larus livens*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Thayer's Gull	*Larus thayeri*
Lesser Black-backed Gull	*Larus fuscus*
Glaucous-winged Gull	*Larus glaucescens*
Glaucous Gull	*Larus hyperboreus*
Bridled Tern	*Onychoprion anaethetus*
California Least Tern	*Sternula antillarum browni*
Gull-billed Tern	*Gelochelidon nilotica*
Caspian Tern	*Hydroprogne caspia*
Black Tern	*Chlidonias niger*
Common Tern	*Sterna hirundo*
Arctic Tern	*Sterna paradisaea*
Forster's Tern	*Sterna forsteri*
Elegant Tern	*Thalasseus elegans*
Black Skimmer	*Rynchops niger*
Pomarine Jaeger	*Stercorarius pomarinus*
Parasitic Jaeger	*Stercorarius parasiticus*
Long-tailed Jaeger	*Stercorarius longicaudus*
Rock Dove	*Columba livia*
Band-tailed Pigeon	*Patagioenas fasciata*
Eurasian Collared-dove	*Streptopelia decaocto*
Spotted Dove	*Streptopelia chinensis*
White-winged Dove	*Zenaida asiatica*
Mourning Dove	*Zenaida macroura*
Inca Dove	*Columbina inca*
Common Ground-dove	*Columbina passerine*
Ruddy Ground-dove	*Columbina talpacoti*

Common Name	Scientific Name
Yellow-billed Cuckoo,	*Coccyzus americanus*
Greater Roadrunner	*Geococcyx californianus*
Barn Owl	*Tyto alba*
Western Screech-owl	*Megascops kennicottii*
Great Horned Owl	*Bubo virginianus*
Burrowing Owl	*Athene cunicularia*
Long-eared Owl	*Asio otus*
Short-eared Owl	*Asio flammeus*
Lesser Nighthawk	*Chordeiles acutipennis*
Common Poorwhill	*Phalaenoptilus nuttallii*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
Black-chinned Hummingbird	*Archilochus alexandri*
Anna's Hummingbird	*Calypte anna*
Costa's Hummingbird	*Calypte costae*
Rufous Hummingbird	*Selasphorus rufus*
Calliope Hummingbird	*Selasphorus calliope*
Belted Kingfisher	*Megaceryle alcyon*
Lewis's Woodpecker	*Melanerpes lewis*
Gila Woodpecker	*Melanerpes uropygialis*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Red-breasted Sapsucker	*Sphyrapicus ruber*
Ladder-backed Woodpecker	*Picoides scalaris*
Northern Flicker	*Colaptes auratus*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Prairie Falcon	*Falco mexicanus*
Olive-sided Flycatcher	*Contopus cooperi*
Western Wood-peewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Hammond's Flycatcher	*Empidonax hammondii*
Gray Flycatcher	*Empidonax wrightii*
Dusky Flycatcher	*Empidonax oberholseri*
Pacific-slope Flycatcher	*Empidonax difficilis*
Black Phoebe	*Sayornis nigricans*
Eastern Phoebe	*Sayornis phoebe*
Say's Phoebe	*Sayornis saya*
Vermilion Flycatcher	*Pyrocephalus rubinus*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird	*Tyrannus verticalis*
Eastern Kingbird	*Tyrannus tyrannus*
Loggerhead Shrike	*Lanius ludovicianus*
Least Bell's Vireo	*Vireo bellii pusillus*
Plumbeous Vireo	*Vireo plumbeus*
Cassin's Vireo	*Vireo cassinii*
Hutton's Vireo	*Vireo huttoni*
Warbling Vireo	*Vireo gilvus*

Common Name	**Scientific Name**
Western Scrub-jay	*Aphelocoma californica*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Horned Lark	*Eremophila alpestris*
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Bank Swallow	*Riparia riparia*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Verdin	*Auriparus flaviceps*
Red-breasted Nuthatch	*Sitta canadensis*
Brown Creeper	*Certhia americana*
Rock Wren	*Salpinctes obsoletus*
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes hiemalis*
Marsh Wren	*Cistothorus palustris*
Bewick's Wren	*Thryomanes bewickii*
Cactus Wren	*Camphylorhynchus brunneicapillus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Black-tailed Gnatcatcher	*Poliptila melanura*
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Townsend's Solitaire	*Myadestes townsendi*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Varied Thrush	*Ixoreus naevius*
Northern Mockingbird	*Mimus polyglottos*
Sage Thrasher	*Oreoscoptes montanus*
Crissal Thrasher	*Toxostoma crissale*
European Starling	*Sturnus vulgaris*
American Pipit	*Anthus rubenscens*
Sprague's Pipit	*Anthus spragueii*
Cedar Waxwing	*Bombycilla cedrorum*
Phainopepla	*Phainopepla nitens*
Lapland Longspur	*Calcarius lapponicus*
Chestnut-collared Longspur	*Calcarius ornatus*
Mccown's Longspur	*Rhynchophanes mccownii*
Northern Waterthrush	*Parkesia noveboracensis*
Black-and-White Warbler	*Mniotilta varia*
Orange-crowned Warbler	*Oreothlypis celata*
Lucy's Warbler	*Oreothlypis luciae*
Nashville Warbler	*Oreothlypis ruficapilla*
MacGillivray's Warbler	*Geothlypis tolmiei*
Common Yellowthroat	*Geothlypis trichas*

Common Name	Scientific Name
American Redstart	*Setophaga ruticilla*
Northern Parula	*Setophaga americana*
Yellow Warbler	*Setophaga petechia*
Chestnut-sided Warbler	*Setophaga pensylvanica*
Palm Warbler	*Setophaga palmarum*
Yellow-rumped Warbler	*Setophaga coronata*
Black-throated Gray Warbler	*Setophaga nigrescens*
Townsend's Warbler	*Setophaga townsendi*
Hermit Warbler	*Setophaga occidentalis*
Black-throated Green Warbler	*Setophaga virens*
Wilson's Warbler	*Cardellina pusilla*
Yellow-breasted Chat	*Icteria virens*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee	*Pipilo maculatus*
Abert's Towhee	*Melozone aberti*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Black-throated Sparrow	*Amphispiza bilineata*
Sage Sparrow	*Artemisiospiza belli*
Lark Bunting	*Calamospiza melanocorys*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow	*Ammodramus savannarum*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Harris's Sparrow	*Zonotrichia querula*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
Summer Tanager	*Piranga rubra*
Western Tanager	*Piranga ludoviciana*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Blue Grosbeak	*Passerina caerulea*
Lazuli Bunting	*Passerina amoena*
Indigo Bunting	*Passerina cyanea*
Red-Winged Blackbird	*Agelaius phoeniceus*
Tricolored Blackbird	*Agelaius tricolor*
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Great-tailed Grackle	*Quiscalus mexicanus*
Bronzed Cowbird	*Molothrus aeneus*
Brown-headed Cowbird	*Molothrus ater*
Hooded Oriole	*Icterus cucullatus*

Common Name	**Scientific Name**
Bullock's Oriole	*Icterus bullockii*
Baltimore Oriole	*Icterus galbula*
Scott's Oriole	*Icterus parisorum*
Purple Finch	*Haemorhous purpureus*
Cassin's Finch	*Haemorhous cassinii*
House Finch	*Haemorhous mexicanus*
Red Crossbill	*Loxia curvirostra*
Pine Siskin	*Spinus pinus*
Lesser Goldfinch	*Spinus psaltria*
Lawrence's Goldfinch	*Spinus lawrencei*
American Goldfinch	*Spinus tristis*
House Sparrow	*Passer domesticus*

Mammal Species List

A comprehensive inventory of the mammals present within the Sonny Bono Salton Sea NWR has not been conducted; however, those species that have been documented are presented below.

Common Name	**Scientific Name**
Desert Shrew	*Notiosorex crawfordi*
California Leaf-nosed Bat	*Macrotus californicus*
Mexican Long-tongued Bat	*Choeronycteris mexicana*
California Myotis	*Myotis californicus*
Western Pipistrel	*Pipistrellus hesperus*
Big Brown Bat	*Eptesicus fuscus*
Hoary Bat	*Lasiurus cinereus*
Western Yellow Bat	*Lasiurus ega*
Spotted Bat	*Euderma maculatum*
Pallid Bat	*Antrozous pallidus*
Mexican Free-tailed Bat	*Tadarida brasiliensis*
Pocketed Free-tailed Bat	*Nyctinomops femorosacca*
Big Free-tailed Bat	*Nyctinomops macrotis*
Raccoon	*Procyon lotor*
Badger	*Taxidea taxus*
Western Spotted Skunk	*Spilogale gracilis*
Striped Skunk	*Mephitis mephitis*
Coyote	*Canis latrans*
Desert Kit Fox	*Vulpes macrotis*
Bobcat	*Lynx rufus*
Round-tailed Ground Squirrel	*Spermophilus tereticaudus*
Botta's Pocket Gopher	*Thomomys bottae*
Little Pocket Mouse	*Perognathus longimembris*
Long-tailed Pocket Mouse	*Chaetodipus formosus*
Desert Pocket Mouse	*Chaetodipus penicillatus*
Spiny Pocket Mouse	*Chaetodipus spinatus*
Desert Kangaroo Rat	*Dipodomys deserti*
Merriam's Kangaroo Rat	*Dipodomys merriami*
Cactus Mouse	*Peromyscus eremicus*

Common Name	Scientific Name
Deer Mouse	*Peromyscus maniculatus*
Hispid Cotton Rat	*Sigmodon hispidus*
White-throated Woodrat	*Neotoma albigula*
Desert Woodrat	*Neotoma lepida*
Muskrat	*Ondatra zibethicus*
Black Rat	*Rattus rattus*
Norway Rat	*Rattus norvegicus*
House Mouse	*Mus musculus*
Desert Cottontail	*Sylvilagus audubonni*

Reptile and Amphibian Species List

A comprehensive inventory of the reptiles and amphibians present within the Sonny Bono Salton Sea NWR has not been conducted; however, those species that have been documented are presented below.

Common Name	Scientific Name
Red-spotted Toad	*Anaxyrus punctatus*
Woodhouse's Toad	*Anaxyrus woodhousii woodhousii*
American Bull frog	*Lithobates catesbeianus*
Rio Grande Leopard frog	*Lithobates berlandieri*
Desert Tortoise	*Gopherus agassizii*
Spiny Softshell	*Apalone spinifera*
Long-nosed Leopard Lizard	*Gambelia wislizenii*
Desert Banded Gecko	*Coleonyx variegates variegatus*
Desert Iguana	*Dipsosaurus dorsalis dorsalis*
Chuckwalla	*Sauromalus ater*
Zebra-tailed Lizard	*Calisaurus draconoides rhodostictus*
Desert Spiny Lizard	*Sceloporus magister*
Western Side-blotched Lizard	*Uta stansburiana elegans*
Long-tailed Brush Lizard	*Urosaurus graciosus*
Flat-tailed Horned Lizard	*Phrynosoma mcallii*
Southern Desert Horned Lizard	*Phrynosoma platyrhinos calidiarum*
Colorado Desert Fringe-toed Lizard	*Uma notata*
Great Basin Whiptail	*Aspidoscelis tigris tigris*
Desert Glossy Snake	*Arizona elegans eburnata*
Colorado Desert Shovel-nosed Snake	*Chionactis occipitalis annulata*
Coachwhip	*Coluber flagellum piceus*
Nightsnake	*Hypsiglena torquata deserticola*
California Kingsnake	*Lampropeltis getula californiae*
Leaf-nosed Snake	*Phyllorhynchus decurtatus*
Sonoran Gopher Snake	*Pituophis catenifer affinis*
Long-nosed Snake	*Rheinocheilus lecontei*
Desert Patch-nosed Snake	*Salvadora hexalepis hexalepis*
Western Diamond-backed Rattlesnake	*Croatlus atrox*
Colorado Desert Sidewinder	*Crotalus cerastes laterorepens*
Desert Threadsnake	*Rena humilis cahuilae*

COACHELLA VALLEY NATIONAL WILDLIFE REFUGE

Bird Species List

The following list includes bird species that have been observed within the Coachella Valley Preserve that are likely to be observed at various time of the year on the Coachella Valley National Wildlife Refuge. The birds' common and scientific names are provided in accordance with the 7th edition (1998), 12th Supplement (2012) of the A.O.U. Checklist of North American Birds.

Common Name	Scientific Name
Gambel's Quail	*Callipepla gambelii*
Turkey Vulture	*Cathartes aura*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Swainson's Hawk	*Buteo swainsoni*
Red-tailed Hawk	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquila chrysaetos*
Rock Dove	*Columba livia*
Band-tailed Pigeon	*Patagioenas fasciata*
Spotted Dove	*Streptopelia chinensis*
White-winged Dove	*Zenaida asiatica*
Mourning Dove	*Zenaida macroura*
Common Ground-dove	*Columbina passerine*
Greater Roadrunner	*Geococcyx californianus*
Barn Owl	*Tyto alba*
Western Screech-owl	*Megascops kennicottii*
Great Horned Owl	*Bubo virginianus*
Burrowing Owl	*Athene cunicularia*
Long-eared Owl	*Asio otus*
Short-eared Owl	*Asio flammeus*
Lesser Nighthawk	*Chordeiles acutipennis*
Common Poorwhill	*Phalaenoptilus nuttallii*
Vaux's Swift	*Chaetura vauxi*
White-throated Swift	*Aeronautes saxatalis*
Black-chinned Hummingbird	*Archilochus alexandri*
Anna's Hummingbird	*Calypte anna*
Costa's Hummingbird	*Calypte costae*
Rufous Hummingbird	*Selasphorus rufus*
Lewis's Woodpecker	*Melanerpes lewis*
Red-naped Sapsucker	*Sphyrapicus nuchalis*
Red-breasted Sapsucker	*Sphyrapicus ruber*
Ladder-backed Woodpecker	*Picoides scalaris*
Northern Flicker	*Colaptes auratus*
Gilded Flicker	*Colaptes chrysoides*
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*

Common Name	Scientific Name
Prairie Falcon	*Falco mexicanus*
Olive-sided Flycatcher	*Contopus cooperi*
Western Wood-peewee	*Contopus sordidulus*
Willow Flycatcher	*Empidonax traillii*
Hammond's Flycatcher	*Empidonax hammondii*
Gray Flycatcher	*Empidonax wrightii*
Dusky Flycatcher	*Empidonax oberholseri*
Pacific-slope Flycatcher	*Empidonax difficilis*
Black Phoebe	*Sayornis nigricans*
Say's Phoebe	*Sayornis saya*
Vermilion Flycatcher	*Pyrocephalus rubinus*
Ash-Throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird	*Tyrannus verticalis*
Loggerhead Shrike	*Lanius ludovicianus*
Western Scrub-jay	*Aphelocoma californica*
Common Raven	*Corvus corax*
Horned Lark	*Eremophila alpestris*
Purple Martin	*Progne subis*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Verdin	*Auriparus flaviceps*
Bushtit	*Psaltriparus minimus*
Red-breasted Nuthatch	*Sitta canadensis*
Rock Wren	*Salpinctes obsoletus*
House Wren	*Troglodytes aedon*
Winter Wren	*Troglodytes hiemalis*
Bewick's Wren	*Thryomanes bewickii*
Cactus Wren	*Camphylorhynchus brunneicapillus*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Black-tailed Gnatcatcher	*Poliptila melanura*
Ruby-crowned Kinglet	*Regulus calendula*
Western Bluebird	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Townsend's Solitaire	*Myadestes townsendi*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Northern Mockingbird	*Mimus polyglottos*
Sage Thrasher	*Oreoscoptes montanus*
California Thrasher	*Toxostoma redivivum*
Crissal Thrasher	*Toxostoma crissale*
Le Conte's Thrasher	*Toxostoma lecontei*
European Starling	*Sturnus vulgaris*
Cedar Waxwing	*Bombycilla cedrorum*

Common Name	**Scientific Name**
Phainopepla	*Phainopepla nitens*
Black-and-White Warbler	*Mniotilta varia*
Orange-crowned Warbler	*Oreothlypis celata*
Lucy's Warbler	*Oreothlypis luciae*
Nashville Warbler	*Oreothlypis ruficapilla*
MacGillivray's Warbler	*Geothlypis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
American Redstart	*Setophaga ruticilla*
Yellow Warbler	*Setophaga petechia*
Palm Warbler	*Setophaga palmarum*
Yellow-rumped Warbler	*Setophaga coronata*
Black-throated Gray Warbler	*Setophaga nigrescens*
Townsend's Warbler	*Setophaga townsendi*
Hermit Warbler	*Setophaga occidentalis*
Wilson's Warbler	*Cardellina pusilla*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee	*Pipilo maculatus*
Abert's Towhee	*Melozone aberti*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Black-throated Sparrow	*Amphispiza bilineata*
Sage Sparrow	*Artemisiospiza belli*
Lark Bunting	*Calamospiza melanocorys*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow	*Ammodramus savannarum*
Fox Sparrow	*Passerella iliaca*
Song Sparrow	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*
Swamp Sparrow	*Melospiza georgiana*
White-throated Sparrow	*Zonotrichia albicollis*
Harris's Sparrow	*Zonotrichia querula*
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Dark-eyed Junco	*Junco hyemalis*
Summer Tanager	*Piranga rubra*
Scarlet Tanager	*Piranga olivacea*
Western Tanager	*Piranga ludoviciana*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Blue Grosbeak	*Passerina caerulea*
Lazuli Bunting	*Passerina amoena*
Indigo Bunting	*Passerina cyanea*
Western Meadowlark	*Sturnella neglecta*
Brewer's Blackbird	*Euphagus cyanocephalus*
Great-tailed Grackle	*Quiscalus mexicanus*
Brown-headed Cowbird	*Molothrus ater*
Hooded Oriole	*Icterus cucullatus*

Common Name	Scientific Name
Bullock's Oriole	*Icterus bullockii*
Scott's Oriole	*Icterus parisorum*
Purple Finch	*Haemorhous purpureus*
House Finch	*Haemorhous mexicanus*
Pine Siskin	*Spinus pinus*
Lesser Goldfinch	*Spinus psaltria*
Lawrence's Goldfinch	*Spinus lawrencei*
American Goldfinch	*Spinus tristis*
House Sparrow	*Passer domesticus*

Reptile and Amphibian Species List

A comprehensive inventory of the reptiles and amphibians present within the Coachella Valley NWR has not been conducted; however, some of the species documented in and around the Refuge are presented below.

Common Name	Scientific Name
Western Banded Gecko	*Coleonyx variegates*
Desert Iguana	*Dipsosaurus dorsalis*
Zebra-tailed Lizard	*Calisaurus draconoides*
Western Side-blotched Lizard	*Uta stansburiana elegans*
Flat-tailed Horned Lizard	*Phrynosoma mcallii*
Southern Desert Horned Lizard	*Phrynosoma platyrhinos calidiarum*
Coachella Valley Fringe-toed Lizard	*Uma inornata*
Western Whiptail	*Aspidoscelis tigris*
Long-nosed Leopard Lizard	*Gambelia wislizenii*
Western Shovel-nosed Snake	*Chionactis occipitalis*
Coachwhip	*Coluber flagellum*
Gopher Snake	*Pituophis catenifer*
Red-diamond Rattlesnake	*Crotalus ruber*
Sidewinder	*Crotalus cerastes*

Plant Species List

The following list includes plants observed on the Coachella Valley National Wildlife Refuge during vegetation mapping conducted in February 2011.

Common Name	Scientific Name
sand verbena	*Abronia villosa*
white bursage	*Ambrosia dumosa*
cheesebush	*Ambrosia salsola*
milkvetch	*Astragalus aridus*
Coachella Valley milk-vetch	*Astragalus lentiginosus*
fourwing saltbush	*Atriplex canescens*
cattle spinach	*Atriplex polycarpa*
lax flower	*Baileya pauciradiata*
sweetbush	*Bebbia juncea aspera*
Sahara mustard	*Brassica tournefortii*

Common Name	**Scientific Name**
brown-eyed primrose	*Cammissonia claviformis*
pincushion plant	*Chaenactis fremontii*
sand mat	*Chamaesyce albomarginata*
desert croton	*Croton californicus*
cryptantha	*Crypthantha sp*
desert dicoria or bug seed	*Dicoria canescens*
brittlebush	*Encelia farinosa*
desert trumpet	*Eriogonum inflatum*
skeleton weed	*Eriogonum deflexum*
storksbill	*Erodium cicutarium*
little gold poppy	*Eschscholzia minuteflora*
barrel cactus	*Ferocactus cylindraceus*
desert sunflower	*Geraea canescens*
creosote bush	*Larrea tridentata*
Arizona lupine	*Lupinus arizonica*
desert dandelion	*Malacothrix glabrata*
sand blazing star	*Mentzellia albicaulis*
dune primrose	*Oenothera deltoides*
golden cholla	*Opuntia echinocarpa*
pencil cholla	*Opuntia ramosissima*
Spanish needle	*Palafoxia arida*
sandpaper plant	*Petalonyx thurberi*
plantago	*Plantago ovata*
honey mesquite	*Prosopis glandulosa*
Mojave indigo bush	*Psorothamnus arborescens*
dyeweed	*Psorothamnus emoryi*
Smoke tree	*Psorothamnus spinosus*
desert chicory	*Rafinesquia neomexicana*
Russian thistle	*Salsola tragus*
Old Han schismus	*Schismus barbatus*
wirelettuce	*Stephanomeria exigua*
Athel tamarisk	*Tamarix aphylla*
saltcedar	*Tamarix ramosissima*
fanleaf crinklemat	*Tiquilia plicata*

Appendix D

Request of Cultural Resource Compliance Form

REQUEST FOR CULTURAL RESOURCE COMPLIANCE

U.S. Fish and Wildlife Service, Region 1 and 8

Project Name:					**FWS Program:** (ES, Refuges, Fisheries, Fire…)	
					Funding Program: (Partners, Refuges, TEA-21, HCP, NAWCA…)	
State: CA, ID, HI, NV, OR, WA		**EcoRegion:** CBE, IPE,KCE, NCE			**FWS Unit: Org Code:**	
Project Location:	**County**	**Township**	**Range**	**Section**	**FWS Contact:** Name, Tel#, Address	
USGS Quad:					**Date of Request:**	**Proposed Project Start Date:**
Total project acres/ linear ft/m:		**APE Acres / linear ft/m** (if different)				

Have you consulted with Tribe(s)?				Have you consulted with other interested parties?				**Is there another federal agency involved with this project?**		No	If yes, provide name:
Yes		No		Yes		No				Yes	
MAPS Attached				**Check below**				**If yes, which agency is taking lead for Section 106 compliance?**		FWS	Other Agency
Copy of portion of USGS Quad with project area marked clearly **(required)**								Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities **(required)**			
Photocopy of aerial photo showing location **(if available)**								Any other project plans, photographs, or drawings that may help CRT in making determination **(if available)**			

Directions to Project: (if not obvious)	
Description of Undertaking:	Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)?

Return Form and maps to: Virginia_parks@fws.gov
If unable to send digitally, mail or fax to USFWS Region 1 Cultural Resources Team, 20555 SW Gerda Lane, Sherwood, OR 97140
Questions: 503-625-4377 or fax 503-625-4887

Area of Potential Effects (APE):	Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project.
Environmental and Cultural Setting:	Briefly describe the environmental setting of the APE. **A)** What was the natural habitat prior to modifications, reclamation, agriculture, settlement? **B)** What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? **C)** What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? **D)** Do you (or does anybody else) know of cultural resources in or near the project area?
Please return this RCRC and map showing APE digitally, if possible, to virginia_parks@fws.gov. Questions, call 503-625-4377	

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Questions: 503-625-4377 or fax 503-625-4887

Sonny Bono Salton Sea
National Wildlife Refuge Complex
906 W. Sinclair Road
Calipatria, CA 92233
760/348-7245

California Relay Service
TTY 1 800/735-2929
Voice 1 800/735-2922

U.S. Fish & Wildlife Service
http://www.fws.gov

For Refuge Information
1 800/344 WILD (9453)

March 2014

Cover Photo:
Great Blue Herons at the Salton Sea
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