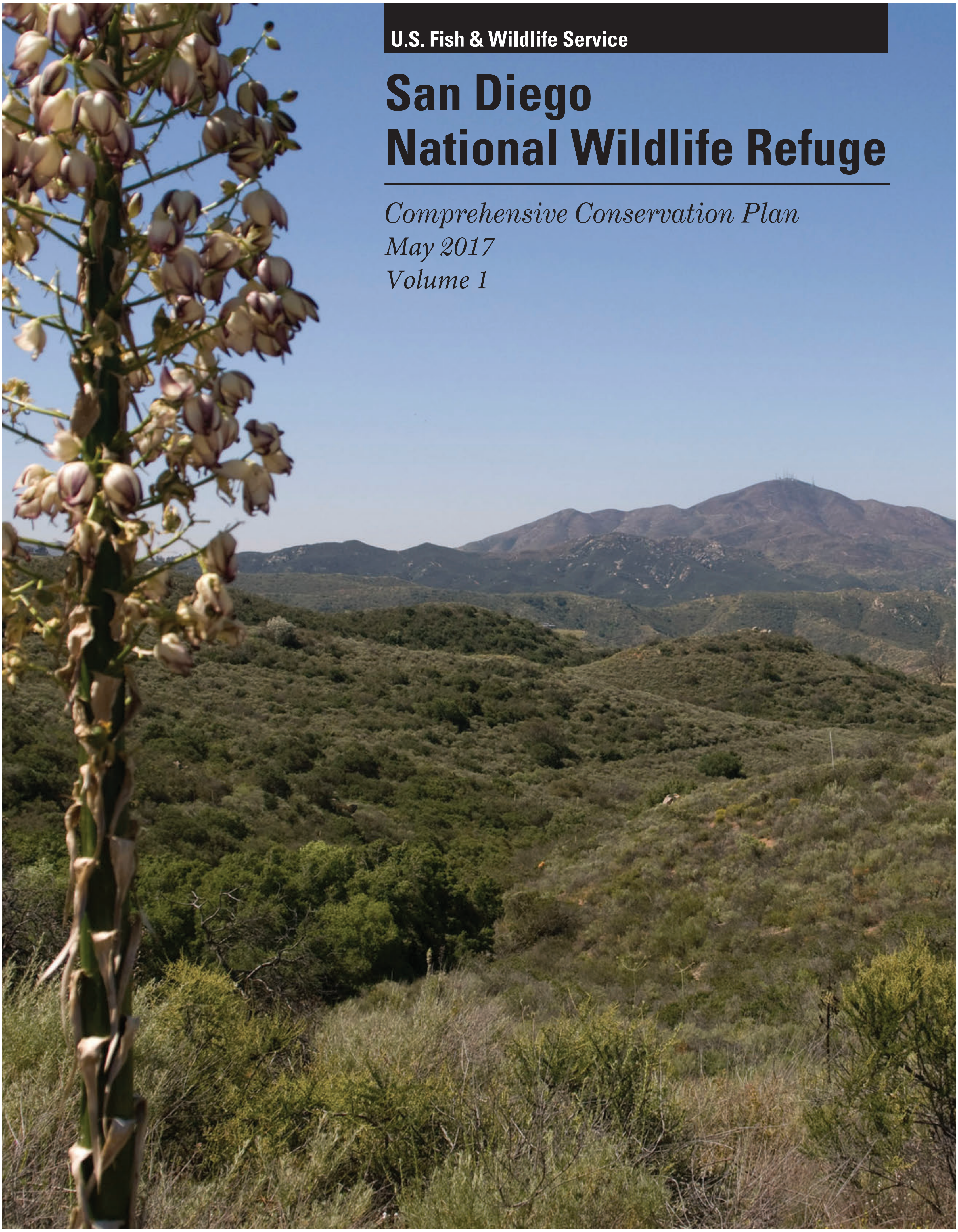
U.S. Fish & Wildlife Service

San Diego National Wildlife Refuge

Comprehensive Conservation Plan
May 2017
Volume 1



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.

San Diego National Wildlife Refuge

Final Comprehensive Conservation Plan

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Approved: ____________________ Date: 5-16-17

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

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U.S. Fish & Wildlife Service

San Diego National Wildlife Refuge

Final Comprehensive Conservation Plan
May 2017

San Diego National Wildlife Refuge Vision Statement

Large, connected, healthy stands of southern California coastal lowland and foothill habitats, including coastal sage scrub, maritime succulent scrub, native grassland, chaparral, riparian woodland, and vernal pools, are conserved through an ecosystem approach to management and monitoring that draws on the talents of Federal, State, and local agencies and other conservation partners to leverage and maximize funds and staffing. Listed and sensitive plant and animal species are protected, and species that historically occurred on Refuge lands are reestablished. One of the last expanses of open space in coastal southern California, with exceptional biological, social, historical, and economic values, is protected as a sanctuary not just for plants and animals but also for people.

U. S. Fish and Wildlife Service
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Disclaimer: CCPs 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.

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1 Introduction

1.1 Introduction and Background

The U.S. Fish and Wildlife Service (Service or USFWS) has prepared this Comprehensive Conservation Plan (CCP) to guide the management of the San Diego National Wildlife Refuge (NWR or Refuge) over the next 15 years. It provides long-range management direction for achieving Refuge purposes, while also providing important background information related to the history of the Refuge, the resources being conserved, past management activities, and any anticipated future conditions that could affect Refuge resources and management.

The San Diego NWR is located in southwestern San Diego County, California (Figure 1-1). Managed by the Service as part of the National Wildlife Refuge System (NWRS or Refuge System), the Refuge protects a variety of native upland and wetland habitats, and plays a critical role in the regional effort to maintain the high biological diversity of southwestern San Diego County. More than 16 species currently listed as threatened or endangered under the Federal Endangered Species Act (ESA) and/or the California Endangered Species Act (CESA) are either known to occur on the Refuge or have occurred here within the last 20 years. Many other species of concern, including at least 35 species covered by the San Diego Multiple Species Conservation Program (MSCP) (City of San Diego 1998a) have also been documented on the Refuge.

In 1997, the Service approved a Land Protection Plan (LPP) and acquisition boundary for the San Diego NWR's Otay-Sweetwater Unit, as well as the Vernal Pools Stewardship Project (Figure 1-2). The Land Protection Plan for the Otay-Sweetwater Unit established an acquisition boundary that has the potential to protect up to 43,860 acres of native habitat (Figure 1-3). Acquisition within this boundary from willing sellers is intended to contribute to the conservation of listed species within southwestern San Diego County and sustain native diversity by conserving large contiguous blocks of undisturbed native habitat (USFWS 1997a). The purpose for these acquisitions, as stated in the LPP, is "to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds and to maintain and enhance the biological diversity of native plants and animals" (USFWS 1997a).

In the years since the LPP was approved, several large areas within the Otay-Sweetwater acquisition boundary have been acquired for inclusion in the Refuge and acquisition efforts will continue per available funding and willing sellers. As of May 2016, the Otay-Sweetwater Unit included about 11,870 acres of USFWS-owned lands (refer to Figure 1-3). Over the next few years, an additional 337 acres of land owned by the California Department of Transportation (Caltrans) are expected to be transferred to the Service for inclusion in the Refuge (Figure 1-4).

In addition to the Refuge's 11,870 acres, there are more than 25,000 acres within the Otay-Sweetwater acquisition boundary that are owned by other Federal, State, and local agencies, tribes, and non-profit conservation organizations (refer to Figure 1-4). Most of this acreage is already managed for habitat conservation and/or watershed protection; therefore, it is unlikely that these lands will ever be incorporated into the Refuge.

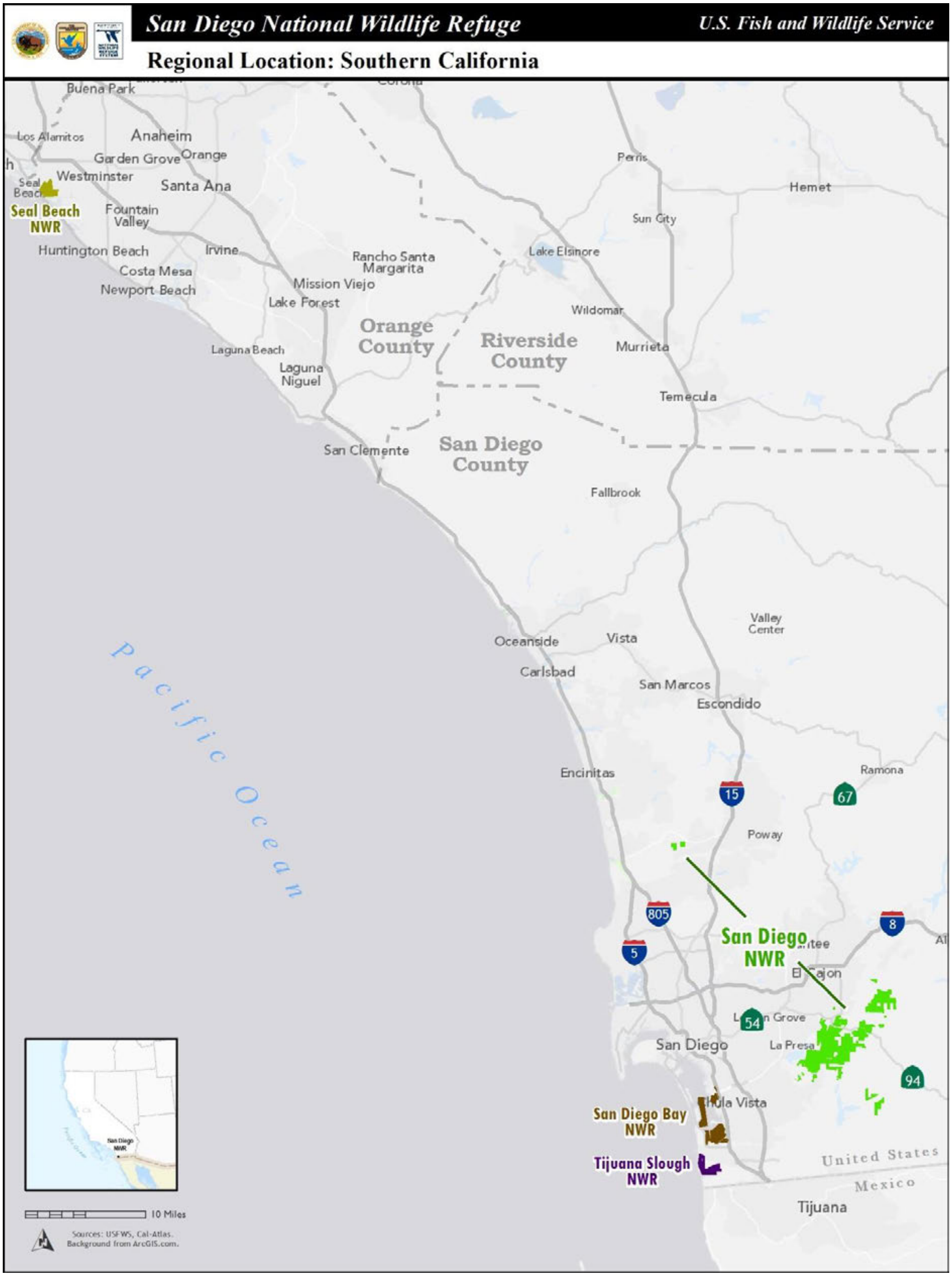

Figure 1-1. Location Map - San Diego National Wildlife Refuge

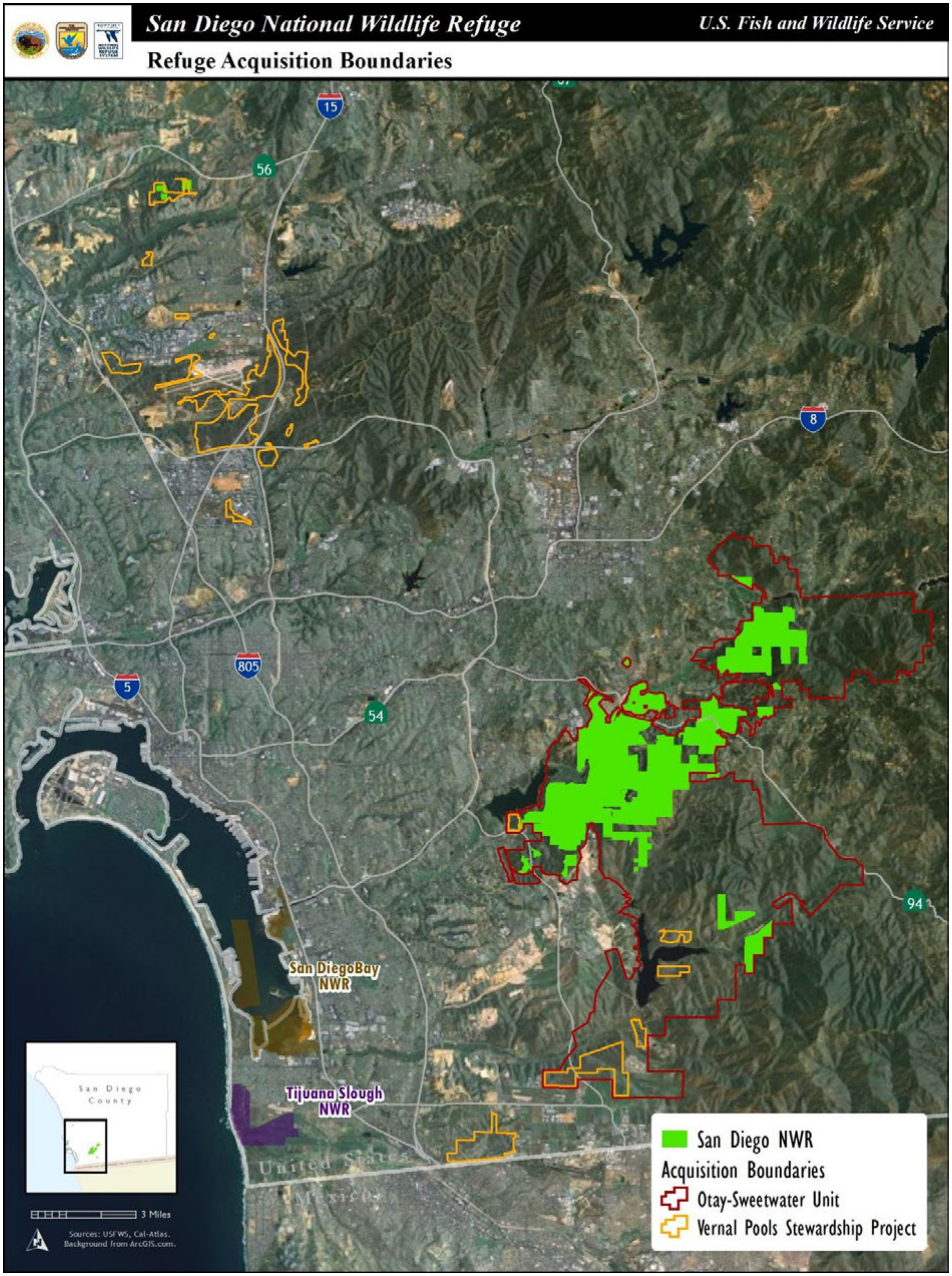

Figure 1-2. Refuge Acquisition Boundaries – San Diego NWR and Vernal Pool Stewardship Project

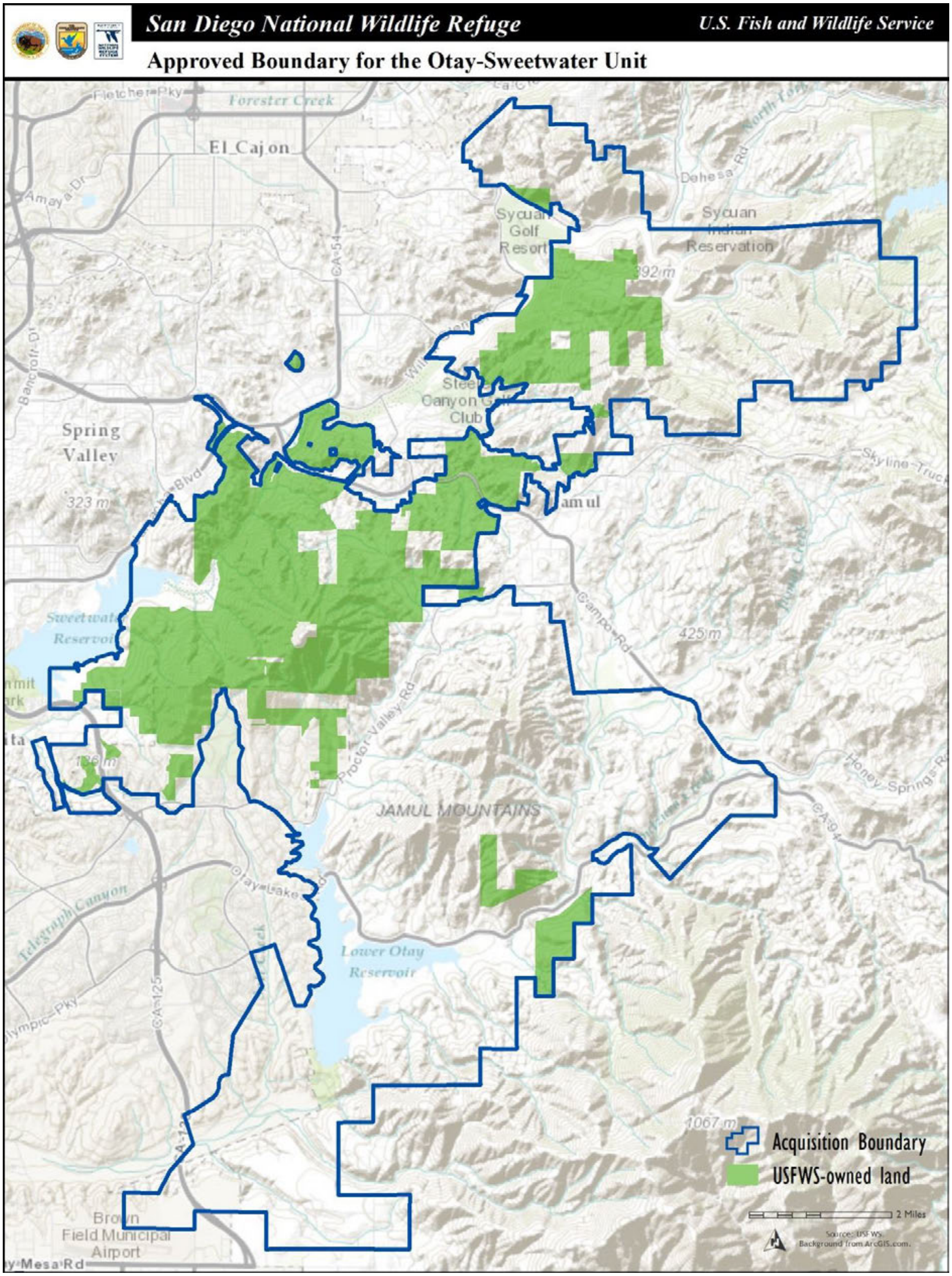

Figure 1-3. Location Map - Otay-Sweetwater Unit (acquisitions as of August 2014)

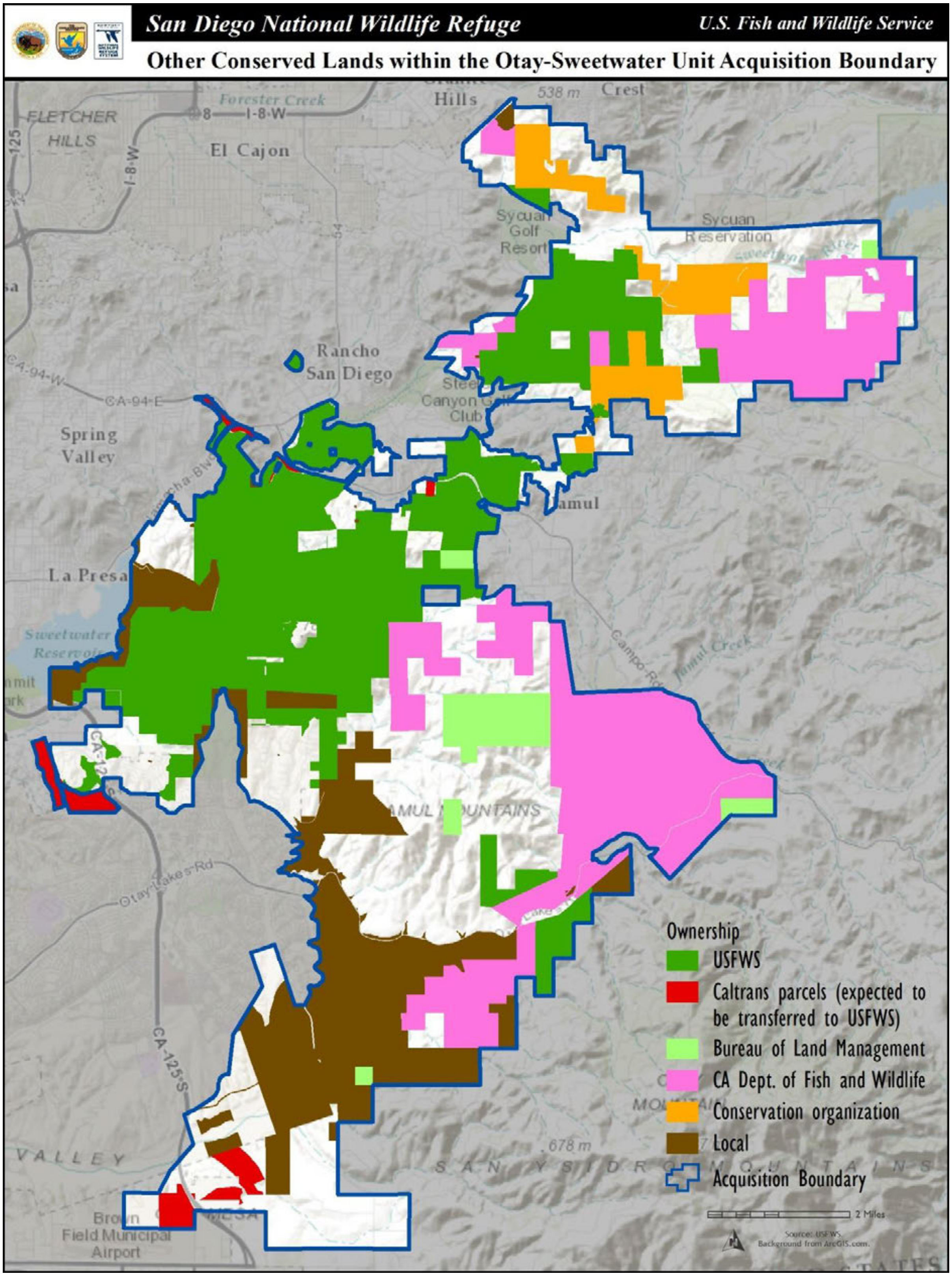

Figure 1-4. Conserved Lands within the Otay-Sweetwater Unit Acquisition Boundary

The LPP for the Vernal Pools Stewardship Project established an approved project boundary (refer to Figure 1-2) to conserve up to 8,220 acres through a variety of habitat protection methods for the purpose of protecting vernal pool habitat and the rare species this habitat supports (USFWS 1997b). As illustrated in Figure 1-2, some portions of the Vernal Pools Stewardship Project boundary overlap with the acquisition boundary for the Otay-Sweetwater Unit.

Between 1997 and 2013, two areas within the Vernal Pools Stewardship Project boundary were incorporated into the Refuge. These areas include 17 acres located near the southeastern end of the Sweetwater Reservoir, which are collocated within the boundaries of the Otay-Sweetwater Unit, and 60 acres located the Del Mar Mesa area (Figure 1-5). Approximately 360 acres of the Caltrans lands to be transferred to the Service are collocated within the boundary of the Vernal Pool Stewardship Project and the acquisition boundary of the Otay-Sweetwater Unit.

1.2 Purpose and Need

The purpose and need for the San Diego NWR CCP is to provide guidance to the Refuge Manager and others for how this Refuge should be managed to best achieve the purposes for which it was established and to contribute to the mission of the NWRS. This CCP provides a 15-year management plan for addressing the conservation of wildlife and plant resources and their related habitats, while also presenting the opportunities on the Refuge for compatible wildlife-dependent recreational uses. It is through the CCP process that the overarching wildlife, public use, and management needs for the Refuge, as well as any issues affecting the management of Refuge resources and public use programs, are identified. Through this process, 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.

The 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 Refuge uses 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.

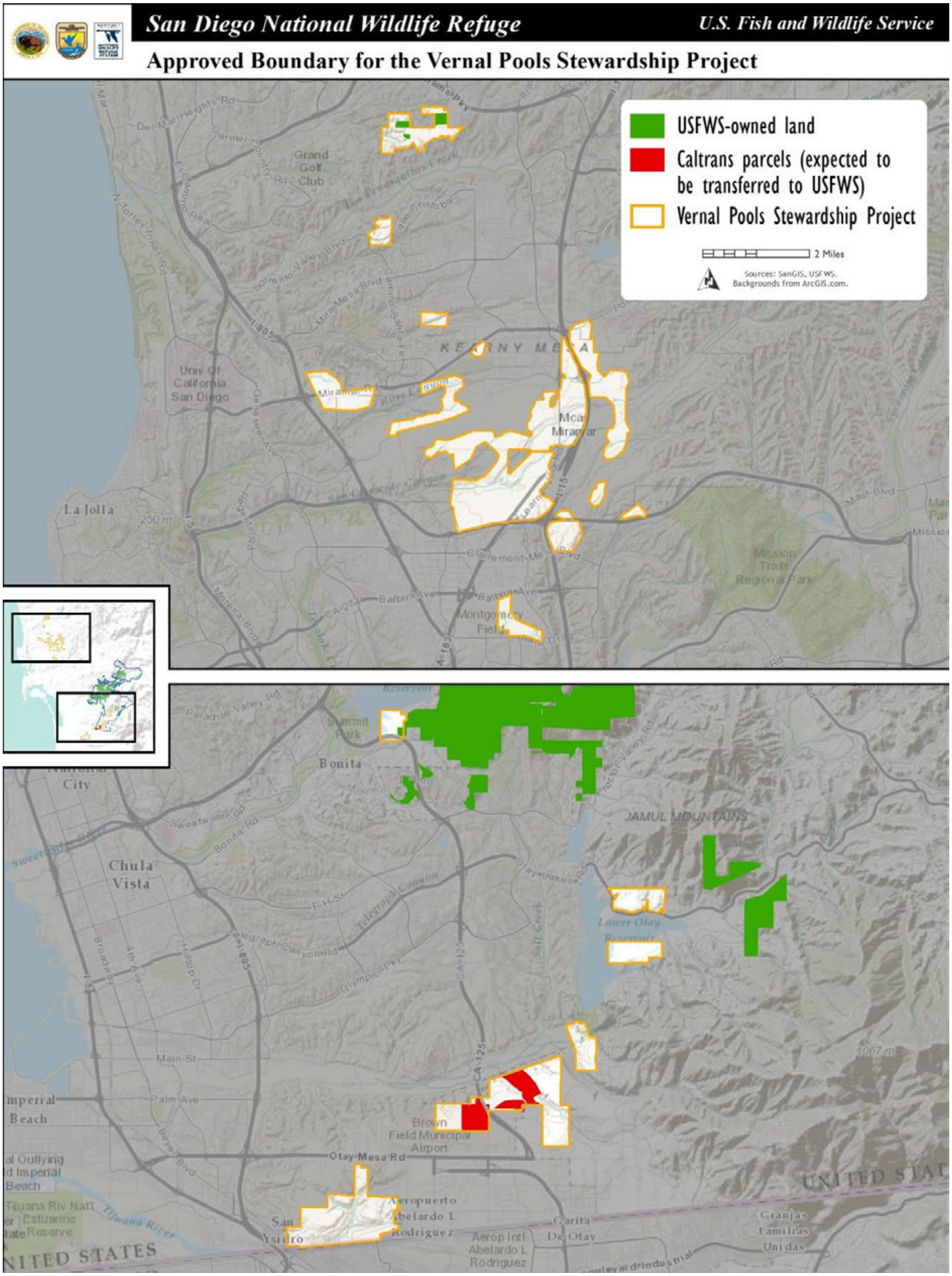

Figure 1-5. Refuge Lands within the Vernal Pool Stewardship Project

The development of this CCP was also required to fulfill 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 (the Improvement Act) (Public Law 105-57). The Improvement Act requires that a CCP be prepared for each refuge or related complex of refuges within the Refuge System.

Prior to the completion of this CCP, there was no overarching management plan in place for the San Diego NWR. Those documents that were available, such as the Conceptual Management Plan for the San Diego National Wildlife Refuge (USFWS 1997b) and the San Diego MSCP Plan (City of San Diego 1998a), provide general direction and guidance, but do not address the full range of activities and strategies that should be considered in managing a national wildlife refuge. The Conceptual Management Plan provides a broad overview of the Service's proposed approach for managing Refuge resources and operations, while the MSCP Plan provides general guidance for habitat and species management and monitoring within the larger MSCP preserve.

As the first comprehensive management plan for the San Diego NWR, this CCP sets forth Refuge goals and objectives and describes the specific 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, such as hunting, may be broadly stated. In such cases, the Refuge staff intends to prepare detailed step-down plans to further describe how a specific management strategy or activities will be implemented. These step-down plans provide specific strategies and implementation schedules for meeting the various goals and objectives identified in the CCP. The step-down plans to be prepared for the San Diego NWR following CCP approval are outlined in Chapter 5.

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. Operated and managed by the Service, the NWRS currently includes more than 150 million acres, consisting of over 560 national wildlife refuges and other units of the Refuge System and more than 35 wetland management districts. The majority of Refuge System lands (over 77 million acres) are in Alaska. The remaining acreage is scattered across the other 49 states and several island territories. About 21 million acres are managed as wilderness under the Wilderness Act of 1964.

The NWRS started in 1903, when 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 sanctuaries for wildlife during his tenure. This small network of sanctuaries continued to expand, later becoming the NWRS. In contrast to other public lands, which are managed under a multiple uses mandate (e.g., national forests managed by the U.S. Forest Service, and lands administered by the U.S. 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 mission of the NWR 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" (the 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 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).
- 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 San Diego NWR are summarized in Table 1-1 and addressed in more detail in Appendix K.

Table 1-1 Federal Laws and Executive Orders Applicable to the Management of the San Diego National Wildlife Refuge
Biological Resources
• Endangered Species Act of 1973 (16 U.S.C. §1531 et seq.), as amended (ESA) • Fish and Wildlife Act of 1956 (16 U.S.C. §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 • Executive Order 13112, Invasive Species • Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. §668 et seq.) • Migratory Bird Treaty Act of 1918, as amended (MBTA) • Fish and Wildlife Coordination Act of 1958 • Emergency Wetlands Resources Act of 1986
Environmental Policy
• National Environmental Policy Act of 1969 (42 U.S.C. §4321 et seq.) (NEPA)
Water Protection and Wetland Management
• Clean Water Act of 1972, as amended (Sections 401 and 404) • Executive Order No. 11990, Protection of Wetlands • Executive Order No. 11988, Floodplain Management
Air Quality
• Clean Air Act of 1970, as amended (P.L.. 91-604; 42 U.S.C. §1857 et seq.)
Contaminants and Hazardous Materials
• Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. §9601, et seq.) • Federal Insecticide, Fungicide, and Rodenticide Act (P.L. 80-104; 7 U.S.C. §136 et seq.)
Cultural Resources and Tribal Coordination
• Antiquities Act of 1906 • Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. §3001 et seq.) • Executive Order 13007, Indian Sacred Sites. 24 May, 1996 • Executive Order No. 11593, Protection and Enhancement of the Cultural Environment • Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. §470aa-47011) • American Indian Religious Freedom Act 1978 (42 U.S.C. 1996) • National Historic Preservation Act of 1966, as amended (16 U.S.C. §470 et seq.; 36 CFR 800) • Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469) • Curation of Federally-Owned and Administered Archaeological Collections (36 CFR 79) • Executive Order 13175, Consultation and Coordination with Indian Tribal Governments

Table 1-1 Federal Laws and Executive Orders Applicable to the Management of the San Diego National Wildlife Refuge
Land Use
• Refuge Recreation Act of 1962, as amended • Fish and Wildlife Improvement Act of 1978 • National Wildlife Refuge System Administration Act of 1966 (16 USC 668dd-668ee), National Wildlife Refuge System Improvement Act of 1997 (PL 105-57) • Executive Order No. 12996, Management and General Public Use of the National Wildlife Refuge System
Paleontological Resources
• Paleontological Resources Preservation Act of 2009 (P.L. 111-11, Title VI, Subtitle D)
Farmland Protection
• Farmland Protection Policy Act (7 U.S.C. §4201 et seq.)
Human Rights
• Executive Order 12898, Environmental Justice • Rehabilitation Act of 1973, as amended (Section 504) • Architectural Barriers Act of 1968, as amended (42 U.S.C. §4151 et seq.)
Agency Coordination
• Executive Order No. 12372, Intergovernmental Review of Federal Programs

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 Refuge System is derived from the National Wildlife Refuge System Administration Act of 1966 (Refuge Administration Act), as amended by the National Wildlife Refuge System Improvement Act of 1997. The Improvement Act directs the Service to manage each refuge to fulfill the mission of the Refuge System, as well as the specific purposes for which that refuge was established. The Improvement Act also states that the, "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 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 are found in the land use management series (600) of the U.S. Fish and Wildlife Service Manual. These policies, which are 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). It also includes the decision making process for determining refuge purposes.
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 Refuge System.
Appropriate Use Policy (603 FW 1)	Describes the initial decision process the Refuge Manager follows when first considering whether or not 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 of existing and proposed uses are located with the compatibility determinations in Appendix C of this CCP.
Compatibility Policy (603 FW 2)	Details the formal process for determining if a use proposed on a NWR 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. Appendix C contains the compatibility determinations prepared for proposed uses on San Diego NWR.
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 reviews for Refuge System lands and waters to determine if these lands and waters 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 review prepared for the San Diego NWR is provided in Appendix L.

1.4.2 National Environmental Policy Act (NEPA) of 1969

As the basic national charter for the protection of the environment, 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 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 environmental assessment (EA) or Environmental Impact Statement (EIS) document that an agency has addressed these issues. Each CCP process must comply with the provisions of NEPA through the concurrent preparation of an EA or EIS that can accompany or be integrated into the draft CCP. The San Diego NWR 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, the required components of an EA were incorporated directly into the draft CCP. The Finding of No Significant Impact (FONSI) and EA prepared for this CCP are provided in Appendix F.

1.5 San Diego National Wildlife Refuge

1.5.1 Location

The San Diego NWR is one of four refuges that comprise the San Diego NWR Complex (Complex). In addition to the San Diego NWR, the Complex includes the Tijuana Slough NWR, San Diego Bay NWR, and Seal Beach NWR (refer to Figure 1-1). The Complex, which provides oversight and administrative functions for its four refuges, is headquartered on the Sweetwater Marsh Unit of the San Diego Bay NWR in Chula Vista, California.

In May 2016, the San Diego NWR included approximately 11,870 acres distributed among several non-contiguous land areas (refer to Figure 1-2). The majority of these Refuge lands are concentrated along the southeastern edge of San Diego County's metropolitan area within the Otay-Sweetwater Unit. For ease of description, we have divided the Otay-Sweetwater Unit into five management areas: McGinty Mountain; Sweetwater River; Las Montañas; San Miguel Mountain; and Otay Mesa and Lakes (Figure 1-6).

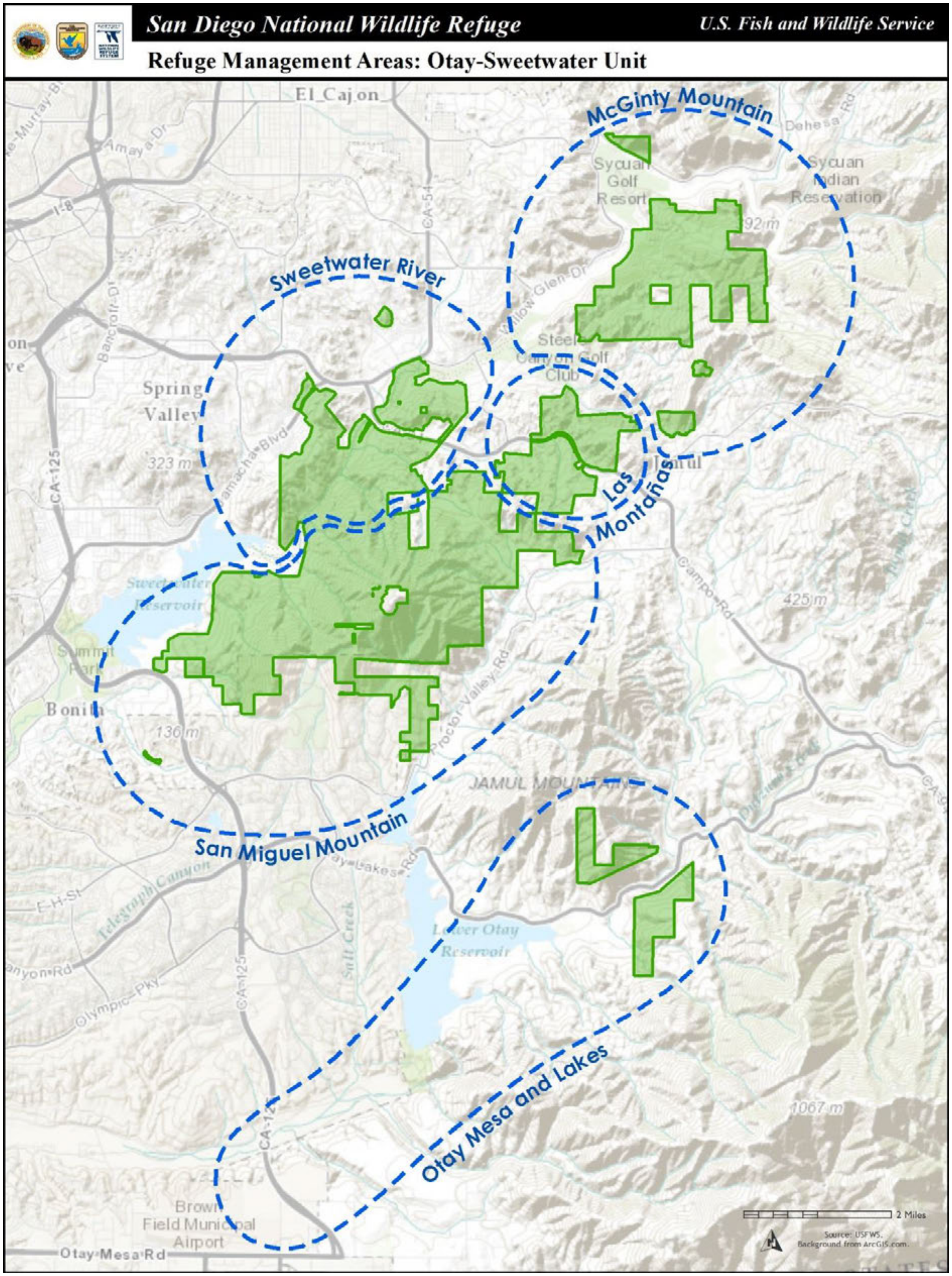

Figure 1-6. Management Areas of the Otay-Sweetwater Unit

An additional 60 acres of Refuge land is located at the northern edge of the City of San Diego (refer to Figure 1-5). For planning purposes, this area is described as the Del Mar Mesa Vernal Pool Unit.

The lands within the Otay-Sweetwater Unit (Table 1-3) are generally located to the southeast of Highway 54 between Otay Mesa to the south and the unincorporated community of Crest to the north. The Del Mar Mesa Vernal Pool Unit is located south of State Route 56 and west of Interstate 15 in northern San Diego.

Table 1-3
Approximate Acreages within the Management Areas of the San Diego NWR

Management Area	Acreage[1] (approximate)
Otay-Sweetwater Unit	
McGinty Mountain Area	2,205 acres
Las Montañas Area	1,035 acres
Sweetwater River Area	1,955 acres
San Miguel Mountain Area	5,975 acres
Otay Mesa and Lakes Area	640 acres
Subtotal	11,810 acres
Del Mar Mesa Vernal Pool Unit	60 acres
Approximate Acreage of the San Diego NWR	**11,870 acres**

[1]Acreage as of May 2016

1.5.2 Physical Setting

The Otay-Sweetwater Unit of the San Diego NWR abuts the southeastern edge of the San Diego metropolitan area. These refuge lands lie to the northeast of the City of Chula Vista, to the southeast of the City of El Cajon, to the west of the unincorporated community of Jamul, to the south of the unincorporated community of Crest, and to the west and north of the undeveloped lower slopes of the San Ysidro Mountains.

The Otay-Sweetwater Unit is characterized by a striking diversity of landforms. The Sweetwater River and its associated floodplain extend through or adjacent to the McGinty Mountain, Sweetwater River, and San Miguel Mountain areas of the Refuge. Smaller drainages, such as those found in Steele Canyon and Coon Canyon, have created steep canyon walls within the Las Montañas and San Miguel Mountain areas. Moderately steep to very steep slopes associated with McGinty Mountain, San Miguel Mountain, Mother Miguel Mountain, and the Jamul Mountains, as well as other more gently sloping foothills, characterize much of the remaining lands. Flatter topography is found within the Otay Mesa area. The variety of topographic features, drainage patterns, underlying geologic formations, and overlaying soil types present within the Refuge boundary support a diverse assemblage of habitat types and species.

The Del Mar Mesa Vernal Pool Unit, located in the northern portion of the City of San Diego, is included within the 980-acre Del Mar Mesa Preserve (Preserve). The largest landowner within the Preserve is the City of San Diego. Other landowners include the County of San Diego, California

Department of Fish and Wildlife, and USFWS. The Refuge lands in this area are characterized by level mesa tops, steep slopes, deep canyons, and undulating mima mounds with intervening depressions referred to as vernal pools. Vernal pool habitat supports extremely sensitive plant and animal species.

1.5.3 Ecosystem Context

To the extent possible, the CCP will assist in meeting the conservation goals established in existing national and landscape-level plans, the California State Wildlife Action Plan, and other regional and species and habitat specific plans covering the same watersheds or ecosystems in which the Refuge resides (602 FW 3.3). In the State of the Birds 2011 (North American Bird Conservation Initiative 2011), a report that addresses the status of birds on public lands and waters in the United States, effective management is identified as essential to healthy bird populations. The report states that "Although birds benefit in part because most public lands are protected from residential and commercial development, increased protections and more effective management of habitats and bird populations are essential. Natural processes must be restored to ensure functional and resilient ecosystems through management actions such as control of nonnative species and diseases, prescribed cuts and burns to reinvigorate forests and grasslands, and water delivery and management to sustain wetlands. Many of these needs are expected to intensify because of climate change. All agencies are faced with the challenge of balancing needs for resource extraction, energy development, recreation, and other uses with the growing urgency to conserve birds and other wildlife. To succeed, they will need additional resources and greater public support to increase land protection and management. Better collaboration among agencies will also increase the effectiveness of public lands management for birds that migrate across political boundaries." These concerns and recommendations also apply to the other wildlife, plants, and habitat protected within the San Diego NWR.

Landscape Conservation Cooperatives

To achieve better collaboration among agencies, conservation organizations, foundations, academia, and commercial enterprises, conservation science partnerships have been formed through the establishment of Landscape Conservation Cooperatives (LCCs). LCCs have two main functions: to provide the science and technical expertise needed to support conservation planning at landscape scales, and to promote collaboration among their members in defining shared conservation goals. LCCs, which are applied conservation science partnerships between the Service and other Federal agencies, states, tribes, non-governmental organizations, universities, and stakeholders within a geographically defined area, are generating the tools, methods, and data that managers need to design and deliver informed landscape conservation planning.

The San Diego NWR is included within the California LCC. The California LCC has been divided into several subunits, and the San Diego NWR is located within the Coastal Southern California subunit. This subunit covers the coastal mountain ranges of central California, southern California, and northern Mexico; lands between the Mojave Desert and the Pacific Ocean; and numerous offshore islands. Like other LCCs, the California LCC will provide a forum for information exchange and feedback among partners and, secondarily, among other interested parties (e.g., organizations, scientists, managers). LCC partners will 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.

Sonoran Joint Venture Bi-national Bird Conservation

Another landscape-level planning effort involves the Sonoran Joint Venture (SJV), a partnership of diverse organizations and individuals from the southwestern United States and northwestern Mexico. The Strategic Plan for the SJV presents a regional strategy for protecting, conserving, restoring, and enhancing bird populations and their habitats. This effort is intended to address and integrate the conservation recommendations of the North American Waterfowl Management Plan, Partners in Flight North American Landbird Conservation Plan, and North American Waterbird Conservation Plan, as well as habitat-specific bird conservation plans (e.g., Coastal Scrub and Chaparral Bird Conservation Plan [CalPIF 2004], Oak Woodland Bird Conservation Plan [CalPIF 2002], Riparian Bird Conservation Plan [Riparian Habitat Joint Venture 2004], draft Grassland Bird Conservation Plan [CalPIF 2000]).

The San Diego NWR is located within the Californian Coast and Mountains Region of the SJV Bird Conservation Plan (SJVBCP) and has been identified as one of 36 focus areas within this region (SJV 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 primary conservation needs identified in the SJVBCP for the lands within the Refuge include protecting coastal scrub and chaparral shrublands from fragmentation and human disturbance related primarily to recreational uses and restoring riparian habitat and the associated natural riparian processes that support this habitat.

California State Wildlife Action Plan

The California State Wildlife Action Plan (Action Plan) (CDFW 2015) includes conservation actions that respond to current and future challenges within the State of California. Three statewide goals are identified in the Action Plan, including:

Goal 1: Maintain and increase ecosystem and native species distributions in California, while sustaining and enhancing species abundance and richness;

Goal 2: Maintain and improve ecological conditions vital for sustaining ecosystems in California; and

Goal 3: Maintain and improve ecosystem functions and processes vital for sustaining ecosystems in California.

These overarching goals, with their associated sub-goals, represent the desired ecological outcomes of the Action Plan's implementation. A multi-species, ecosystem approach was used as the guiding framework for developing the Action Plan, and plan strategies focus on restoring ecological function and processes capable of withstanding the stresses imposed by a changing environment. Collaboration and partnerships are identified as imperative to the successful implementation of Action Plan goals.

The Action Plan divides the State into several provinces. The San Diego NWR is located within the South Coast Province, which is recognized as one of the world's hotspots of biological diversity and is also "distinguished by the tremendous population growth and urbanization that have transformed the landscape since the 1940s" (CDFW 2015). As a result, the South Coast Province has been identified as the most-threatened biologically diverse area in the continental U.S. (U.S. Geological Survey [USGS] 2003).

Conservation targets and strategies for achieving goals for each target are presented in the Action Plan for the South Coast Province. The targets selected are those considered immediately under threat and not currently being addressed through existing conservation actions, such as the Natural Community Conservation Planning (NCCP) program. Targets present within the San Diego NWR that are addressed by the Action Plan include California grassland and flowerfields, freshwater marsh, American southwest riparian forest and woodland, and native aquatic herp assemblage (CDFW 2015).

1.5.4 Refuge Purposes

The San Diego NWR was established in 1996 under the authorities of the Fish and Wildlife Act of 1956, as amended (16 U.S. C. 742(a)-754), Endangered Species Act of 1973, as amended (16 U.S.C. 1531-1544, 87 Stat. 884), and Refuge Recreation Act of 1962, as amended (16 U.S.C. 460k-460k-4) (USFWS 1995a). Establishment occurred on April 10, 1996, when approximately 1,826 acres of land (referred to at the time as Rancho San Diego) were conveyed to the Service for management as a national wildlife refuge.

The purposes for this initial acquisition included:

> "... to conserve (A) fish or wildlife which are listed as endangered species or threatened species ... or (B) plants..." 16 U.S.C. § 1534 (Endangered Species Act of 1973);
>
> "... for the development, advancement, management, conservation, and protection of fish and wildlife resources ..." 16 U.S.C. § 742f(a)(4) "... for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude ..." 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956); and
>
> "... (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species and threatened species ..." 16 U.S.C. § 460k-460k-4 (Refuge Recreation Act of 1962).

Subsequent acquisitions have been made to meet these and other refuge purposes outlined in the Land Protection Plan (LPP) for the Otay-Sweetwater Unit of the San Diego NWR, approved in April 1997. In accordance with the LPP, "The purpose of the San Diego National Wildlife Refuge is to protect, manage, and restore habitats for federally listed endangered and threatened species and migratory birds and to maintain and enhance the biological diversity of native plants and animals" (USFWS 1997a).

1.5.5 Refuge Vision Statement and Goals

Our vision for the future of the San Diego NWR is:

> *Large, connected, healthy stands of southern California coastal lowland and foothill habitats, including coastal sage scrub, maritime succulent scrub, native grassland, chaparral, riparian woodland, and vernal pools, are conserved through an ecosystem approach to management and monitoring that draws on the talents of Federal, State, and local agencies and other conservation partners to leverage and maximize funds and staffing. Listed and sensitive plant and animal species are protected, and species that historically occurred on Refuge lands are reestablished. One of the last expanses of open space in coastal southern California, with exceptional biological, social, historical, and economic values, is protected as a sanctuary not just for plants and animals but also for people.*

The goals for the San Diego NWR include:

Goal 1: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of the federally and State listed endangered and threatened species and other species of concern currently or historically present on the Refuge.

Goal 2: Protect, manage, and restore the Refuge's native habitats, MSCP-covered species, and other species of concern for their inherent value and to contribute to the regional effort of conserving the biological diversity of southwestern San Diego County.

Goal 3: Engage in partnerships and provide leadership in coordinating land management and acquisition efforts throughout southwestern San Diego County in support of the Multiple Species Conservation Program (MSCP) and other resource protection objectives developed for the Region.

Goal 4: Provide safe and high-quality opportunities for compatible wildlife-dependent recreational uses that foster public appreciation of the unique natural heritage of the San Diego region.

1.5.6 History of Refuge Establishment

The events that led to the establishment of the San Diego NWR in 1996 can be traced back to the adoption of the Clean Water Act (CWA) (33 U.S.C. §1251 et seq.) in 1972. Included in the CWA was a provision requiring wastewater treatment plants to provide a minimum of secondary treatment before discharging the effluent back into the environment. An exception to this provision was provided in CWA Section 301(h), which allowed those wastewater treatment plants discharging into a marine environment to request a waiver from these secondary treatment standards (City of San Diego 2009a). In 1979, the City of San Diego applied for such a waiver for its Point Loma Wastewater Treatment Plant, which was discharging primary treated wastewater into the Pacific Ocean. The city subsequently withdrew, revised, and then resubmitted its application in 1983. In 1986, the U.S. Environmental Protection Agency (USEPA) tentatively denied the request for waiver due in part to the city's lack of compliance with the California Ocean Plan. As a result, the city withdrew its application and in 1987, USEPA sued the City of San Diego for numerous violations of the CWA (National Research Council 1993).

In the midst of the court battle over CWA violations, the San Diego City Council, in 1988, established the "Clean Water Program" (subsequently reorganized as the City of San Diego Metropolitan Wastewater Department) to assist with the lawsuit, as well as to develop a program to meet the water and sewage treatment needs of the City through water reclamation and reuse (National Research Council 1993). From 1988 through 1990, the Clean Water Program prepared plans for the construction and operation of a secondary treatment plant composed of two wastewater treatment plants, an additional ocean outfall, four water reclamation systems, associated pipeline conveyance systems, and proposals for regional sludge processing and disposal (Harper 1991). The potential environmental impacts of implementing this proposal, referred to as the Greater San Diego Secondary Treatment System and Associated Sludge Management Facilities Project, were described in a joint Environmental Impact Report/Environmental Impact Statement issued for public review and comment in the fall of 1990. Included in the draft was an analysis of the project's potential for inducing growth within the region, as well as an evaluation of the secondary impacts to the environment, including native habitats and listed species, that would result from such growth.

The Service, in considering the implications of this growth inducement on wildlife and habitat, concluded that a countywide mitigation program would be necessary to address the extensive loss of habitat projected to occur as a result of implementing the city's expanded sewage treatment proposals (Saldaña 1993). In 1991, the City of San Diego agreed to prepare a Multiple Species Conservation Program (MSCP) as partial mitigation to offset impacts resulting from the secondary growth related effects of the city's Clean Water Program. The purpose of the MSCP was to develop a program for the conservation of federally endangered, threatened, or key candidate species and their habitats (Opdycke 1991) within the Metropolitan Sewerage System Services Area of the Clean Water Program, encompassing approximately 900 square miles in southwestern San Diego County (City of San Diego 1998a). Further, the MSCP was to be designed to identify, evaluate, and delineate a network of lands that, if acquired and properly managed, would conserve habitat and provide for wildlife movement on a large scale in an effort to ensure the long-term protection of the biodiversity within the greater San Diego area.

Also at this time, proposals for habitat conservation planning were being discussed at the State level. In April 1991, California Governor Pete Wilson unveiled an environmental initiative entitled "Resourceful California." This initiative included a proposal to develop a regional habitat conservation plan for southern California (Pollak 2001). Legislation that would implement the proposals in this initiative was introduced in the form an amendment to AB 2172. After several revisions, the legislation was signed into law in October 1991. The intent of the legislation (the Natural Community Conservation Planning [NCCP] Act, was to foster voluntary collaboration between the California of Fish and Wildlife (CDFW), then referred to as California Department of Fish and Game (CDFG), and the Service, local governments, and private development interests in addressing species and habitat protection and providing a predictable, streamlined regulatory process (Pollak 2001).

The NCCP Act authorized CDFW to enter into agreements with other public agencies or private interests for the purpose of preparing habitat conservation plans "to provide comprehensive management and conservation of multiple wildlife species, including but not limited to" species listed as endangered or threatened under the CESA (Pollak 2001). The primary objective of the NCCP program was and continues to be conservation of natural communities at the ecosystem level while at the same time accommodating compatible use.

In accordance with the NCCP Act, a pilot program was initiated in southern California to address the protection of coastal sage scrub habitat and the species it supports, including the coastal California gnatcatcher (*Polioptila californica californica*). In December 1991, the Service and the CDFW agreed in a Memorandum of Understanding (MOU) to jointly undertake habitat conservation planning for the Southern California Coastal Sage Scrub NCCP.

On March 30, 1993, the Service published a Final Rule in the *Federal Register* listing the coastal California gnatcatcher as threatened under the provisions of the Federal ESA. This action was followed on December 10, 1993, with a special rule allowing incidental take of the gnatcatcher if, among other conditions, the take results from activities conducted pursuant to the State's NCCP and in accordance with a NCCP plan for the protection of coastal sage scrub habitat (Federal Register Vol. 58, No. 236, December 10, 1993). It was the approval of this special rule the allowed the integration of the California's NCCP program into the Habitat Conservation Plan/incidental take requirements of Section 10(a)(1)(B) of the EAS.

California gnatcatcher (Kevin Hamm)

To develop a habitat conservation plan for southwestern San Diego County that complied with both Section 10 of the ESA and the NCCP Act required cooperation among a full range of participants, including local, State, and Federal agencies, developers, private conservation groups, and private landowners. Initiated in 1991, the MSCP, which represents the first large-scale, proactive and ecosystem-based conservation planning effort of its kind in the Nation, was approved by the participating agencies in 1998 (City of San Diego 1998a, Conservation Biology Institute and The Nature Conservancy 2007). Developed to conserve the diversity and function of the natural ecosystem within the planning area, the MSCP proposed the preservation of large blocks of interconnected habitat, as well as smaller areas of habitat that support rare vegetation communities such as vernal pools.

An important component in the preparation of the MSCP was defining a Multiple Habitat Planning Area (MHPA) within which preserve planning could be focused (City of San Diego 1997). In defining the MHPA, core biological areas and associated habitat linkages were identified throughout the study area. Core areas were defined as areas supporting high concentrations of sensitive biological resources that, if lost or fragmented, could not be replaced. The location and configuration of these core areas provided the framework for ultimately identifying a regional preserve network.

In addition to the development of the subregional MSCP, local jurisdictions and special districts within the MSCP planning area were required to implement their portions of the plan through subarea plans (City of San Diego 1998a). The MSCP Subarea Plan for the City of San Diego and the County of San Diego's Subarea Plan were both approved in 1997. An Incidental Take Permit under the MSCP for the County's Subarea Plan was issued on March 17, 1998.

Along with the approval of the subarea plans and Incidental Take Permits, Implementing Agreements by and between the Service, CDFW, and the participating jurisdiction were also issued. The City of San Diego's Implementing Agreement was signed in 1997 and the County's was signed in 1998. As part of the Implementing Agreements, the Service and CDFW agreed to "apply their best efforts to contribute public lands and funds to the acquisition and management, maintenance, and monitoring of habitat lands within the MHPA."

Per the Service's commitment to provide a contribution towards the implementation of the MSCP, studies to establish the San Diego NWR were initiated in 1995 when a Concept Plan for the San Diego NWR was distributed to government agencies, tribes, interested citizens, and landowners within and adjacent to the planning areas for the proposed Refuge, including the Vernal Pools and Otay-Sweetwater planning areas (USFWS 1997a, 1997c). The planning proposed for the Otay-Sweetwater Unit represented the largest expanse of undeveloped land in the MSCP planning area and was considered one of the cornerstone conservation areas in the MSCP.

In the midst of the MSCP planning process, the Nation's savings and loans were in crisis due in part to high interest rates, high gasoline prices, and misconduct as a result of deregulation. In 1992, approximately 1,830 acres of undeveloped land owned by Home Federal Savings and Loan were placed in Federal receivership under the control of the Resolution Trust Corporation (RTC). The RTC was responsible for liquidating this property, referred to as Rancho San Diego, as well as other real estate assets owned by Home Federal.

The Rancho San Diego parcels were identified as a core biological resource area in the draft MSCP. These parcels contained large blocks of high value coastal sage scrub supporting approximately 25 pairs of coastal California gnatcatchers. In addition, a significant riparian woodland corridor extended through the parcels that supported approximately 30 pairs of the endangered least Bell's vireo (*Vireo bellii pusillus*). The Service recognized that the acquisition of these lands would prevent the loss of habitats critically important to the recovery of listed species and would represent an important contribution by the Federal government to the MSCP. Based on the sensitivity of the biological resources present on the parcels, as well as the importance of this area to the implementation of the MSCP, the Service entered into a purchase agreement with the RTC, and on April 10, 1996, approximately 1,826 acres within the Rancho San Diego area were acquired by the Service. (This agreement included the establishment of the Rancho San Diego Mitigation Bank, which is discussed in Chapter 4.) Although the Service was still in the process of preparing Land Protection Plans for the Otay-Sweetwater Unit and Vernal Pools Stewardship Project, this acquisition marked the establishment of the San Diego NWR. In 1997, the Service approved the acquisition boundary for the Otay-Sweetwater Unit (refer to Figure 1-2).

To complement the MSCP and assist in the recovery of vernal pool species, the Service also approved the Vernal Pools Stewardship Project in April 1997. The approved acquisition boundary encompassed approximately 8,220 acres, of which about half could be acquired by the Service from willing sellers for inclusion in the Refuge and half would be managed by the Department of the Navy at MCAS Miramar under existing authorities and through the development of a cooperative agreement with the Service and CDFW under the Sikes Act (USFWS 1997b). The intent of this action was to allow the Service to establish a Vernal Pool Unit of the San Diego NWR (USFWS 1997b) for the purpose of providing for the long-term conservation of the San Diego region's vernal pool habitats and their associated flora and fauna. The Vernal Pools Stewardship Project includes a number of non-contiguous land areas extending from Del Mar Mesa, located just south of Highway 56, to Otay Mesa, located to the east of Interstate 805 and abutting the U.S./Mexico border (refer to Figure 1-5). Specific areas include Del Mar Mesa, Lopez Ridge, Miramar, Montgomery Field, Otay Mesa, and areas adjacent to Sweetwater Reservoir and the Otay Lakes.

When the Conceptual Management Plan for the San Diego NWR was initially prepared, the Refuge was described as including three areas, the Otay-Sweetwater Unit, Vernal Pools Stewardship Project, and the South San Diego Bay Unit (USFWS 1997c). When the South San Diego Bay Unit was established in 1999, it was still a part of the San Diego NWR. However, on July 13, 2004, the South San Diego Bay Unit and the Sweetwater Marsh NWR were reorganized to become the San Diego Bay NWR. The San Diego Bay NWR is now made up of the South San Diego Bay Unit and Sweetwater Marsh Unit; the San Diego NWR is made up of the Otay-Sweetwater Unit and the Vernal Pools Stewardship Project. This change was made to streamline management and facilitate public understanding and recognition of the two Refuge areas (USFWS 2006a).

In May 2012, a refuge boundary expansion was approved for the San Diego NWR by the Service's Region 8 Regional Director. As a result of this action, the boundary of the Otay-Sweetwater Unit was expanded by approximately 327 acres to accommodate four parcels of land to be donated by Caltrans for inclusion in the Refuge. The largest parcel, about 237 acres, is located to the south of Proctor Valley Road and west of Highway 125 (refer to Figure 1-4). When donated, this parcel will become part of the San Miguel Mountain management area. Several parcels located to the south of Highway 94 and west of Jamacha Road (totaling approximately 79 acres) and another parcel (2.4 acres), located to the south of Highway 94 and west of Millar Ranch Road, will become part of the Sweetwater River management area. The remaining 25.75-acre parcel located south of Highway 94 and east of Steele Canyon Road will become part of the Las Montañas management area.

2 The Planning Process

2.1 Preparing a Comprehensive Conservation Plan

The purpose of the CCP for the San Diego NWR (Otay-Sweetwater Unit and Del Mar Mesa Vernal Pool Unit) is to guide the management of the Refuge over the next 15 years. The CCP was developed in association with the preparation of an accompanying EA to meet the dual compliance requirements of the Improvement Act and NEPA. Preparation of the CCP was guided by the Improvement Act, as well as the Service's 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 "reasonable" range of alternatives, or different approaches to refuge management, that can reasonably be implemented to achieve refuge purposes and goals and help fulfill the Refuge System mission. The range of management alternatives must include a "no action" alternative that reflects current conditions and management strategies on the Refuge. Alternative approaches to management of the San Diego NWR were developed as part of the planning process and were considered in the EA.

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;
- preparing the draft CCP/EA;
- revising draft documents and releasing the Final CCP;
- implementing the CCP; and
- monitoring and adapting management practices as necessary.

Figure 2-1 shows the overall CCP process in a linear cycle, but this 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 July 2005 with the establishment of a core planning team. The team consists of the Refuge Manager, Refuge Planner, Refuge Wildlife Biologist, and other members of the San Diego NWR Complex. Appendix A lists the members of the planning team, as well as other participants who provided important insight regarding planning issues and ongoing Refuge management. The State (CDFW) was invited to participate as a core team member, but was not available to participate at this level due to time constraints. However, CDFW did participate as part of an extended planning team that also included biologists from the Carlsbad Fish and Wildlife Office and the Regional Office (Region 8) of Fish and Wildlife, the Sweetwater Authority biologist, and representatives from USGS.

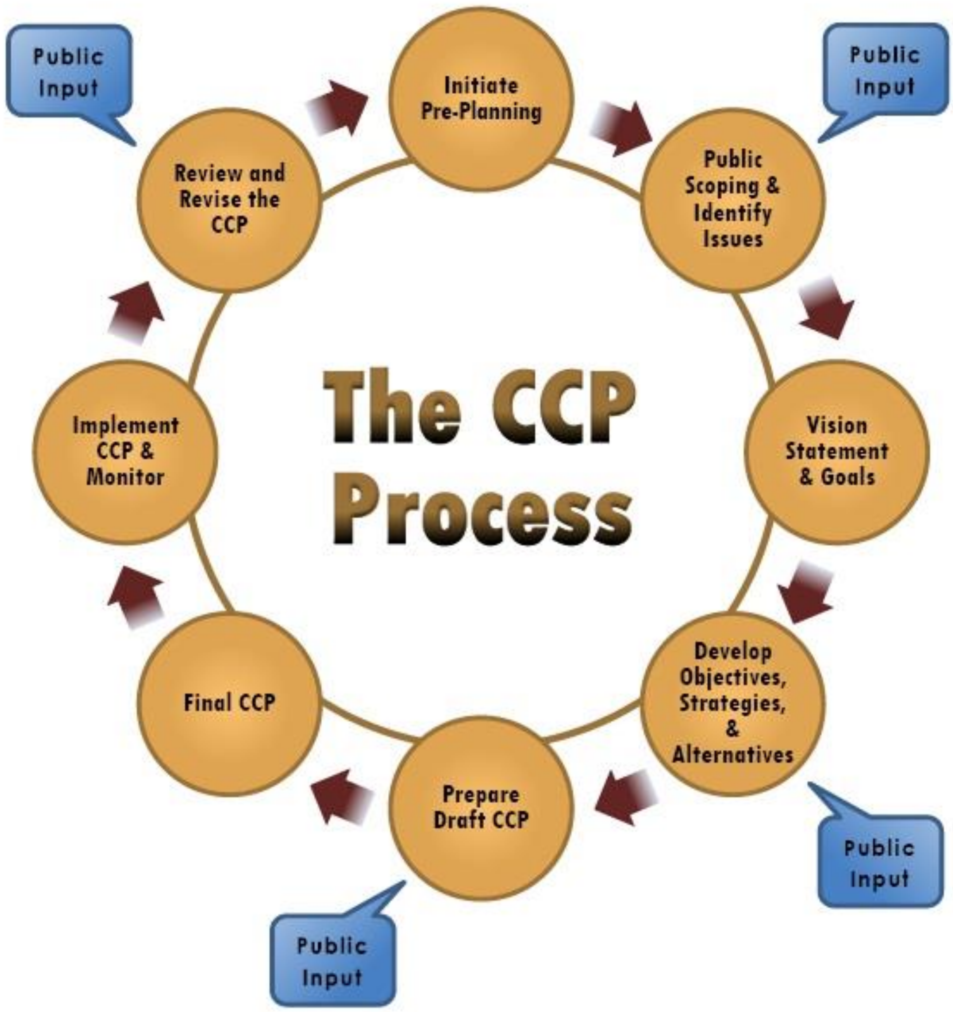

Figure 2-1. Comprehensive Conservation Planning Process

One of the first tasks of the core planning team was to identify preliminary issues, concerns, and opportunities. To do this, the team relied on information derived from wildlife and habitat monitoring and field experience associated with the past management of the Refuge. Through this process, three primary areas of focus were identified: habitat management, endangered species recovery, and wildlife-dependent recreation. These areas of focus were presented to the public during the scoping process to encourage input regarding the future management of the Refuge.

2.3 Public Involvement in Planning

Public involvement is an essential component of the CCP and NEPA process. The public is invited to participate from the initiation of the planning effort through plan implementation. The initial planning effort for the San Diego NWR CCP was initiated on May 24, 2006 when a Notice of Intent to prepare a CCP was published in the *Federal Register* (71 FR 100 [24 May 2006]). At the same time, over 1,000 newsletters (e.g., "Planning Updates") were distributed to local, State, and Federal agencies; special districts; tribes; interested organizations; adjacent property owners; potential user groups; and other members of the public. The Planning Update described the planning process, requested input on future Refuge management, and invited the public to future scoping meetings.

Two public scoping meetings were held in June 2006 to further develop and ascertain Refuge planning issues. More than 70 individuals, representing the interests of public agencies, private property owners, hunters, trail users, environmental organizations, land conservancies, and others, attended these meetings. Many 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. More than 150 different issues ranging from law enforcement and fire management to public use and habitat protection were addressed in these comment letters. Once all of these issues were compiled, a second Planning Update was distributed in December 2006 to provide the public with the results of the initial scoping process.

Many of the comments received during the scoping process focused on public use, particularly trail use and hunting. Due to the considerable public interest related to these topics, a Public Use Workshop was held on January 6, 2007, and a follow-up Trail Planning Workshop was held in February 2008.

A third Planning Update was distributed to over 700 individuals and entities in March 2008 to solicit public input related to the draft Refuge goals and preliminary management alternatives that were developed as a result of the initial scoping process. Throughout the planning process, Refuge staff also attended meetings held by various organizations interested in learning more about the San Diego CCP; coordinated with representatives from the County and City of San Diego, City of Chula Vista, CDFW, Caltrans, Bureau of Land Management (BLM), U.S. Forest Service, various special districts, and interested tribes; and met with various elected officials.

The draft CCP/EA represented the next step in the public involvement process. On June 19, 2014, a Notice of the Availability of the draft CCP/EA was published in the Federal Register (79 FR 35183). More than 1,500 notices were distributed to individuals, agencies, local community groups, and interested organizations announcing both the availability of the draft CCP for a 60-day comment period and the opportunity to attend a public meeting on July 15, 2014. During the initial public comment period, Refuge staff also presented the proposals in the draft CCP to the five San Diego County recognized community planning groups whose community boundaries overlap the Refuge boundaries.

Based on the level of interest in the draft CCP/EA, the comment period was extended for an additional 30 days. Approximately 1,500 postcards were mailed out to inform the public of the time extension. In addition, a notice was published in the Federal Register on September 2, 2014 (79 FR 52037) stating that the public comment period had been reopened until September 17, 2014.

As a result of concerns raised about the trail proposals included in the draft CCP/EA, four additional community meetings were held on August 20 (focusing on Jamul trails), August 25 (focusing on Spring Valley/Rancho San Diego/Valle de Oro trails), August 26 (focusing on Bonita/Sweetwater trails), and September 10 (focusing on Dehesa/Sloane Canyon areas) specifically to gather public input on trails. Although each of these trail meetings was focused on a specific area, comments were accepted for any area within the Refuge boundaries.

The Refuge received more than 35,800 written communications on the draft CCP/EA, including 637 original letters and emails and 35,189 organized email petition responses (opposing hunting) from two different sources. In addition, a petition, signed by numerous individuals (some of whom also submitted separate comments) was submitted to the Refuge office that addressed concerns about the trail plans presented in the alternatives. The issues addressed in the public comments, as well as our responses, are presented in Appendix F-2.

2.4 Overview of Issues and Public Scoping Comments

Early in the planning process, the planning team identified issues, concerns, and opportunities internally and through discussions with other Federal, State, and local agencies; wildlife and habitat professionals; and other key contacts. In addition, a wide range of issues, concerns, and recommendations were expressed during the public scoping process and at subsequent public workshops. All of this input was compiled by the Service and taken into consideration during the development of management alternatives described in the draft CCP/EA. This input was also used to further refine Refuge goals.

The issues raised and comments received during the scoping process fall into several categories, including wildlife and habitat management, public use, cultural resources, Refuge operations (e.g., law enforcement, fire management, regulatory signage, maintenance), and the acquisition boundary and acquisition process. A summary of the key issues and comments provided during the public scoping process and public workshops is provided here.

Wildlife/Habitat Management

- Comprehensively plan for habitat and wildlife conservation, management, and monitoring within the Refuge acquisition boundary, regardless of ownership.
- Incorporate as appropriate the statewide and South Coast Region conservation actions described in the California Wildlife Action Plan.
- Restore and/or enhance native habitats and expand or reintroduce populations of listed and sensitive species that are supported by these habitats.
- Control invasive plant and animal species.
- Monitor water quality and quantity.
- Ensure adequate water availability to support Refuge resources.

Listed and Sensitive Species Conservation

- Restore and enhance habitat for listed species currently or historically present on the Refuge.
- Conduct systematic mapping of the rare plant species present on the Refuge.
- Identify the actions that should be taken to sustain and restore priority species and the habitats that support these species over the next 15 years.

Public Use

- Open the Refuge to a full range of wildlife-dependent recreational uses.
- Designate as multiple use trails those trails that support the county's regional trail system.
- Develop a trail sign plan for all designated trails within the Refuge to ensure adequate wayfinding and to provide information related to trail accessibility, length, permitted uses, and appropriate trail conduct.
- Consider wildlife needs, conflicts with other users, and the proximity of the Refuge to developed areas when evaluating requests for hunting and other public uses.
- Provide a visitor center to accommodate educational and research activities.

Cultural Resources

- Identify and protect important cultural resources.

Refuge Operations

- Improve conditions on Millar Ranch Road through the Refuge to reduce safety issues for adjacent residents and other road users.
- Clearly post all Refuge boundaries, and identify and secure entry points being used for unauthorized access onto the Refuge.
- Work in cooperation with other agencies to address off-road vehicle trespass, homeless and migrant encampments, illegal dumping, and other law enforcement issues.
- In partnership with private property owners, implement actions that will prevent vehicular access onto Refuge lands through adjacent private parcels.
- Consider including prescribed burns as an appropriate action for facilitating habitat restoration and maintenance and for reducing the presence of hazardous fuels.
- Develop a volunteer program to assist the Refuge in habitat enhancement and restoration projects, trail maintenance, and conducting environmental education programs.
- Encourage research within the Refuge that will benefit Refuge resources and management, including research that focuses on wildland-urban interface issues.
- Ensure that adequate staffing and funding is available to implement the Refuge's obligations for habitat conservation, maintenance, and monitoring under the MSCP.
- Ensure that any new Refuge facilities are designed to be energy efficient.

Approved Refuge Boundary/Future Acquisitions

- Consider amending the acquisition boundary to address changes in development patterns and habitat conditions.
- Acquire and protect wildlife corridors to ensure continued wildlife movement between protected habitat areas.
- Accelerate the acquisition of properties within the approved acquisition boundary to avoid the permanent loss of potential Refuge lands to development.
- Set acquisition priorities to ensure that adequately sized contiguous blocks of native habitat are acquired to support native plants and wildlife, as well as to better support priority public uses such as hunting and wildlife observation.
- Analyze the effect of continued acquisition within the approved Refuge boundary on essential public facilities and planned public roadways within the region.
- Consider the impacts of continued land acquisition on the availability of aggregate mineral resources.

2.5 Management Concerns and Opportunities

In addition to the issues raised during the public scoping process, the planning team, with input from other partners, identified several challenges, threats, and/or opportunities that will likely affect Refuge management over the next 15 years and beyond. These challenges include several factors of global or regional significance (e.g., climate change, increased prevalence of invasive plant species in the San Diego region, degraded air quality, uncertainty over the long-term availability of surface water and groundwater within riparian areas, increased wildfire frequency) that cannot be altered simply by the actions taken on an individual Refuge. Instead, individual Refuge responses 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. Additional challenges identified by the planning team included lack of connectivity among the various Refuge landholdings and lack of direct access to Refuge lands from dedicated public streets. These challenges, which are described in the following text, were considered during the development of the management alternatives and responses to these challenges are reflected in the actions proposed in the final CCP.

Climate Change

The Intergovernmental Panel on Climate Change (IPCC) defines climate change as "a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC 2007). Based on long-term, independent records of weather data from various sources, scientists have confirmed that the earth is warming, precipitation patterns are changing, sea level is rising, and extreme weather events are increasing. These records indicate that the average temperature in the U.S. has increased by about 1.5°F since 1895 (Menne et al. 2009). This increase however has not been constant over time. Temperatures generally rose until about 1940 and then declined until about 1980 when a rapid increase in temperature was observed with 80 percent of the total increase occurring after 1980. In its Summary for Policymakers (IPCC 2007), the IPCC states "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.

Increases in minimum, average, and maximum temperatures, changes in total precipitation, and increased storm intensity can have significant effects on species and habitat quality. These changes can influence fire frequency, ground and surface water elevations, invasive plant presence, soil stability, and vegetation and species composition. Recognizing that changing climate will have a variety of effects on the natural resources being conserved on refuges, the Secretary of the Interior (Secretarial Order 3289) has directed the Service to consider the effects of climate change on Refuge management, particularly during the CCP planning process. Anticipated effects 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.

Addressing the effects of climate change requires coordination among a variety of agencies at all levels of government. The Service, in its strategic plan for responding to climate change (USFWS 2010a), has established a basic framework for how we will work as part of the larger conservation community to help ensure the sustainability of fish, wildlife, plants, and habitats in the face of accelerating climate change. The three major strategies in the plan for addressing climate change are:

1) **Adaptation**: Minimizing the impact of climate change on fish and wildlife through the application of cutting-edge science in managing species and habitats;
2) **Mitigation**: Reducing levels of greenhouse gases in the Earth's atmosphere; and
3) **Engagement**: Joining forces with others to seek solutions to the challenges and threats to fish and wildlife conservation posed by climate change.

As part of the Service's strategy, the NWRS initiated a national inventory and monitoring program to compile data that can be used to develop a long-term understanding of the effects of changing climate on fish and wildlife. The data will also be available for assessing the success of conservation actions taken on the ground to address the effects of climate change on fish and wildlife. Additional discussion regarding the implications of climate change on Refuge resources is provided in Chapter 4, section 4.2.8.

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 in the NWRS, including the San Diego NWR. 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 types of invasive plant species occurring on the San Diego NWR range from non-native annual grasses and annual weeds that invade burned areas and other disturbed sites to non-native woody shrubs that displace native willows (*Salix* sp.). Invasive animal species of concern include a wide range of vertebrates, including feral pigs (*Sus scrofa*); invertebrates of several phyla; and aquatic and terrestrial species, such as bullfrogs (*Rana catesbeiana*). More information about the various invasive species that threaten habitat quality on the Refuge is provided in Chapter 4.

Air Quality

Various research studies indicate that there may be a connection between degraded air quality and the persistence of invasive plant species in native habitat areas. Studies on the effects of elevated levels of carbon dioxide (CO_2) indicate that the long-term success of exotic annual grass may be enhanced in the presence of elevated levels of CO_2 (Smith et al. 2000), and nitrogen deposition resulting from emissions of oxides of nitrogen (NO_x) from fossil fuel combustion may enhance the growth of invasive plants in coastal sage scrub vegetation (Allen et al. 1998, Fenn et al. 2003). In addition, research indicates that air pollution, along with other factors, appears to be a predictor of species distribution in coastal sage scrub (Westman 1981). Westman found a decreased presence of white sage (*Salvia apiana*) and wishbone plant (*Mirabilis californica*) in areas subject to high levels of oxidants, while also identifying an increased presence of the invasive, non-native grass *Schismus barbatus* in these same areas. Developing a better understanding of how air quality may be influencing the distribution of species in certain habitats will be important as we attempt to manage the wide range of invasive plants present on the Refuge.

Wildland Fires

The vast majority of the wildlife habitat on San Diego NWR consists of highly flammable vegetation, both native and exotic. Fires occurring in wildlife habitat directly kill animals and plants, and they greatly modify the vegetation community and thus the quality and quantity of habitat for wildlife. Fire has historically been a natural phenomenon in arid shrublands of southern California, and the native plants and animals have evolved life history strategies to enable their populations to persist despite large areas of periodic devastation of habitat. However, the effects of fire in southern California today are more deleterious to wildlife and habitats than they were prior to European colonization of the area for three reasons. The first is that fires occur more frequently today than they did prehistorically (Keeley and Fotheringham 2001). Unnaturally frequent fires do not allow sufficient time for plants to accumulate resources to survive a subsequent fire or for seed banks to repopulate an area after fire. Additionally, the burned habitat may not have time to develop sufficiently between fires to support animals that require relatively mature habitats.

A second reason stems from the fact that non-native annual plants now dominate large areas of the landscape. Such non-native plant communities recover more quickly than native plant communities, outcompeting native perennial plants, suppressing their recruitment and growth, and facilitating the conversion of the vegetation community from coastal sage scrub or chaparral to non-native grassland.

Finally, movement of animals and plants from one area to another is greatly constrained by habitat loss due to development in southern California, such that likelihood of recolonization of burned habitat from non-burned habitat is reduced. Additional discussion on fire management practices within the San Diego NWR is provided in Chapter 5.

Human Activity

San Diego NWR is located within San Diego County, which supports a human population of just over three million people. Several million of these people live within easy driving distance of the Refuge, which receives a significant but unquantified amount of visitation (estimated at 22,000 visitors annually) by a variety of recreationists. Some of the Refuge visitors participate in permitted recreational activities such as trail use and organized Refuge events, while others participate in unpermitted activities such as fishing, off-roading, geocaching, paint-ball shooting, and allowing dogs to roam unleashed. The proximity of the Refuge to development also results in other illegal activities such as dumping trash and other waste, releasing unwanted pets, habitation (homeless camps), encroachment of backyard gardens from adjacent residential lots onto the Refuge, vandalism of facilities and habitat, and theft of Refuge equipment. All of these activities are potentially or actually deleterious to wildlife and habitats. San Diego's human population will continue to increase, and it is reasonable to assume that deleterious activities are likely to continue and could potentially increase. Implementing the management actions described in the CCP will enable Refuge staff to more effectively manage these activities, with the goal of reducing potentially harmful effects on Refuge resources.

Refuge Connectivity and Access

As illustrated in Figures 1-2 and 1-3, the San Diego NWR currently consists of several large blocks of non-contiguous land, along with several smaller isolated parcels. These disconnected lands that comprise the Refuge are separated by private property and/or lands being conserved by other public or non-profit entities. The management problems associated with the current assemblage of Refuge lands (e.g., reduced defensibility, fragmentation of habitats, increased edge effects, and inadequate habitat linkages between various conserved habitats) are compounded by limited accessibility to these lands from existing public rights-of-way. This accessibility issue adversely affects the ability of Refuge staff to efficiently manage and monitor sensitive habitats and species, as well as to provide defined access points for accommodating compatible public use.

The extent of wildland-urban interface within the San Diego NWR, which is due in large part to the number of non-contiguous parcels that constitute the Refuge, provides opportunities for unauthorized access onto the Refuge by adjacent residents and others. This situation exacerbates illegal actions, including dumping, trail cutting, vandalism, fires, homeless camps, and disturbance of wildlife by people and pets.

Opportunities

Despite the issues and threats described here, opportunities exist for protecting the Refuge's habitat quality, listed species populations, and other trust species. These opportunities include:

1) the potential to cooperatively manage conserved lands in the vicinity of the Refuge involving, as appropriate, other Federal, State, and local agencies; tribes; land conservancies; and private landowners 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 on specific species, species interactions, methods for optimizing restoration, better control of invasive plants, and other topics that would provide information essential for the management of the highly diverse habitats included within the Refuge.

While climate change and degraded air quality are difficult to address at the Refuge level, adaptive management provides an important tool for adjusting current management practices in response to changes on the Refuge related to these issues. Information learned and shared by other partners or acquired through research projects will assist Refuge staff in determining how best to address changing management needs on the Refuge.

2.6 Development of a Refuge Vision

A vision statement, which is developed or reviewed for each individual refuge unit as part of the CCP process, is 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)). The Refuge vision provides a descriptive picture of how the Refuge will look in the future and describes the desired future conditions in the long term (more than 15 years). The Refuge vision is 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 the San Diego NWR 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 San Diego NWR 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 analysis of environmental effects, as required by 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; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of each refuge and the Refuge System; and resolve identified issues. These alternatives are to consist of different sets of objectives and strategies for management of the Refuge. NEPA also requires analysis of a "no action" alternative, which constitutes a continuation of current conditions and management practices.

The process of developing alternatives involved 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 other information gathered during subsequent meetings and workshops and from various interested individuals, agencies, and organizations. A range of alternatives for the San Diego NWR CCP, including a no action and three action alternatives, were developed and analyzed in the draft CCP/EA. Each alternative received an equal and full assessment of the environmental effects associated with implementation. The four alternatives differed in the extent and focus of the wildlife and habitat management actions to be implemented on the Refuge, as well as in the types and levels of public use opportunities to be provided. A description of the alternatives is provided in Appendix F.

2.9 Selection of the Proposed Action

In the draft CCP/EA, we identified Alternative D as the preferred alternative based on our preliminary analysis of environmental effects and Refuge issues, goals, and objectives. Following consideration of all the comments received from the public, agencies, tribes, and/or other stakeholders during the public review period, we modified the proposals in Alternative D to address comments related to public use and protection of biological and cultural resources. We have determined that implementation of the modified Alternative D alternative will best achieve Refuge purposes, vision, and goals; help fulfill the Refuge System mission; maintain and, where appropriate, restore the ecological integrity of the Refuge; be consistent with principles of sound fish and wildlife management; and minimize adverse effects on the environment. The selected action is described in detail in Chapter 3.

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. Chapter 3 outlines the Refuge goals, objectives, and strategies to be implemented to achieve the goals and objectives. Chapter 5 provides additional details regarding the implementation of the CCP over the next 15 years, and addresses personnel and project funding, current and potential partnerships, step-down management plans needed to implement the CCP, and the monitoring framework that will be used to assess the effectiveness of the plan strategies in achieving Refuge goals and objectives. It is however important to note that the implementation of the CCP within the stated timeframes is dependent upon the availability of adequate funding and staffing.

3 Refuge Management

3.1 Introduction

The management direction outlined here for the San Diego NWR acknowledges the need to conserve existing intact ecological communities on the Refuge, as well as to protect the Refuge's many imperiled species and habitats. Management actions also address the need to enhance and/or restore those habitats that have been altered by human activity or wildland fire, as well as to expand current monitoring efforts to detect changes in habitat quality, wildlife and plant populations, and population trends over time. In addition to habitat and wildlife protection, the CCP also addresses the desire to instill a stewardship ethic among Refuge visitors for the habitats and species being conserved on the Refuge and elsewhere in the region. To accomplish this objective, the CCP includes various compatible public use opportunities that will provide the public with opportunities to discover and enjoy the diversity of wildlife and plants on the Refuge.

View of the San Miguel and Sweetwater River areas of the Refuge (USFWS)

Refuge goals and objectives, as well as the specific strategies (projects) for achieving the goals and objectives, are presented in this chapter. Although it is our intent to implement the proposed strategies by the dates presented, the timing of implementation may vary depending upon a variety of factors, including funding, staffing, partnerships, compliance with Federal regulations, and information gained from the evaluation of monitoring results. Some strategies, such as those related to habitat restoration and hunting, will require the preparation of step-down plans and the implementation of these and other proposals addressed in the CCP will occur in compliance with the National Environmental Policy Act (NEPA) of 1969, Section 7 of the Endangered Species Act of 1973, and other applicable Federal regulations.

The CCP serves as the primary reference document for all Refuge management actions, operations, and step-down planning. The strategies presented will likely be implemented 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. Some of the partnership opportunities to be explored are described here, as are the step-down plans, monitoring responsibilities, and staffing and funding requirements needed to successfully implement the CCP.

CCPs are intended to evolve with each refuge, and the Improvement Act requires that these plans be formally reviewed and updated as necessary at least every 15 years. This review process will follow steps similar to those implemented for the initial CCP process and will encourage continued 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. The 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 one or more proposed actions within the plan. The goals described will not change until they are reevaluated as part of a formal CCP revision process. Objectives and strategies may, however, be revised to better address changing circumstances or to take advantage of increased knowledge of Refuge resources.

3.2 Refuge Vision, Goals, Objectives, and Strategies

Our vision of the future conditions on the San Diego NWR is:

> *Large, connected, healthy stands of southern California coastal lowland and foothill habitats, including coastal sage scrub, maritime succulent scrub, native grassland, chaparral, riparian woodland, and vernal pools, are conserved through an ecosystem approach to management and monitoring that draws on the talents of Federal, State, and local agencies and other conservation partners to leverage and maximize funds and staffing. Listed and sensitive plant and animal species are protected, and species that historically occurred on Refuge lands are reestablished. One of the last expanses of open space in coastal southern California, with exceptional biological, social, historical, and economic values, is protected as a sanctuary not just for plants and animals but also for people.*

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 NWRS 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 here 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 information, in the form of a step-down management plan, restoration plan, or site plan, is required to implement a strategy.

The Refuge goals, objectives, and strategies are presented here.

Goal 1: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of the federally and State listed endangered and threatened species and other species of concern currently or historically present on the Refuge.

***<u>Objective 1.1:</u>* Coastal California Gnatcatcher**
By 2028, provide 3,500 acres of very high-quality gnatcatcher habitat consisting of gentle slopes (less than or equal to 40 percent) dominated by coastal sage scrub or coastal sage scrub/needlegrass grassland ecotone vegetation to support coastal California gnatcatchers at an occupancy rate of 0.48.

<u>Rationale</u>: The MSCP (City of San Diego 1998a) identifies the need to maintain ecosystem functions and extant populations of covered species, including the federally listed threatened coastal California gnatcatcher, as an essential goal of the program. The San Diego NWR was established in part to support the goals of the MSCP and the recovery of the gnatcatcher by conserving large blocks of occupied gnatcatcher habitat (USFWS 1995a). The acquisitions of very high-quality gnatcatcher habitat that have been completed to date for the San Diego NWR represent contributions by the Service towards the implementation of the MSCP (USFWS 1997a) and support the objective for the western San Diego County region of conserving approximately 30,000 acres of very high value gnatcatcher habitat (City of San Diego 1998a).

For the purpose of designing a reserve network in San Diego County, a habitat model (Technology Associates International Corporation [TAIC] 2002) was developed to qualify areas as low, medium, high, and very high-quality habitat for California gnatcatchers. The model, which used presence only data, weighed several variables, including vegetation type (i.e., California sagebrush presence or absence), patch size, slope, and climate (i.e., temperature, precipitation) as an accumulation of scores, with higher values indicating gnatcatcher preference (Winchell and Doherty 2008). Based on results from a large-scale survey effort for gnatcatchers in 2002, Winchell and Doherty (2008, 2010) found that their occupancy modeling supported the habitat categories in the reserve design model initially developed by TAIC. However, their study results suggested the variables associated with slope and climate are stronger influences on occupancy than patch size. The 2002 study also provided data used to develop quantitative estimates of occupancy for each habitat quality category, including an estimate of 48 percent area occupied for very high-quality habitat; 28 percent for high-quality habitat; 8 percent for medium-quality habitat; and essentially no probability of occupancy in low-quality habitat (Winchell and Doherty 2008).

Coastal California Gnatcatcher Strategies

- Continue to participate in MSCP-wide monitoring of gnatcatcher populations and trends consistent with accepted monitoring protocols.
- Expand current invasive non-native plant control to include unburned areas along habitat edges, trails, and roads.
- Restore coastal sage scrub habitat on sites where conditions indicate this habitat type occurred in the past.
- Ensure that large blocks of coastal sage scrub vegetation, undissected by trails, are retained to support gnatcatchers and other species.
- Explore the potential for incorporating into a future Fire Management Plan for the Refuge Complex the limited use of controlled burns on the Refuge where necessary to enhance habitat for gnatcatchers or to modify fuels to protect existing habitat.
- To minimize disturbance to gnatcatchers from dogs, require dogs to be on a leash at all times, with the exception of hunting dogs accompanying permitted hunters in the Otay Mesa and Lakes area.

***Objective 1.2**: Least Bell's Vireo and Southwestern Willow Flycatcher*
Over the next 15 years, actively manage the riparian vegetation along approximately four linear miles of the Sweetwater River to provide suitable breeding habitat for the least Bell's vireo and southwestern willow flycatcher that consists of structurally diverse areas of native shrub and tree cover along the watercourse, including patches of dense shrubs (e.g., mulefat, sandbar willow) within three to six feet (0.9 to 1.8 meters) of the ground (Goldwasser 1981, Salata 1983a, USFWS 1998b), some at least 10 feet (3.0 meters) tall (Sogge et al. 2010), and a dense, stratified canopy of mature native trees (e.g., arroyo and Goodding's willow, cottonwoods, western sycamore, coast live oak) all interspersed with small openings and shorter, sparser native vegetation.

Rationale: The portion of the Sweetwater River that extends through the Otay-Sweetwater Unit is designated by the Service as critical habitat for the least Bell's vireo (59 FR 4845) and southwestern willow flycatcher (78 FR 344). The target habitat to support these species, particularly the vireo, is early to mid-successional dense riparian vegetation. Prior to human modification of rivers and streams, the streambed-scouring effects of episodic flood events within riparian habitats resulted in the availability of a range of successional vegetation phases. Today, water flow within the section of the Sweetwater River that extends through the Refuge is influenced by the activities of the Sweetwater Authority. The potential for significant flood events through this portion of the Sweetwater River are greatly reduced due to the presence of the Loveland Reservoir upstream of the Refuge. As a result, the vegetation community has continued to mature, perhaps reducing habitat quality for nesting vireos and willow flycatchers. In the future, active management of this riparian vegetation to mimic natural succession after flood disturbance may be conducted to improve nesting conditions for these species, which will in turn support their recovery. Potential benefits of management to mimic natural disturbance to benefit the vireo will be weighed against the potential impacts to other wildlife and habitat resources on the Refuge.

Least Bell's Vireo and Southwestern Willow Flycatcher Strategies

- Continue to control invasive exotic vegetation within the Sweetwater River corridor.
- Continue monitoring least Bell's vireo populations along the Sweetwater River, while also conducting incidental surveys for southwestern willow flycatcher.
- Develop and implement a riparian habitat management plan for the Refuge that includes management, restoration, and enhancement actions necessary to support the listed and sensitive species currently or historically supported on the Refuge, including actions that will result in the availability of areas of early to mid-successional riparian vegetation to support vireos and flycatchers.
- Manage some portions of the riparian habitat within the McGinty Mountain and/or Sweetwater River management areas to mimic the natural disturbance regime to optimize habitat value for least Bell's vireo.
- If local monitoring indicates that cowbird numbers or parasitism levels on least Bell's vireos exceed 20 percent (Kus and Whitfield 2005), support additional cowbird trapping operations in partnership with others where it is likely to reduce nest parasitism.
- If monitoring results warrant, support investigations of the frequency of West Nile virus disease in least Bell's vireo.
- Incorporate adequate buffers between future refuge public use facilities and riparian areas to minimize disturbance to listed and sensitive nesting birds.

<u>Objective 1.3</u> : Quino Checkerspot Butterfly
Over the next 15 years, protect and maintain 30 Quino checkerspot focal habitat patches, consisting of hilltop or ridge top areas supporting at least 200 square meters of contiguous, high-quality open-canopy coastal sage scrub or chamise chaparral habitat that include primary and secondary larval host plants, multiple species of annual nectar plants for adult feeding, and bare soil overlain with cryptobiotic crust.

Rationale: One of the recovery criteria for Quino checkerspot butterfly involves the permanent protection of suitable habitat within occurrence complexes (estimated occupied areas based on habitat within 0.6 mile [1 kilometer] of recent butterfly occurrences) in a configuration designed to support resilient populations (USFWS 2003b).


Quino checkerspot butterfly (USFWS)

The San Diego NWR includes areas known to support and/or are capable of supporting Quino checkerspot butterfly. These areas, described here as focal habitat patches, include the basic habitat requirements of the subspecies during its four distinct life stages: egg, larva (caterpillar), pupa (chrysalis), and adult. Each of these life stages has fairly specific habitat requirements: open areas with high solar exposure for basking, specific host plants for larval feeding (e.g., erect plantain, owl's clover, thread-leaved birds' beak), and flowering plants appropriate for feeding by butterflies (i.e., low-growing plants with short corollas). Protection of these areas from disturbance and management to control invasive plants are consistent with proposed recovery actions for this species.

Quino Checkerspot Butterfly Strategies

- Expand Quino checkerspot butterfly monitoring to include all habitat with the potential to support this butterfly in an effort to increase our understanding of its status and distribution within the Refuge.
- Seek funding to implement Quino checkerspot butterfly habitat restoration and/or enhancement projects that will result in improved connectivity within and between known species occurrences. Develop and implement a program to control non-native invasive weeds in focal Quino checkerspot butterfly habitat patches.
- Identify potential threats to focal habitat patches from public use activities and take appropriate actions to alleviate these threats (e.g., trail closure/realignment, fencing, posting area closed signs, enforcement).
- Assess the susceptibility of focal habitat patches to wildfire and, if warranted, implement measures (e.g., creation of firebreaks, mechanical thinning of shrubs, chemical control of weeds) to reduce the likelihood for and/or intensity of wildfire in habitat patches.
- As part of the annual monitoring efforts for this species, identify and assess potential sites for population augmentation using captive-bred Quino checkerspot butterflies.
- Support research related to this species and its habitat that would assist the Refuge in the management and recovery of the species.

<u>Objective 1.4</u>: Vernal Pools on the Otay-Sweetwater Unit
Protect, maintain, and, as necessary, enhance the integrity of at least 60 hydrologically functional vernal pools on 30 acres within the Otay-Sweetwater Unit by controlling invasive plants, minimizing soil disturbance through access control (e.g., fencing, signage), addressing issues associated with past disturbance (e.g., altered topography and associated changes in drainage patterns, loss of species previously known to be present in the pools) to increase resilience to environmental stochasticity, maintain genetic diversity, and ensure persistence of a range of site-appropriate vernal pool species, including San Diego fairy shrimp, Otay mesa mint, spreading navarretia, San Diego button-celery, and California Orcutt grass over the long term (>100 years) in ecologically sustainable vernal pool habitat.

Rationale: The recovery goal for listed vernal pool species, as presented in the Vernal Pools of Southern California Recovery Plan (USFWS 1998a), is to conserve and enhance southern California vernal pool ecosystems, with specific emphasis on stabilizing and protecting existing populations of the listed species supported in these ecosystems (i.e., San Diego button-celery, California Orcutt grass, San Diego mesa mint, Otay mesa mint, spreading navarretia, Riverside fairy shrimp, San Diego fairy shrimp). Conserving the vernal pools located within the Shinohara parcel on the Otay-Sweetwater Unit will assist in achieving this goal. Proposals to secure and protect existing vernal pools and their associated watersheds, reestablish vernal pool habitat to its historical structure, and manage and monitor habitat and listed species are all identified as recovery actions in the vernal pools recovery plan (USFW 1998a). Monitoring of habitat quality and species populations within the pools will inform Refuge staff of potential threats that require action. Such threats include unauthorized off-trail activity (e.g., hikers, equestrians, mountain bikers) and illegal access by OHVs, all of which can result in habitat trampling, direct loss of vernal pool plants and animals, alteration of drainage patterns, and the introduction of invasive plants (USFWS 2010g). Additional threats that could require future research and/or changes in current management approaches include the movement of nonnative plants from adjacent areas into the site, the limited population size of some of the species present in the pools, loss of pollinators, and changes in climatic conditions (e.g., drought).

Otay-Sweetwater Unit Vernal Pool Strategies

- Control weeds in and around the pools through an integrated approach to pest management (e.g., mechanical, chemical, cultural).
- Distribute seed or otherwise inoculate unoccupied vernal pools with appropriate listed vernal pool species.
- Develop interpretive materials addressing the need to preserve the vernal pool habitat in the Otay-Sweetwater Unit and informing the public about the listed and sensitive species this habitat supports.
- Encourage research that will assist the Refuge in optimizing habitat values, controlling threats (e.g., invasive plants), and ensuring genetic variability.

***Objective 1.5:* Vernal Pools on the Del Mar Mesa Vernal Pool Unit**
Over the next 15 years, partner with the other landowners at the Del Mar Mesa Preserve to cooperatively conserve approximately 12.5 acres of vernal pool habitat, including the vernal pool habitat located within the Del Mar Mesa Vernal Pool Unit to support a range of site-appropriate vernal pool species, including San Diego Mesa mint, San Diego button-celery, and San Diego fairy shrimp.

Rationale: Protecting and enhancing (e.g., controlling invasive plants, correcting past impacts to the microtopography and drainage patterns) the existing vernal pools and associated watersheds on Del Mar Mesa is consistent with the recovery actions in the Recovery Plan for the Vernal Pools of Southern California (USFWS 1998a). These recovery actions involve securing existing vernal pools and their associated watersheds and reestablishing vernal pool habitat, where necessary, to its historical structure.


Vernal pool in the Del Mar Mesa Preserve (USFWS)

Many vernal pool creation and enhancement projects on other portions of the Refuge and elsewhere in San Diego County have proved successful in establishing or restoring the function and characteristics of natural undisturbed pools and supporting some of the listed vernal pool species populations historically present in the project areas (Black and Zedler 1996, AECOM 2010). Conserving listed species within these vernal pools will also assist in achieving the Recovery Plan objective of conserving and enhancing southern California vernal pool ecosystems, with specific emphasis on stabilizing and protecting existing populations of San Diego button-celery, San Diego Mesa mint, and San Diego fairy shrimp.

Del Mar Mesa Vernal Pool Unit Strategies

- In cooperation with other partners at the Del Mar Mesa Preserve, control access (including motor vehicle, bicycle, equestrian, and pedestrian), trash dumping, and general habitat disturbance within vernal pool habitat.
- Support rare plant monitoring on the Refuge and throughout the MSCP Preserve using the City of San Diego's revised rare plant monitoring protocols.
- In cooperation with other partners at the Del Mar Mesa Preserve, reduce edge effects along trails and roads through fencing and/or signage or realign trails or roads to avoid impacts; monitor the effectiveness of these measures and implement additional measures (e.g., enforcement when necessary) to protect sensitive species and habitat.
- Work with the City of San Diego to ensure that development occurring adjacent to Refuge resources will not be directly or indirectly impacted by grading, increased run-off, lighting, noise, invasive species, or other construction related consequences.
- Implement non-native plant removal strategies that are site-specific and prioritize habitat patches that support sensitive species.
- Restore and/or enhance vernal pool habitat (e.g., restore natural hydrology, reintroduce species) per available funding.
- Conduct a baseline vegetation survey of Refuge lands.

***Objective 1.6:* Conserve Federally Listed Upland Plant Species**
Over the 15 year life of the CCP, protect and manage existing occurrences of Otay tarplant, San Diego thornmint, San Diego ambrosia, Mexican flannelbush, and Del Mar manzanita on the Refuge and, where appropriate, reintroduce, translocate, or otherwise enhance populations of these species to lower the probability for extinction.

California Orcutt's grass/Otay mesa mint (USFWS)

Rationale: National wildlife refuges have been established, in part, to conserve America's fish, wildlife, and plants. The establishment of many refuges, including the San Diego NWR, takes this a step further by focusing conservation efforts on listed species, while also managing for the range of native plants and wildlife supported on the Refuge. As described in the preamble of the Endangered Species Act of 1973, as amended, endangered and threatened species of wildlife and plants "are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people." Therefore, efforts are proposed on the San Diego NWR to protect and aid in the recovery of those listed species plant species that are known to occur on the Refuge or have historically occurred in and around the Refuge. Conservation will be implemented in accordance with the management recommendations and recovery actions outlined in specific species recovery plans and the San Diego MSCP Plan.

Strategies for Conserving Federally Listed Upland Plant Species

- Continue management of Otay tarplant on the Otay Tarplant Preserve portion of the Refuge to ensure the long-term protection of this population.
- Continue to monitor known occurrences of listed plant species on the Refuge, as well as conduct opportunistic inspections of areas with the potential to support the Refuge's listed plant species to determine species presence or absence.
- Establish populations of Mexican flannelbush on alluvial benches of low-gradient canyons within the McGinty Mountain and San Miguel Mountain management areas.
- Where listed plant species occur in proximity to public use areas, implement actions (e.g., fencing, trail closure/realignment, signage, enforcement) to minimize the potential for trampling and other disturbance.
- Monitor exotic species invasion in areas supporting listed plant species, and, when necessary, implement actions per the IPM Plan to eradicate or control the invasive species.
- Work with Carlsbad Fish and Wildlife Office biologists and other species experts to determine whether reintroduction, translocation, or other propagation of listed plant species currently or historically present on the Refuge should be implemented to assist in the recovery of the species.
- Assess the occurrence of native pollinators on the Refuge, and, where appropriate, implement actions to ensure presence and/or persistence of these pollinators to support listed and sensitive plant species.

Goal 2: Protect, manage, and restore the Refuge's native habitats, MSCP-covered species, and other species of concern for their inherent value and to contribute to the regional effort of conserving the biological diversity of southwestern San Diego County.

***Objective 2.1*: Coastal Sage Scrub**
For the life of the CCP, protect and manage 3,500 acres of coastal sage scrub dominated by low, soft-woody subshrubs (i.e., California sagebrush, California buckwheat, black sage, white sage, bush monkey flower, and sawtooth goldenbush along with laurel sumac and lemonade berry) with less than 30 percent coverage of non-native herbs.

Rationale: As stated in the Coastal Scrub and Chaparral Bird Conservation Plan (CalPIF 2004), the protection of large blocks of high-quality coastal sage scrub habitat is essential to the conservation of a diverse assemblage of native California plants and animals, including such focal species as the California gnatcatcher, coastal cactus wren, and orange-throated whiptail. In fact, coastal sage scrub habitat supports more than 100 species of plants and animals that are considered endangered, threatened, rare, or sensitive by the Service or CDFG (Atwood 1993, McCaull 1994). Many of these plant and wildlife species, including 19 species covered by the San Diego MSCP, occur within coastal sage scrub habitat on the San Diego NWR.

Human activity has resulted in substantial losses of coastal sage scrub vegetation throughout southern California. O'Leary (1995) estimated that urban and agricultural development accounted for 66 to 90 percent of this loss. The State of California recognized the potential biological effects of these losses in the Southern California Coastal Sage Scrub Natural Community Conservation Plan (NCCP), which states that coastal sage scrub habitat has been reduced "to the point where conservation action is crucial to prevent endangerment of many species." The Service, in approving the San Diego MSCP, also recognized that adequate areas of connected coastal sage scrub habitat had to be preserved to ensure the long-term conservation of a number of MSCP-covered species. Many parcels acquired for inclusion in the San Diego NWR (established in part as the Federal contribution to the MSCP) were targeted for acquisition because they supported high-quality coastal sage scrub habitat. Managing the Refuge to protect the quality of the coastal sage scrub habitat is essential to achieving the purpose and goals of the Refuge, as well as the conservation goals of the MSCP.

Coastal Sage Scrub Strategies

- Periodically monitor areas of coastal sage scrub habitat to identify potential threats (e.g., signs of unauthorized activity, presence of invasive species, edge effects from activities on adjacent parcels) to habitat quality and implement actions as necessary to address these threats.
- Ensure the retention of several large blocks (e.g., greater than 300 acres) of coastal sage scrub vegetation undissected by trails.
- Review the current Fire Management Plan to ensure that it includes adequate measures to protect areas of high-quality coastal sage scrub habitat on the Refuge.
- Expand current invasive non-native plant control to include areas along coastal sage scrub habitat edges, trails, and roads to prevent their spread into larger habitat areas.
- Restore disturbed areas to coastal sage scrub habitat where conditions (e.g., soil type, slope aspect, percent slope) indicate that it likely occurred there in the past.
- Support the continued MSCP-wide monitoring of coastal sage scrub habitat quality.
- Support the development and implementation of methods to reduce cover of exotic invasive species in coastal sage scrub on the Refuge.

Objective 2.2: Chaparral
For the 15-year life of the CCP, protect and manage approximately 2,100 acres of chaparral vegetation to preserve the characteristic species composition, structure, and distribution of the four associations of chaparral present on the Refuge including southern maritime chaparral (open, low growing, coastal vegetation including Del Mar manzanita, wart-stemmed ceanothus, and summer-holly), southern mixed chaparral (dominated by broad-leaved sclerophyllous [i.e., hard-leaved] shrubs or small trees, including chamise, mission manzanita, Ramona lilac, and laurel sumac, that occupy protected north-facing slopes and canyon slopes or ravines), chamise chaparral (nearly monotypic stands of chamise occupying areas of shallow, dry soils on xeric slopes and ridges), and scrub oak chaparral (a tall, dense, evergreen chaparral association, dominated by scrub oak, including Nuttall's scrub oak, occupying more mesic sites than other chaparral associations and often found at slightly higher elevations).

Rationale: Chaparral, which is the most widespread shrub vegetation community in California (CalPIF 2004), is considered an integral part of California's historical natural landscape. It is drought tolerant, has evolved with fire, and where present is an important component of a healthy watershed. Although its density, uniform cover, and general lack of herbaceous understory limit the overall wildlife diversity of this habitat, chaparral vegetation is important to several shrubland birds including wrentit, western scrub-jay, California towhee, spotted towhee, and California thrasher, all of which occur on the Refuge. The Refuge's chaparral habitat also supports a number of reptiles, including San Diego horned lizard and orange-throated whiptail, both of which are identified as California Special Status Species. In all, 17 species of plants and wildlife covered by the San Diego MSCP are found on the Refuge in one or more of the Refuge's four chaparral associations.

Conservation recommendations for chaparral habitat in the Coastal Scrub and Chaparral Bird Conservation Plan (CalPIF 2004) include: 1) preservation or protection of large blocks of coastal scrub and chaparral habitats to maximize the long-term viability of many shrubland bird species in California; and 2) management of fire to promote habitat conditions favorable to native species, which generally means extending the interval between fires to promote development of late seral stage habitat. The San Diego MSCP (City of San Diego 1995) also addresses the need to protect chaparral habitat.

Chaparral Strategies

- Support ongoing MSCP preserve-wide monitoring of chaparral habitat quality.
- Monitor all chaparral habitat within the Refuge to identify potential threats to habitat quality (e.g., signs of unauthorized activity, including off trail use; presence of invasive species, including signs of goldspotted oak borer damage to scrub oaks; edge effects associated with trail use); and implement appropriate management actions to address these threats.
- Expand current invasive non-native plant mapping and control to include areas along chaparral habitat edges, trails, and roads to prevent their spread.
- Restore disturbed areas on the Refuge to chaparral habitat where conditions (e.g., soil type, slope aspect, percent slope, surrounding vegetation) indicate that it likely occurred there in the past. Ensure the retention of large blocks (e.g., greater than 200 acres) of chaparral undissected by trails.
- Review the current Fire Management Plan to ensure that it includes adequate measures to protect areas of high-quality chaparral habitat on the Refuge.

***Objective 2.3:* Riparian and Other Wetland Plant Communities**
Within five years of CCP approval, complete and begin to implement a step-down habitat management plan that addresses specific management actions for the riparian and other wetland habitats present in the Otay-Sweetwater Unit to support the suite of listed and sensitive plant and animal species that occur or historically occurred along approximately five linear miles of the Sweetwater River and Steele Canyon Creek, as well as within the wetland habitat present around the Refuge's man-made ponds

Rationale: Riparian and other wetland plant communities provide habitat for a diversity of resident and migratory terrestrial and aquatic wildlife, including endangered, threatened, and sensitive species. In terms of bird diversity and abundance, mature cottonwood-willow riparian forests of the Southwest are among the richest habitats in North America (Carothers et al. 1974, Anderson and Ohmart 1977). On the Refuge, this habitat supports nesting endangered least Bell's vireo and historically supported the endangered arroyo toad, California red-legged frog (*Rana draytonii*), and southwestern willow flycatcher, as well as the southwestern pond turtle and yellow-billed cuckoo.

The Partners in Flight North American Landbird Conservation Plan (Rich et al. 2004), Riparian Bird Conservation Plan (Riparian Habitats Joint Venture 2004), and the Sonoran Joint Venture Bird Conservation Plan (Sonoran Joint Venture Technical Committee 2006) identify habitat conservation and restoration needs throughout the region. Refuge management strategies for protecting, restoring, and enhancing riparian and other wetland habitats will support these objectives. This objective is also consistent with the management goals established for the San Diego MSCP (City of San Diego 1995) and the conservation strategies for riparian areas presented in the California State Wildlife Action Plan (CDFW 2015).

Strategies for Riparian and other Wetland Plant Communities

- Continue to control invasive plants within riparian areas and around man-made ponds.
- Continue to monitor riparian and other wetland areas to identify potential threats (e.g., signs of unauthorized activity, presence of invasive plants and other pests [e.g., shot hole borers], edge effects from activities on adjacent parcels, disturbance erosion) to habitat quality and implement actions necessary to address these threats.
- Prohibit fishing to avoid disturbance in sensitive wetland habitats.
- Prepare a step-down habitat management plan to address the habitat protection, management, restoration, and enhancement needs of the Otay-Sweetwater Unit, including actions to support listed and sensitive riparian-dependent species that are currently present (e.g., least Bell's vireo), could recolonize (i.e., arroyo toad, southwestern willow flycatcher, yellow-billed cuckoo, Harbison's dun skipper, southwestern pond turtle), or could be reintroduced (i.e., California red-legged frog).
- Manage portions of the riparian habitat within the McGinty Mountain and/or Sweetwater River management areas to mimic the natural disturbance regime.
- Provide adequate buffers between riparian and other wetland areas and existing and proposed trails to protect sensitive riparian and other wetland habitat and the listed and sensitive species this habitat supports.
- Select sites for public use amenities (e.g., parking areas, trailheads, kiosks, interpretive elements) that are outside of and appropriately setback back from riparian and other wetland areas.

<u>Objective 2.4</u>: Oak Woodland
For the life of the CCP, protect and manage at least 90 acres in the Otay-Sweetwater Unit that support oak woodland (dominated by coast live oak with Engelmann oak and/or scrub oak also present in some areas), including all seral stages and dominated by mature oaks and an established understory of appropriate native herbaceous, vining, and shrubby vegetation.


Coast live oak on the Refuge (USFWS)

<u>Rationale</u>: Mature oaks provide thermal cover and an abundance of acorns, nest sites, and trunk hollows that shelter wildlife. This habitat type, although widespread throughout California and in other western states, is relatively rare in southwestern San Diego County, when compared to the acreages of other native habitat types in the region (City of San Diego 1995). Oak woodlands currently account for less than one percent (about 114 acres) of the overall vegetation in the Otay-Sweetwater Unit (although historically the Unit likely supported larger areas of oak woodlands). Oak woodland supports species such as oak titmouse (*Baeolophus inornatus*), Hutton's vireo (*Vireo huttoni*), and acorn woodpecker (*Melanerpes formicivorus*) not found in other vegetation types on the Refuge. The Oak Woodland Bird Conservation Plan (CalPIF 2002) includes a series of conservation recommendations for oak woodlands that focus on protection, restoration, and management intended to preserve existing mature stands of oak woodland, as well as facilitate and promote natural recruitment of oaks and oak woodland-obligate species within existing and restored oak woodland. On the Refuge, this habitat supports three MSCP-covered species (i.e., western bluebird, mountain lion, southern mule deer).

Oak Woodland Strategies

- Monitor oak woodlands to identify potential threats (e.g., signs of unauthorized activity, presence of invasive species [e.g., nonnative plants, insect pests], edge effects from activities on adjacent parcels) to habitat quality and implement actions as necessary to address these threats.
- In appropriate locations, plant acorns within the Otay-Sweetwater Unit, watering them and controlling weeds as necessary
- Monitor oaks for evidence of infestation by insect pests and other pathogens (e.g., fungi) and take appropriate action if identified.
- Continue to coordinate with other public and private entities in the research, education, and outreach efforts being developed to manage and control the effects to native oaks of goldspotted oak borer, shot hole borers, and other insect pests
- Ensure that short and long-term impacts to oak woodlands will be minimized through sensitive trail planning, the implementation of sustainable trail construction techniques, and avoidance of this habitat type when siting other public use amenities (e.g., parking areas, visitor contact station).

***<u>Objective 2.5</u>*: Hermes Copper Butterfly**
Over the 15 year life of the CCP, maintain existing large expanses (i.e., around McGinty Mountain) of high-quality late-successional coastal sage scrub, coastal sage scrub/chaparral ecotone, and/or southern mixed chaparral that include abundant spiny redberry and California buckwheat as potential habitat for Hermes copper butterfly. Continue to work with other San Diego conservation biologists to learn more about the species' habitat requirements, life history, and measures to conserve and protect Hermes copper and its habitat.

<u>Rationale</u>: In April 2011, the Service determined that the current status of Hermes copper butterfly warranted its listing as endangered or threatened (76 FR 20918). This butterfly is endemic to the coastal foothills of San Diego County and northern Baja California, Mexico. It is dependent on spiny redberry as its larval host and for completion of its lifecycle; however, this butterfly only occurs within a small portion of the range of spiny redberry for reasons which have not yet been determined. Hermes copper takes nectar almost exclusively from California buckwheat.


Hermes copper butterfly (USFWS)

The species' abundance, distribution, life history, habitat requirements, population genetic structure, and threats (other than wildfire) are not well understood. Wildfire, at least temporarily, eliminates the butterfly and its habitat, and the species is slow to recolonize burned areas, even after habitat has apparently regrown.

The extensive wildfires in coastal San Diego County in the last decade, in conjunction with extensive development within the species' range, have greatly reduced its abundance and distribution, and the fires may have impaired dispersal behavior necessary to recolonize formerly occupied but recently burned habitat.

Hermes Copper Butterfly Strategies

- Include spiny redberry and California buckwheat in post-fire emergency stabilization and rehabilitation measures.
- Identify focal habitat patches of occupied Hermes copper habitat that may be more easily protected from wildfire due to low fuel load, topography, or natural barriers, and, if necessary, implement measures (e.g., creation of firebreaks, mechanical thinning of shrubs, chemical control of annual weeds) to reduce the likelihood for and/or intensity of wildfire in these areas.
- Ensure adequate protection of occupied Hermes copper habitat when implementing the trail plan for the Otay-Sweetwater Unit.
- Continue to work with other San Diego conservation biologists to learn more about the species' habitat requirements, life history, and measures to conserve and protect Hermes copper and its habitat.

***Objective 2.6*: MSCP-Covered Bird Species**
Throughout the life of the CCP, implement management actions including providing adequate buffers between sensitive habitat and areas of public use, managing vegetation where necessary to reduce the adverse effects of wildfire on highly suscepti ble habitat features, and coordinating with utility companies to minimize threats to raptors from utility lines present on the Refuge, and, as needed, restore or enhance native habitat to support healthy populations of the 11 San Diego MSCP-covered bird species supported on the Refuge.


Cactus wren (Rinus Baak)

Rationale: The San Diego NWR was established for a variety of purposes, including participating in the implementation of the San Diego MSCP, a comprehensive habitat conservation planning program for southwestern San Diego County (City of San Diego 1995). The Refuge's participation in the MSCP includes acquisition of lands supporting biologically important habitats that are needed to ensure that the preserve will adequately protect the species it was intended to cover. In addition, this participation includes commitments to provide for the long-term management and monitoring of acquired lands to protect biodiversity and ensure that the MSCP-covered species are, in fact, being conserved. The lands acquired for inclusion in the Refuge to date include habitat to support 11 MSCP-covered bird species.

MSCP-Covered Bird Species Strategies

- Continue to acquire lands within the Refuge acquisition boundary from willing sellers to conserve large blocks of undisturbed native habitats (e.g., coastal sage scrub, chaparral, oak woodland, riparian, and grassland habitats).
- During step-down trail planning, ensure that large blocks of undisturbed habitat needed to conserve MSCP-covered bird species are protected from human disturbance.
- To minimize impacts to burrowing owls from disturbance by the public and/or dogs, align trails in manner that will maintain at least a 330-foot-wide (100 meters) buffer between the trail and burrowing owl nest boxes or other occupied burrowing owl nest locations. Wherever possible, trails should be aligned to avoid traversing burrowing owl nesting areas, and dogs shall be required to be on a leash at all times.
- Maintain approximately 30 acres of existing burrowing owl habitat at and near the Shinohara vernal pool complex, and create suitable open grassland or coastal sage scrub/grassland ecotone habitat for an additional 15 pairs of owls in a suitable location.
- Identify and implement measures to protect cactus wren habitat from destruction by wildfire (e.g., fuel reduction, fuel breaks).
- By 2022, maintain, restore, and/or create cactus wren habitat on the Otay-Sweetwater Unit to provide 124 acres (50 hectares) of coastal sage scrub with about 200 mature (≥ 3 feet [one meter] high) coastal cholla, coastal prickly pear, and/or chaparral prickly pear per 2.5 acres (one hectare).
- Work with the Carlsbad Fish and Wildlife Office and others to identify opportunities to salvage cactus from future construction sites for planting in existing cactus scrub habitat or in new cactus scrub patches.
- Work with various land managers to create cactus wren habitat in an amount and configuration that will facilitate movement of cactus wrens around the perimeter of

Sweetwater Reservoir and between the Otay-Sweetwater Unit and Salt Creek Preserve in Chula Vista.

- Monitor golden eagle activity on and near the Otay-Sweetwater Unit and implement additional disturbance-avoidance measures if necessary to protect eagles outside of the San Miguel Mountain area.
- Work with SDG&E to retrofit utility poles on the Refuge and in the surrounding areas to reduce the risk of electrocution to perched raptors and to retrofit wires to reduce collision risk (e.g., arrange multiple wires in a horizontal rather than a vertical plane).
- Provide adequate acreage of undisturbed habitat to accommodate two breeding pairs of harriers on the Otay-Sweetwater Unit; and between late December and mid-July of each year, maintain a 900-foot (300-meters) radius disturbance-avoidance zone around nesting sites, including the historic nest site in the Mother Miguel grassland.

***<u>Objective 2.7</u>:* Monitoring and Baseline Surveys**
By 2022, using Refuge staff or in partnership with others, conduct all required monitoring for listed and MSCP-covered species; implement a baseline survey of the vegetation types present on the Del Mar Mesa Vernal Pool Unit, a baseline survey of vernal pool species within the Shinohara vernal pools and Del Mar Mesa vernal pools, and a directed survey for listed and sensitive plant species throughout the Otay-Sweetwater Unit and Del Mar Mesa Vernal Pool Unit; and support other monitoring efforts that will benefit Refuge management.

<u>Rationale</u>: Knowledge of the distribution and abundance of species and species' needs and status is critical for Refuge management. Obtaining this knowledge begins with baseline surveys, which establish a starting point for comparing the results of future surveys. With baseline data, we can begin a monitoring process (i.e., comparing baseline data to the result of similar future surveys to identify any changes that may have occurred, including changes related to climate change, increased fire frequency, expansion of invasive non-native plants and animals). As part of the San Diego MSCP, monitoring protocols have been or are being developed for various covered species and habitats. In addition, monitoring protocols have been developed by the Service for some of the listed species present on the Refuge, and for other species, presence/absence surveys are conducted.

Biological monitoring is necessary to assess the status of listed and sensitive species, as well as to assess their response to management actions. Analysis of monitoring and survey data also allows us to detect changes over time (e.g., changes in vegetative structure and/or composition, changes in bird species composition and/or abundance) due to factors such as disturbance, climate change, air or water pollution, and/or invasion by exotic species.

Management effectiveness is evaluated and revised, if needed, based on monitoring and survey results. Conducting monitoring and base line surveys on the Refuge is consistent with the requirements of the San Diego MSCP, the recommendations of various bird conservation plans, and the data collection and analysis conservation strategies in the California State Wildlife Action Plan (CDFW 2015).

Monitoring and Baseline Surveys Strategies

- In coordination with public and private partners, continue to conduct monitoring and presence/absence surveys for listed and MSPC-covered species on the Refuge.
- Continue to conduct one annual survey for Harbison's dun skipper larvae in winter and another for adults in June along Steele Canyon Creek.
- Seek funding to survey and map vegetation and sensitive species on the Del Mar Mesa Vernal Pool Unit.
- Support creating two MAPS (Monitoring Avian Productivity and Survivorship) stations (chaparral/ coastal sage scrub and oak woodland) on the Refuge.
- Per available funding, periodically inventory and sample terrestrial invertebrates present in chaparral vegetation on the Otay-Sweetwater Unit.
- Support and facilitate management-oriented research on wildlife and habitat, including monitoring the impacts of climate change.
- Seek funding to conduct periodic monitoring of surface water and groundwater quality on the Otay-Sweetwater Unit and groundwater levels within riparian and oak woodland areas of the unit.
- In cooperation with CDFW and BLM, support periodic surveys of hunted species in the Otay Mesa and Lakes area to monitor populations and population trends.

<u>Objective 2.8</u>: Control Invasive Non-native Species
Over the life of the CCP, implement an integrated approach to pest management to reduce the percent coverage of non-native, invasive forbs, grasses, woody shrubs, and trees by at least 20 percent in areas of relatively intact shrubland; remove at least 90 percent of all large non-native woody shrubs and trees from cottonwood-willow riparian forest and oak riparian forest; and implement actions when necessary to address other pests including insects, such as shot hole borers, feral pigs, and at least 80 percent of the wild turkeys from the Otay-Sweetwater Unit.

<u>Rationale</u>: Nationwide, invasive species cause environmental damage and losses that total more than $120 billion annually (Pimentel et al. 2005). The ecological consequences associated with invasive species, which are often difficult to perceive and quantify (Hanson and Sytsma 2001), include direct and indirect adverse effects to a range of plant and animal species. Displacement or predation by or competition with invasive species has resulted, at least in part, in the listing of approximately 400 species as threatened or endangered. 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 southern California endemic species found on the San Diego NWR, are particularly vulnerable. Invasive species can alter ecosystem structure and function and disrupt food chains and other ecosystem characteristics vital to wildlife (including rare and endangered species), and alter key ecosystem processes such as hydrology, productivity, nutrient cycling, and fire regime (Randall 1996, Brooks and Pyke 2001).

Of particular concern are insects that kill or severely damage trees. The goldspotted oak borer (*Agrilus auroguttatus*) is an invasive pest contributing to the on-going oak tree mortality occurring on Federal, State, private, and local tribal lands in many areas of San Diego County (http://ucanr.edu/sites/gsobinfo/). Two recently introduced insect pests: Polyphagous and Kuroshio shot hole borers (*Euwallacea* sp.) and the pathogenic fungi they introduce (*Fusarium euwallaceae* and *Graphium* sp.) have the potential to damage a wide range of tree species, including native riparian forests and agriculturally important trees such as avocados. Where native riparian stands have been infested (e.g., the Tijuana River Valley) native trees have suffered very high mortality, drastically altering the structure and species composition of the forest. Plant pathologists and natural resource managers continue to investigate the biology of this insect/fungus pest complex, its effect on natural and agricultural resources, and control methods.

A National Strategy for Management of Invasive Species (National Invasive Species Strategy Team 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 strategy, which functions as the internal guidance document for invasive species management throughout the Refuge System, includes 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. Refuge management strategies will assist in achieving these goals. The implementation of an Integrated Pest Management (IPM) Plan can assist in achieving these goals.

Strategies for the Control of Invasive Non-native Species

- Per available funding, continue to remove invasive plants from sensitive habitat areas using a combination of mechanical and chemical controls.

- Implement the control invasive plants, address the prevalence of invasive aquatic species in Refuge wetland areas, and eradicate and/or control other types of pests in accordance with the IPM Plan (Appendix D).
- By 2020, develop and implement an Invasive Species Rapid Response Program to assist in addressing potential new invasive species threats before they become a significant problem.
- Seek funding to systematically reestablish areas of native grassland or annual forbland in appropriate locations throughout the Otay-Sweetwater Unit by controlling invasive plants and, where necessary, seeding these sites with appropriate native plants.
- As funding permits, enhance the quality and quantity of Quino checkerspot habitat through control of non-native invasive forbs and grasses.
- As funding permits, remove non-native woody shrubs and trees from cottonwood-willow riparian forest and oak riparian forest.
- As necessary, control tree tobacco and other shrubs to reduce "predator ladders" in cactus wren nesting habitat.
- Implement the Feral Pig Monitoring and Eradication Plan to monitor for the presence of feral pigs on the Refuge and, if necessary, take actions (e.g., trapping, shooting) to eradicate them from the Refuge in collaboration with the Inter-Governmental Group on Feral Pig Impacts that has been formed in San Diego County.
- When wild turkeys are documented on the Refuge, implement actions to control them.
- In coordination with others, identify and implement appropriate actions to reduce the effect of invasive pests on trees and shrubs in the region.
- By 2020, incorporate into the Refuge's public outreach program information (e.g., kiosk poster, brochure) to educate the public about the hazards (e.g., illness, starvation, death by predation) to unwanted pets and the impacts to native wildlife of releasing a pet "back into the wild."
- Work with the San Diego Turtle and Tortoise Society (or other established adoption program) to place non-native turtles encountered on the Refuge and deemed to be in good health with people who have demonstrated a commitment to their long-term care.
- Control non-native fish, crayfish, and herpetofauna in the Sweetwater River and other wetland areas on the Refuge at levels that will support the reestablishment of native aquatic species (i.e., southwestern pond turtle, California red-legged frog, arroyo toad) in appropriate habitats.
- To effectively manage invasive plant species, complete an inventory of invasive plant infestations on the Otay-Sweetwater Unit by 2022 that prioritizes those areas in need of treatment based on the extent of the infestation and the potential effects of the infestation on adjacent native habitat areas.

Goal 3: Engage in partnerships and provide leadership in coordinating land management and acquisition efforts in support of the San Diego Multiple Species Conservation Program (MSCP), as well as the protection of water quality and cultural resources.

***Objective 3.1**: MSCP 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 ensure ongoing communication and coordination of land management practices and habitat and species monitoring to achieve the goals of the San Diego NWR, as well as the conservation goals of the San Diego MSCP.

Rationale: The San Diego MSCP was developed for the conservation of plants and animals in southwestern San Diego County under the Federal Endangered Species Act of 1973, as amended, and the California Natural Community Conservation Planning Act of 1991. The program is intended to guide future development within the MSCP planning area and conserve at-risk species with the oversight of both Federal and State agencies. The primary goal of the MSCP is the preservation of important habitats to conserve some 85 “covered” species. Achieving this goal requires the acquisition of lands that support these species and the adaptive management of these lands and the habitats and species they support in perpetuity.

A series of recent studies have been prepared to assess and make recommendations for how to improve the San Diego MSCP Biological Monitoring Plan and achieve the biological conservation goals of the MSCP. A common recommendation of these studies has been the need for coordination and consistency among MSCP partners involving such issues as monitoring methods and priorities, data analysis and accessibility, and feedback between decision-makers and land managers (Hierl et al. 2005). Coordination is a critical factor in the success of the MSCP’s biological monitoring program, and recent actions by SANDAG to fund the San Diego Management and Monitoring Program have already resulted in better communication among land managers. Continuing to improve communication and expanding the conservation to other land managers in the region will ensure a better understanding of not only how the MSCP reserve is currently meeting its biological conservation goals, but also how these goals can continue to be met well into the future through adaptive management.

MSCP Partnerships Strategies

- Actively participate in efforts to refine existing or create additional monitoring protocols for MSCP-covered species.
- Continue active involvement in the San Diego Management and Monitoring Program to stay connected to other land managers, be aware of the latest best management practices, and participate in prioritizing regional management and monitoring needs.

***Objective 3.2*: Coordinated Land Management**
Over the next 15 years, continue current coordination efforts with other managers of conserved lands in the San Diego south county region, as well as the City of San Diego and other landowners in the Del Mar Mesa Preserve area, meeting at least twice annually to share experiences and information, identify common information gaps, explore joint funding opportunities, develop coordinated monitoring and management strategies, and generally foster cooperation across jurisdictional boundaries.

Rationale: Coordination among land managers can 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. Management efforts on the San Diego NWR have benefited in a variety of ways from Refuge staff leadership and participation in the South County Land Managers Group, as well as in working with City of San Diego staff on issues related to the Del Mar Mesa Preserve. Through the sharing of information, issues common to various land managers have been addressed via joint projects, sharing of personnel, equipment, and/or volunteers, and partnering to secure grant funding need to address area-wide management problems. Continued participation in these partnerships will strengthen relationships, facilitate ongoing communication, and ensure long-term coordination of regional management efforts.

Coordinated Land Management Strategies

- Continue active involvement in the South County Land Managers Group to coordinate management activities, increase management efficiencies through sharing of resources, and ensure continued communication.
- Coordinate with City of San Diego on issues related to the protection of habitat in the Del Mar Mesa Preserve, including ensuring that adjacent development projects will not directly or indirectly impact habitat quality, soil stability, water quality, or long-term public use management actions.
- Coordinate with public agencies, land managers, and private landowners to control, monitor, and enforce regulations related to illegal off-road vehicle access on and through conserved and/or private lands.
- Coordinate with adjacent landowners to address mutual concerns and opportunities.
- Actively look for partnering opportunities with other land managers, local and regional conservation groups, academic institutions, organizations, tribal governments, and other local, State, and Federal agencies that will result in improvements to management, monitoring, or opportunities for compatible public use.

***Objective 3.3*: Cultural Resources Protection**
Over the next 15 years, implement proactive management of cultural resources that focuses on protecting these resources within the Refuge and meeting the requirements of the National Historic Preservation Act and other cultural resource mandates related to identification and protection, consultation with tribes, and, when appropriate, interpretation of the Refuge's historical and archaeological resources to increase the public's appreciation for cultural resource preservation.

Stabilizing the Barn at the Oaks (USFWS)

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 historical and archaeological sites are known to exist on the lands within the San Diego NWR, and many other sites are likely present that have not yet been discovered or recorded. 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 also 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 true value of these resources rests in what they offer us in terms of cultural identity, scientific information, and interpretive opportunities. 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 public access is restricted in areas identified as having a high potential for undiscovered cultural resources.

Cultural Resources Protection Strategies

- Comply with all applicable cultural resource regulations and policies prior to implementing projects that would disturb any surface or subsurface cultural resources.
- Seek funding to update existing site records for the Refuge, to identify, evaluate, and protect important cultural resources, and to implement activities that will assist in filling existing information gaps such as special thematic studies, surveys, National Register of Historic Places evaluations, site enhancements, and site interpretation.
- Coordinate cultural resource protection efforts with the Regional Historic Preservation Office and qualified Kumeyaay representatives.
- Establish relationships with interested tribes, the Kumeyaay Heritage Preservation Committee, and the Kumeyaay Diegueño Land Conservancy to develop a better understanding of the cultural resources present on Refuge lands and the Native American's unique perspective on the cultural landscape in which these resources exist.
- Work with interested tribes to ensure the protection of cultural and ethnobotanical resources on the Refuge.
- Inform the Regional Historic Preservation Office when new properties are acquired and work together to determine if cultural resources are present that require the implementation of protection or management actions.

- Work with local tribes and the Kumeyaay Cultural Repatriation Committee to finalize a Memorandum of Understanding for implementing the inadvertent discovery clause of the Native American Graves Protection and Repatriation Act (NAGPRA).
- Maintain the current condition of the historic Barn at the Oaks, protect the structure and its immediate surroundings from vandalism, and interpret the history and relationship of the structure to historical farming activity in the area.
- Ensure that Refuge staff are kept current on historic preservation requirements, including implementation of the requirements associated with the NHPA, Archaeological Resources Protection Act, and NAGPRA.

Goal 4: Provide safe and high-quality opportunities for compatible wildlife-dependent recreational uses that foster public appreciation of the unique natural and cultural heritage of the San Diego region.

***Objective 4.1:* Hunt Plan**
Within 18 months of the approval of the San Diego NWR CCP, complete a hunt plan for the Otay-Sweetwater Unit that will ensure high-quality upland hunting opportunities on about 160 acres within the Otay Mesa and Lakes area. Within a year of completing the hunt plan, publish the final refuge-specific regulations in the Federal Register.

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. Hunting can instill a unique understanding and appreciation of wildlife, their behavior, and their habitat needs. Public input during the scoping process for the CCP included requests to consider hunting opportunities within the San Diego NWR. As a result, the Refuge proposes to develop and implement a hunting program within the Otay-Sweetwater Unit. This hunting program would be developed in partnership with CDFW and interested members of the public; comply with the Code of Federal Regulations (CFR) Title 50, 32.1; and be managed in accordance with Service Manual 605 FW 2, Hunting.

Hunting Plan Strategies

- Upon approval of the Final CCP, initiate the development of a step-down hunt plan for the Otay-Sweetwater Unit to facilitate a hunting program on about 160 acres in a portion of the Otay Mesa and Lakes area that abuts other public lands open to hunting.
- Working closely with CDFW and the public, develop Refuge specific hunting regulations as part of the step-down planning process. The hunt plan may include issues such as wildlife species to be hunted, seasons, bag limits, methods of hunting, description of the area open to hunting, needs and funding for any facilities, and other issues applicable to providing a quality hunting program that is compatible with Refuge purposes.
- Work with CDFW and BLM to establish an annual special hunt for youth and disabled hunters.
- Work with CDFW, BLM, and other landowners in the immediate vicinity of the proposed hunt area in an effort to improve accessibility into this area for hunters.
- Within the hunt plan, assess the need for hunting retrieval and safety zones in those areas designated for hunting.
- Once drafted, distribute the draft hunt plan for review by agencies, tribes, various recreational user groups, adjacent property owners, and interested individuals and other organizations.
- Following completion of the hunt plan, prepare an opening package for Regional Director approval and publication in the *Federal Register*.
- Develop partnerships with hunting interests to assist with design, development, and maintenance of any hunting-related facilities.
- Work cooperatively with CDFW to enforce State hunting laws and Refuge-specific regulations.

***Objective 4.2*: Plant and Wildlife Observation**
Over the next five years, expand the Refuge's current outreach program to support guided and self-directed opportunities for plant and wildlife observation by annually accommodating guided nature walks for school students and the general public; in addition, through the establishment of a designated trail system on the Refuge, provide self-directed opportunities for up to 30,000 visitors annually to observe the wide range of plant and wildlife species on the Refuge.

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 the Refuge's contribution 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 San Diego NWR was established, in part, to contribute to the conservation of the high diversity of native plants and animals present in southwestern San Diego County. Conservation of these resources requires that the public understand and appreciate the need for protection of these resources. Achieving the objective of providing quality opportunities for resource 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 and Plant Observation Strategies

- Expand existing opportunities for wildlife and plant observation from the Refuge trail system in a manner that ensures compatibility with Refuge purposes and expands the public's understanding of the need to protect the range of listed and sensitive species present on the Refuge.
- Continue to provide opportunities for wildlife and plant observation by conducting periodic guided hikes on the Refuge.
- Develop a designated system of sustainable trails and associated parking areas on the Refuge to provide access for wildlife and plant observation.
- Develop a birding trail within the Las Montañas area of the Otay Sweetwater Unit once legal access into the area has been established.

<u>Objective 4.3</u>*: *Nature Photography
Provide quality opportunities for up to 250 nature photography-related visits to the Refuge annually.

<u>Rationale</u>: The Improvement Act identifies wildlife photography as a priority public use that that should be allowed on refuges when it is 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 nature 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.

Nature Photography Strategies

- Continue to support opportunities for nature photography from a system of public trails designed to ensure capability with Refuge purposes.
- By 2020, construct a photo blind within the Otay-Sweetwater Unit to provide opportunities for photographing birds and other wildlife.
- On the Refuge website, provide information about nature photography opportunities on the Refuge; the best times and locations for photographing birds, wildflowers, and landscapes; and photographer etiquette that emphasizes respect for Refuge resources through the minimization of visitor impacts.

***Objective 4.4*: Environmental Education**
Within 10 years of the CCP being adopted, develop and implement a multi-disciplinary environmental education program to reach up to 400 K-12 and college students annually. The program curricula would be aligned with national and State educational standards and would incorporate the use of the Refuge as an outdoor classroom.

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 and conservation history and 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 is encouraged that relies on existing curricula or a course of study involving natural and social sciences, history, and the arts. Environmental education can be conducted on the Refuge and/or in the classroom. Often the Refuge is used as an outdoor classroom, a site of structured environmental education activities that focus on the natural environment and cultural resources. These education activities are part of an approved course of study with identified learner outcomes. In developing environmental education programs for a specific refuge, refuge resources and ecosystem characteristics are assessed; then, working with educators, target audiences are identified and creative ways to tie resource priorities to local environmental education needs and curricula are developed. The Refuge's proximity to schools serving K-12 students and to a community college provides several opportunities for developing environmental education partnerships.

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.
- Designate a portion of the Sweetwater River area as an outdoor classroom for hands-on activities.
- Provide opportunities for partners (e.g., San Diego Audubon, YMCA, Water Conservation Garden at Cuyamaca College) to implement all or a portion of their after-school or other educational programs on the Refuge.
- Post environmental education program offerings on the Refuge website.

***Objective 4.5*: Refuge Resource Interpretation**
Within five years of the CCP being adopted, develop and begin to implement an expanded Refuge natural and cultural resource interpretative program that will address multiple topics to appeal to a broad spectrum of interests, age groups, and learning styles and abilities and by 2026 will result in 5,000 additional annual visits to the Refuge that are focused on interpretation.

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 the purposes for which a refuge has been established. 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 why and how to minimize their impact on Refuge resources.

The San Diego NWR, which is situated immediately adjacent to the highly urbanized San Diego metropolitan area, provides an excellent opportunity for visitors to escape the urban environment and connect with the natural environment, vegetation, and wildlife conserved within the Refuge. Through the interpretation of these resources, visitors can begin to imagine how this natural setting once dominated all of southwestern San Diego County and develop an understanding of why it is important to protect what remains of this historical landscape within the Refuge and on other conserved lands throughout the MSCP planning area. A long-range, multi-disciplinary interpretive plan that reflects consistency in design, function, and placement on the Refuge should incorporate themes unique to the habitats, wildlife, and past uses of the land, and contain content that is easily understood by the visiting public. Interpretive themes and content should also incorporate innovative activities intended to reach new and non-traditional audiences.

Refuge Resource Interpretation Strategies

- Continue to provide interpretive signage in the Sweetwater River area.
- Develop an interpretive program that includes a combination of stationary interpretive elements distributed throughout the Refuge and interactive programs, addressing natural resources, Native American cultural, and past agricultural and mining activities within the Refuge, which can be adjusted to meet the demands of the audience in terms of theme, age appropriateness, interest, and other factors.
- Develop interpretive messages related to natural and cultural resources, ethnobotany, and stewardship.
- Incorporate interpretive signage into the kiosks proposed for installation at major trailheads.
- In partnership with other agencies, participate in creating a vernal pool interpretive site at an appropriate location on the Del Mar Mesa Preserve.
- Develop a geocaching program, which could include a Refuge-maintained traditional geocache, an EarthCache, or other similar form of geocaching, as part of the Refuge's interpretive program.

***Objective 4.6*: Connecting People with Nature**
By 2019, 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 partners 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) (Louv 2005). If children are raised with little or no connection to nature, they may miss out on the many health benefits of playing outdoors. Studies show that health is declining in children. Childhood obesity rates are increasing, as are the number of children taking prescription medications to treat Attention Deficit Hyperactivity Disorder (ADHD) and depression (Louv 2005, Migliarese 2008). Fortunately, research also shows that connecting children and families with nature can provide positive benefits, leading to improved physical and mental health (Faber and Kuo 2009, Pretty et al. 2009). Being out in nature can improve student learning and can build strong family bonds.

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.

Connecting People with Nature Strategies

- 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. Activities may include a nature-related scavenger hunt for after-school groups, painting sessions for seniors, or a "hike with the grandkids" event.
- In partnership with the Friends of the San Diego Refuges and others, incorporate a "connecting people with nature" theme into at least three events per year.

***Objective 4.7*: Recreational Trails**
Over the 15-year life of the CCP, per available funding and staffing and with assistance from various partners, implement a sustainable Refuge trail system that protects natural and cultural resources and provides opportunities for at least 20,000 visitors annually to enjoy and appreciate the resources protected on the Refuge.


Mountain biking on the Otay-Sweetwater Unit (USFWS)

Rationale: The trail system developed for both the Otay-Sweetwater Unit and the Del Mar Mesa Vernal Pools Unit of the Refuge has taken into consideration the need to minimize impacts to sensitive wildlife and habitat, protect cultural resources, ensure long-term trail sustainability, minimize user impact on trails and adjacent areas, ensure a high quality of visitor experience, and maximize management efficiency. The intent is to avoid recreation activities that result in damage to sensitive resources, disturbance in proximity to listed species, and erosion that impacts species, habitat, and water quality. While the use of trails simply for recreation is not considered a priority public use of the NWRS, a sustainable trail system will support and provide compatible access for uses that are considered priority public uses, including wildlife observation, photography, environmental education, and interpretation. To ensure that trail use on the Refuge can be found both appropriate and compatible, a sustainable trail system will be implemented per available funding, staffing, and volunteer assistance. Identifying parameters for trail use, such as resource protection needs, prohibiting off-trail activities, providing appropriate signage, facilities, and visitor information needs, will all be necessary to ensure that use of the Refuge's trail system is and remains compatible with Refuge purposes.

Recreational Trails Strategies

- Prioritize and phase the implementation of the trail plan for the Otay-Sweetwater Unit based on the availability of funding, staffing, and volunteers, while also considering the need to protect sensitive biological and cultural resources, trail conditions, current and future use patterns, and the need to improve connectivity.
- Develop and implement a trail sign plan, with the first priority to sign those trails that are part of the designated trail plan, followed by the installation of trailhead kiosks that include trail maps and use regulations.
- Working with volunteers, develop and implement a monitoring program for estimating trail use and trail use patterns throughout the Otay-Sweetwater Unit.
- Continue to work with the Sweetwater Authority and County of San Diego to establish a trail alignment for the County's Sweetwater River Trail that protects vernal pool habitat both on and off the Refuge.
- Work with the City of San Diego and other partners to ensure the trail use on the approved trail system for the Del Mar Mesa Preserve remains compatible with the conservation of sensitive species and habitats.
- Continue to work with adjacent land managers to identify potential access points onto the Refuge.
- To ensure the long-term protection of the Refuge's natural and cultural resources, develop, distribute, and post educational materials describing the importance of staying on the designated trail system.

- Work with other land managers in the Region to develop a coordinated message about the importance of the resources being protected within the San Diego MSCP preserve network and the need for all trail users to limit their activities to designated trails.
- Expand the existing volunteer trail patrol to assist Refuge staff in monitoring trail conditions, use patterns, and compliance with established regulations.
- Develop a volunteer trail maintenance crew to assist in general trail maintenance, installation and replacement of trail signage, and, as necessary, to take appropriate actions needed to correct problems and protect Refuge resources.
- Routinely monitor the effects to Refuge resources of permitting leashed dog walking on the Refuge, and where necessary, take appropriate actions to eliminate any adverse effects.
- Post regulations related to leashed dogs on the Refuge at all trailheads, and clearly indicate that use of the trails for dog walking is conditional and non-compliance with posted regulations may lead to the prohibition of dogs on the Refuge.

***<u>Objective 4.8</u>*: Volunteers**
By 2022, increase to approximately 2, 000 volunteer hours per year the number of volunteer hours provided on the Refuge to assist in various aspects of Refuge management such as habitat restoration and enhancement, resource surveys, Refuge cleanups, trail maintenance, trail patrol, environmental education, interpretation, and visitor contact.

<u>Rationale</u>: 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 U.S. 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 seek funding in partnership with other land managers to support a Community Outreach Coordinator to recruit volunteers and coordinate volunteer projects on preserved lands in south San Diego County.
- Add a Community Outreach FTE staff position to the San Diego NWR Complex, allocating 50 percent of this position's time to volunteer recruitment and volunteer project coordination for the San Diego NWR.
- By 2018, conduct at least two major volunteer workday events annually in an effort to recruit volunteers for small events and/or projects.
- By 2020, conduct at least four 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.
- Continue to develop and expand the Refuge's volunteer trail patrol.
- Develop a volunteer trail maintenance team by recruiting individuals from various trail user groups in the region.
- Facilitate a range of volunteer training opportunities (e.g., docent training, trail maintenance, trail patrol, habitat restoration) as funding and staff time permits.

***Objective 4.9*: Environmentally Conscientious Refuge Operations**
Reduce the Refuge's energy consumption by 3.5 percent annually to achieve a total reduction of 28 percent by 2020; incorporate water conservation measures into our facilities and practices; strive to reduce the total amount of manufactured goods and materials used on the Refuge; and 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. We can reduce our impacts on wildlife resources that we are trying to protect by reducing the Refuge's own consumption of resources and by choosing materials and practices that lessen impacts to wildlife and habitats worldwide.

Depending on the model and assumptions, scientists project the average annual temperature in California to rise from 4°F to 10.5°F above the current average temperature by the end of the century (Hayhoe et al. 2004). 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 (State of California Office of Planning and Research 2008). By reducing our carbon footprint, we can assist in the efforts to address climate change. There are many ways in which GHG emissions can be reduced, including reducing the amount of electricity and fuel consumed directly by Refuge operations, reducing the total consumption of goods and materials, and purchasing locally produced products whenever possible.

The overconsumption 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 (USFWS 1995c, 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 goods.
- Replace Refuge vehicles with more fuel-efficient vehicles (hybrid, electric, etc.) as funding and management need permits.
- Retrofit existing facilities to increase energy efficiency (e.g., use compact fluorescent bulbs, increase insulation, add photovoltaic panels, and replace single paned windows).
- Retrofit existing facilities to increase energy efficiency (e.g., use compact fluorescent bulbs, increase insulation, add photovoltaic panels, and replace single paned windows).
- Seek funding to incorporate effective energy and water conservation measures into current and future Refuge operations and 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 and materials.
- Prepare a fact sheet or poster for inclusion on a kiosk and/or posting on the Refuge website that describes the efforts being made by the Refuge to reduce consumption and emission and that explains why such efforts are important locally and globally.

3.3 Management of the San Diego NWR

3.3.1 Establishment and Acquisition Boundaries

The San Diego NWR, which is situated on the eastern edge of the San Diego metropolitan area, was established in 1996. The creation of this Refuge coincided with an effort by the Service and the City of San Diego, as well as a variety of other public agencies and interest parties, to develop a Multiple Species Conservation Program (MSCP) for the southwestern San Diego region. The lands acquired for inclusion in the San Diego NWR represent the Service's contribution towards the implementation of the San Diego MSCP (USFSW 1997a). The establishment of the Refuge and the implementation of the MSCP share many of the same purposes, including protecting and managing key habitats for a range of endangered, threatened, and rare species, and maintaining the high biological diversity of southwestern San Diego County.

In April 1997, the Service approved a boundary for the Otay-Sweetwater Unit of the San Diego NWR that encompassed approximately 43,860 acres (refer to Figure 1-3) and a boundary for the Vernal Pools Stewardship Project that encompassed approximately 8,220 acres (refer to Figure 1-5). These boundaries are often referred to as the Refuge acquisition boundary, and it is within these boundaries that the Service is able to negotiate with willing participants to acquire their lands. The boundary of the Otay-Sweetwater Unit was expanded by approximately 327 in 2012 to accommodate the donation of surplus lands from the California Department of Transportation.

Not all lands included within the approved acquisition boundary will become part of the Refuge. Some lands have already been or will be developed, others will continue to be held by the current public or private landowner, and still other parcels will likely be acquired by the Service, other public agencies, or land trusts for the purpose of conserving native habitat and species. The lands acquired by the Service become part of the San Diego NWR. Generally, the lands incorporated into a refuge are acquired as a result of a direct sale from a willing seller at fair-market value; however, there may be occasions in which a parcel is acquired through a donation, partial donation, transfer, or an exchange. Refuge lands are never acquired through condemnation.

The lands included within the Otay-Sweetwater Unit acquisition boundary were selected based on a number of factors. These include a determination that the lands supported "very high" to "moderate" habitat values, high biological diversity and species richness, priority target species, vernal pool habitat, and/or that the lands would provide appropriate habitat connections (wildlife corridors) between larger areas of preserved land (City of San Diego and USFWS 1997). An additional factor that has been considered during the ongoing acquisition process is improving the contiguity (i.e., eliminating inholdings, reducing edge/area ratio) of the lands preserved within and surrounding the Refuge.

Although the boundary for the Vernal Pools Stewardship Project was not approved until 1997, planning for this area was actually initiated in 1989 to ensure the conservation of outstanding vernal pool resources in the San Diego Region. The lands within the boundary of the Vernal Pools Stewardship Project consist of both private and public lands, including lands on MCAS Miramar and the City of San Diego's Montgomery Field. The Land Protection Plan (LPP) for the Vernal Pools Stewardship Project describes a variety of habitat protection methods, including leases and cooperative agreements, conservation easements, and fee-title acquisition. The intent of developing an LPP for the vernal pools of southwestern San Diego County was to coordinate efforts with landowners, local jurisdictions, government agencies, and the Department of Defense to protect native habitats for rare species (USFWS 1997b). The LPP for the Stewardship Project acknowledges that not all of the lands in the proposed acquisition boundary would become part of the Vernal Pools Unit of the San Diego NWR, and to date the vast majority of the lands included within the Vernal Pools Stewardship Project boundary have not been acquired by the Service.

3.3.2 Current Land Ownership and Acquisition History

As of May 2016, the San Diego NWR included about 11,870 acres, 60 acres of which are included within the Del Mar Mesa Vernal Pool Unit and the remainder within the Otay-Sweetwater Unit (refer to Figure 1-3). Other portions of the approved Refuge acquisition boundary (approximately 19,000 acres) have been acquired for habitat and species conservation by other public agencies and land trusts, including the CDFW and The Nature Conservancy (TNC) (refer to Figure 1-4). An additional 6,000 acres are managed by other public agencies to protect the watersheds around two major reservoirs, Sweetwater Reservoir and the Otay Lakes. The Service will likely enter into additional acquisition agreements over the life of the CCP, as various blocks of land within the approved acquisition boundary remain undeveloped and privately held. The County of San Diego, City of Chula Vista, and Service have been in ongoing discussions regarding the possible transfer of some of the lands in Proctor Valley east of Otay Lakes into the Refuge, but these talks were not finalized as of December 2016.

The lands within the Otay-Sweetwater Unit that have already been acquired by the Service are generally located within several non-contiguous blocks of land, situated to the south of Interstate 8, east of Highway 54, north of Otay Lakes Road, and west of the unincorporated community of Beaver Hollow in the north and to the west of Jamul Creek in the south (refer to Figure 1-3).

Only 77 acres of the 8,220 acres included within the approved boundary of the Vernal Pools Stewardship Project (refer to Figure 1-5) have been acquired by the Service; of this total, 17 acres are located near the Sweetwater Reservoir within the Otay-Sweetwater Unit. The other 60 acres are located within the Del Mar Mesa Vernal Pool Unit. An additional 5,400 acres within the Stewardship Project boundary are owned by other local, State, or Federal agencies or non-profit land trusts.

Land acquisition efforts for the San Diego NWR began in 1992 when approximately 1,840 acres of undeveloped land owned by Home Federal Savings and Loan were placed in Federal receivership under the control of the Resolution Trust Corporation (RTC). Based on the quality of the habitats and populations of listed species supported by these habitats, the Service entered into a purchase agreement with the RTC to acquire approximately 1,826 acres of this land. With this acquisition, the San Diego NWR was established in 1996.

As of May 2016, 83 fee-title acquisitions have been completed and six easements have been acquired. A complete listing of the Refuge's acquisition history is provided in Appendix I. Some of the most significant acquisitions include the acquisition of about 1,700 acres of the western and northern slopes of Mother Miguel Mountain in August 1997; the Las Montañas area in 1998; several large parcels on the lower northern slopes of McGinty Mountain, as well as some smaller parcels near the top of San Miguel Mountain, in 1999; and a large area along the lower western slopes of McGinty Mountain and over 500 acres near the top of San Miguel Mountain in 2000. Also in 2000, the vernal pool parcels located adjacent to the Sweetwater Reservoir were acquired. In 2012, the 1,905-acre Hidden Valley area was acquired, filling a large gap in Refuge ownership between the San Miguel Mountain and Las Montañas management areas.

Over the next few years, approximately 700 additional acres of land located in various portions of the acquisition boundary are expected to be transferred to the Service from Caltrans (refer to Figure 1-4), including 2.4 acres along Highway 94 near Millar Ranch Road.

3.3.3 Initial Management Guidance

Prior to the development of this CCP, the Refuge had no comprehensive management plan to direct Refuge management and operations. There was, however, a *Conceptual Management Plan for the San Diego National Wildlife Refuge*, which was prepared by the Service in 1997. This plan presented a broad overview of the Service's proposed management approaches for wildlife and habitats, public uses and wildlife-dependent recreational activities, wildfire suppression and prescribed burning, rights-of-way and easements, law enforcement, facilities, interagency coordination with the MSCP preserve, and public outreach (USFWS 1997b). The key area of management focus in this initial plan was management of native habitat and plant communities for the recovery of endangered, threatened, and rare species. Active modification and manipulation of intact native plant communities was to be avoided, while enhancement and restoration actions on disturbed or degraded sites was encouraged. Monitoring of distribution and abundance patterns for selected species was also proposed. The plan also encouraged opening the Refuge for compatible recreational uses to ensure opportunities for the public to gain a better appreciation for and understanding of the region's unique wildlife heritage and to enjoy the Refuge's open spaces. In so doing, the plan acknowledged that high-quality wildlife-dependent recreational uses rely on healthy habitats and healthy populations of birds and other wildlife; as a result, the plan acknowledged that some constraints on public use and recreation would be necessary and that certain core areas within the Refuge would not be open to public use (USFSW 1997b).

Additional guidance for how the Refuge should be managed is provided within the various components of the San Diego MSCP (City of San Diego 1998a), including the framework management plans and resource management plans associated with each MSCP subarea plan prepared by the participating jurisdictions (i.e., cities of San Diego [City of San Diego 1997] and Chula Vista [City of Chula Vista 2003], County of San Diego [County of San Diego 1997]). The management direction provided in the MSCP focuses primarily on preserve management activities intended to ensure that preserved lands, such as those included in the San Diego NWR, are managed for the long-term conservation of biological resources.

Monitoring is also a key component of the MSCP, as it facilitates the documentation of ecological trends and the effectiveness of management activities, while also providing data on species population and wildlife movement. Monitoring also informs mangers of any impacts to resources from recreational use, as well as from adjacent land uses and construction activity. Initial monitoring guidelines and timetables were developed by Ogden Environmental and Energy Services Co., Inc. in 1996 and reviewed and updated by Conservation Biology Institute in 2001. The San Diego Management and Monitoring Program (http://www.sdmmp.com/), a science based program seeking to provide a coordinated approach to management and biological monitoring of San Diego's MSCP lands, has been working with participating jurisdictions and agencies to coordinate monitoring across the San Diego region, with a focus on plants, animals, and connectivity. The San Diego NWR continues to be an active participant in the SDMMP.

3.3.4 Management History and Past Refuge Actions

3.3.4.1 Management History

The lands within the San Diego NWR are dominated by coastal sage scrub, chaparral, and grassland habitats. Several parcels contain regionally significant vernal pool habitat, and a variety of other sensitive native upland and wetland habitats occur throughout the Refuge. The Refuge protects habitat that supports or has the potential to support at least 16 federally listed species and at least one candidate species. The majority of the Refuge ownership is included in the Otay-Sweetwater Unit; the remaining acreage, about 60 acres, is included within the Del Mar Mesa Vernal Pool Unit.

Following approval of the Refuge boundary in 1997, two permanent full-time employees—a Refuge Manager and Refuge Wildlife Biologist—were assigned to the San Diego NWR to manage Refuge resources and facilitate daily Refuge operations. A Refuge office was opened on Lyons Valley Road in Jamul. Also in 1997, the Refuge Complex (which oversees the management of several Refuges including the San Diego NWR, San Diego Bay NWR, Tijuana Slough NWR, and Seal Beach NWR) contracted with BLM to provide part-time law enforcement in an effort to reduce the extent of illegal activities (e.g., off-road vehicle use, dumping, homeless encampments) occurring on Refuge lands. Some of the initial management activities implemented by the new Refuge staff, with assistance from the Refuge Complex, Ecological Services and the Regional Office, included:

- initiation of Quino checkerspot butterfly surveys,
- conducting cultural resource reviews of several existing structures on the Refuge,
- facilitating on-Refuge research by two Dartmouth College students on the sensitivity of the rufous-crowned sparrow (*Aimophila ruficeps*) to residential edge effects, and
- supporting herpetofaunal monitoring by USGS and San Diego State University's Department of Biology.

As of 2016, the Refuge staff positions include a Refuge Manager, Refuge Operations Specialist, and a Wildlife Biologist, with offices located off-Refuge on the Rancho Jamul Ecological Reserve in space shared with CDFW and BLM. The San Diego NWR staff receives assistance from the Complex staff, including Federal Wildlife Officers, the Environmental Education Specialist, Park Ranger, and Maintenance Mechanic. The Refuge Complex maintains a fire crew, which is stationed at Fire Station Number 36 on Highway 94 and Peaceful Valley Ranch Road in Jamul. The fire crew is responsible for the protection of Refuge resources and adjacent private property. The crew also assists in controlling other wildland fires on public lands when the need for additional crews is identified.

3.3.4.2 Past Refuge Actions

A variety of management actions have been implemented on the Refuge since its establishment, with many focused on improving habitat conditions for listed species. Some of the more significant actions are summarized here.

Installation of Nest Boxes to Support Burrowing Owls

Artificial nest boxes have been installed on the Refuge in multiple locations to provide nesting habitat for burrowing owls. In 1997, 10 boxes were placed in the disturbed coastal sage scrub and grassland habitats near Par Four Drive. Burrowing owls that were habitually preying on federally endangered California least terns (*Sternula antillarum browni*) at coastal areas were translocated to the Par Four site. Disturbance by coyotes and/or domestic dogs interfered with the introduction, and burrowing owls no longer persist at this site. In October 2007, 10 nest boxes were installed at the Shinohara vernal pool restoration site, and another 10 boxes were added east of that location in 2010. At least 14 owls fledged from these boxes from 2009 through 2011.

Recovery of Otay Tarplant

This project was initiated as part of a Stipulated Settlement Agreement and Order (Case No 99CV1454 L (LAB) finalized on December 21, 2000, for the purpose of conserving and recovering the federally threatened plant, Otay tarplant. The project was implemented on an area of about 70 acres located west of State Route 125 (SR-125) between San Miguel Ranch Road to the north and Proctor Valley Road to the south. This site, along with three other mitigation parcels, were incorporated into the Refuge in 2013 as mitigation for impacts related to an associated housing development.

Initiated in 2005, work on the site, referred to as the San Miguel Ranch (formerly Trimark) Otay Tarplant Preserve, involved the removal of the dense thatch of dead exotic vegetation that covered the site, followed by a series of herbicide treatments implemented to control non-native plants. Tarplant seeds and seeds from other native plant species from the surrounding area were collected and distributed over the prepared site. The population of Otay tarplant at this site has benefitted from this restoration work; however, weed control has not been consistently effective throughout the life of the project. Though exotic annual grass species have been drastically reduced, the site continues to support abundant broadleaf annual weeds, most notably short-pod mustard. The distribution of Otay tarplant increased from 1.1 acres in 2005 to 6.25 acres in 2006, despite dramatically lower rainfall in 2006. Work on the project ended in January 2011.

In 2011, despite continuing weed problems, the Otay tarplant population remained abundant and productive, occurring over an area of about 13.4 acres; in fact, tarplant on the site in 2011 was more extensive than it has been in the history of tarplant monitoring on this site (since 2001). Individual tarplants have been tall and vigorous, apparently producing large amounts of seed. It is likely that the Otay tarplant seed bank on this site is much larger than it was at the outset of the project.

Stabilization of the Historic Barn at the Oaks

In 2006, efforts were initiated to stabilize the Barn at the Oaks, a historic structure located in the Las Montañas area of the Otay-Sweetwater Unit. Stabilization was necessary to prevent any further structural deterioration and to reverse the effects of ongoing vandalism. Stabilization of the existing barn structure involved removing the existing roof, which was in danger of caving in and collapsing the entire structure; constructing a new roof; realigning and bracing some of the walls of the structure to prevent collapse from lateral and seismic forces; repairing decayed wood; salvaging historic materials for later reuse; and replacing an existing chain link fence to prevent trespass and vandalism. The project was completed in 2009.

Translocation of San Diego Ambrosia

In June 2006, San Diego NWR began a project to reduce the likelihood of extinction of San Diego ambrosia. Prior to initiation of this project, there were three occurrences on the Refuge, all of which were subject to deleterious disturbances (e.g., foot, bicycle, horse, and off-road vehicle traffic; weeds; wildfire). Establishment of a new protected population of ambrosia was proposed in an effort to increase the likelihood of persistence of this species on the Refuge and throughout its range.

Prior to planting, three receptor sites, approximately 33 x 66 feet (10 x 20 meters) each and approximately 985 feet (300 meters) apart, were mowed with weed-whackers, raked to reduce the amount of thatch, and then treated with glyphosate herbicide to reduce weeds that may compete with the translocated plants. Cuttings from the wild population on the Refuge were collected to use as donor stock. In November 2006, 600 plants in one-gallon pots were planted at the receptor sites. Plants were placed at 1.6 to 3.3 foot (0.5 to 1.0 meter) intervals and watered as needed to ensure survival during the first four months after planting. In late 2009, two additional receptor sites were prepared. An assessment done in April 2010, showed that the sites were dominated by exotic annual weeds (primarily broadleaf species), though the receptor sites are less weedy than the adjacent untreated non-native grassland. Despite the presence of these weeds, the ambrosia appears to be well established, showing similar stem densities to the donor population at Par Four Drive. Many of the plants have spread via rhizomes at least 17 inches (50 centimeters) from the site of original planting. An additional 400 plants were installed at these sites in late 2010.

Protection of San Diego Ambrosia

The three native occurrences of San Diego ambrosia on the Refuge were initially threatened by impacts from pedestrians, bicycles, and horses on trails adjacent to or within the ambrosia patches. In three separate projects, Eagle Scout candidates worked with Refuge staff to supervise other scouts and volunteers in erecting post-and-rail fences to redirect traffic in and near the ambrosia patches. The projects have successfully excluded traffic from native occurrences of San Diego ambrosia, and the plants have responded by spreading via rhizomes into previously trampled areas.

Translocation of Mexican Flannelbush

In August 2006, San Diego NWR began a project to reduce the likelihood of extinction of Mexican flannelbush. Prior to initiation of this project, the species was known to occur only in two canyons on Otay Mountain in extreme southern San Diego County. Though location information associated with historic collections of Mexican flannelbush is not as precise as that customarily recorded with modern plant collections, the information suggested that the species formerly occurred in Jamul and may have occurred on lands now managed by the Refuge. Seeds were collected from the wild population in August 2006, and a local native plant nursery was contracted to grow container stock from this seed. In November 2010, 141 plants were planted in two canyons on the southwest and northeast sides of Mother Miguel Mountain. As of July 2011, about 75 percent of the plants had survived. The mortality rate for these plants is expected to decline after their first dry season in the field.

Vernal Pool Restoration on the Shinohara Parcel

The restoration of approximately 30 acres of vernal pool habitat, including a surrounding matrix of coastal sage scrub/foothill needlegrass grassland ecotone, was initiated in spring 2007. The restoration site is located in the southwesternmost corner of the Otay-Sweetwater Unit to the south of Sweetwater Reservoir. The site had been degraded by agriculture, grazing, and exotic plant invasion. Weed control began in April 2007 and continued through the present January 2012. Thirty-three vernal pool basins were re-contoured in 2007, and an additional 30 were created in 2009. Planting of native shrubs and perennial grasses began in January 2011. Soil inoculum from contiguous vernal pool habitat was spread in selected basins in November 2008. Seed of native vernal pool plants was broadcast into selected basins in December 2009 and November 2010. Vegetation change has been monitored annually using permanent transects, and species have been inventoried in vernal pool basins. As of January 2012, the site supported five federally listed plant species, 10 vernal pool obligates, and six additional regionally sensitive species. Qualitative and quantitative monitoring show that native species richness and cover are increasing throughout the site, but the need for weed control to maintain populations of listed and sensitive flora and fauna continues. The site is contiguous with another vernal pool restoration site maintained by the Sweetwater Authority, which enhances the effectiveness of both projects in conserving vernal pool species and ecological function.

Reestablishment and Enhancement of Oak Woodland

Though oak woodlands currently occur on less than two percent of the Refuge, these woodlands constitute especially valuable wildlife habitat. It is likely that the area historically supported more extensive oak woodlands than it does today. Oaks were probably consumed for fuel and young oaks destroyed by grazing cattle. To address this historic loss, and to mitigate potential future loss of oak woodlands due to depredation by the recently introduced goldspotted oak borer, we began to plant oaks on the Refuge in 2007. Since then, volunteers and Refuge staff have direct-seeded acorns in many locations. As of early 2013, acorns (about three per location) had been planted in approximately 290 locations on the Otay-Sweetwater Unit where conditions are appropriate for supporting oak woodland habitat. As expected, mortality has been high. However, in response to new information on oak woodland restoration, we plan to incorporate weed control into future oak planting efforts, which is expected to increase the rate of successful oak establishment.

Construction of a Trail Bridge for the Sweetwater River Regional Trail

To reduce disturbance to sensitive riparian habitat from ongoing trail use and improve conditions for users of the county's Sweetwater River Regional Trail, the Refuge partnered with the County of San Diego in 2005 to construct a 170-foot-long multiple use trail bridge over the Sweetwater River to the south of Highway 94. This bridge, constructed in April 2008 and dedicated in July 2008, provides access for hikers, equestrians, and bicyclists to cross the Sweetwater River with minimal impact to sensitive riparian habitat. With the installation of the bridge, a two-mile trail loop was created that allows users to travel on both sides of the Sweetwater River between the bridge and Singer Lane at Highway 94.

Sweetwater River trail bridge (USFWS)

Habitat Rehabilitation in Burned Areas

With over $750,000 in funding from the Burned Area Emergency Response and Emergency Stabilization and Rehabilitation Programs, the Refuge implemented a San Diego NWR Emergency Stabilization Plan for impacts related to the Harris Fire of October 2007. Infrastructure damage to guardrails, signs, and radio equipment were repaired under the plan. In addition, the Refuge has been managing selected habitat polygons within the over 4,000-acre burn area to increase the likelihood that high-quality habitat for sensitive species on the Refuge will regenerate and be retained. This habitat rehabilitation focused on two different species and their critical habitats: the Quino checkerspot butterfly and the coastal California gnatcatcher.

The work implemented to support Quino checkerspot involved de-thatching approximately 138 acres in fall 2008. Invasive weedy plants were controlled with selective application of glyphosate in spring 2009 and 2010. In 2010, the initial herbicide application was a non-selective broadcast, using either glyphosate or the grass-specific herbicide fluazifop, depending on the species composition of the weeds and native vegetation in the area.

Native seed was collected to reestablish native plants on the sites. The objective was to reestablish an open coastal sage scrub/grassland ecotone, with larval host plants and nectar source plants used by Quino checkerspot.

Site rehabilitation in fall 2009 for the coastal California gnatcatcher involved de-thatching approximately 90 acres of previously occupied gnatcatcher habitat. In 2010, the initial herbicide application within the de-thatched areas was once again a non-selective broadcast of either glyphosate or fluazifop, depending on the species composition of the weeds and native vegetation in the area. Native seed was collected to reestablish native coastal sage scrub vegetation suitable to support gnatcatchers.

In addition to Quino checkerspot and California gnatcatcher, these treatments are expected to benefit a variety of MSCP-covered species including burrowing owl, peregrine falcon (*Falco peregrinus*), rufous-crowned sparrow, coastal cactus wren, ferruginous hawk (*Buteo regalis*), golden eagle, northern harrier, orange-throated whiptail, San Diego horned lizard, Otay tarplant, San Diego barrel cactus, San Diego goldenstar, and variegated dudleya.

Reduction of Hazardous Fuels in the Sweetwater River

With funding provided by the Service's Fire Management Wildland-Urban Interface Program, a five-year project was initiated in 2008 to remove exotic, invasive plants along portions of the Sweetwater River and Steele Canyon Creek that traverse the San Diego NWR (totaling 4.6 linear miles of riparian habitat). Plants removed from this area included giant reed, salt cedar, and various species of non-native trees and palms.

Restoration of Cactus Wren Habitat

To facilitate and accelerate recovery of cactus wren nesting habitat damaged by the 2007 Harris Fire, in 2009 with funding from a Transnet Environmental Mitigation Program grant, several hundred pounds of cactus stem sections ("joints"), primarily coastal cholla but including smaller amounts of coastal prickly pear, were salvaged from the construction footprint of the Bayshore Bikeway, located adjacent to the San Diego Bay NWR. From this material and other salvaged cactus, including specimens of foothill prickly pear, over 6,000 cactus plants were grown in a nursery at Rancho Jamul Ecological Reserve. In fall 2010, a contractor was retained to collect and plant an additional 6,000 cactus for this restoration project. In early 2011, these 12,000 cactus plants were planted on three large areas, totaling approximately 123 acres, west of Mother Miguel Mountain. In 2011, mortality of the planted cacti was negligible, and moderate growth was observed during the 2011 growing season.

Restoration on the Jamacha Parcel

In November 2008, we began a project to enhance habitat quality for Otay tarplant and other grassland and coastal sage scrub species on the Jamacha parcel: a 30-acre parcel adjacent to Jamacha Boulevard in Spring Valley. The site includes several acres dominated by purple needlegrass and supports other clay-soil grassland species. The entire site was de-thatched in late 2008. From 2009 through 2011, weeds were controlled with glyphosate. Herbicides with the active ingredients fluazifop and chlorsulfuron have also been used to a lesser extent to control exotic annual grasses and onionweed (*Asphodelus fistulosus*), respectively. In 2012, efforts continued to remove large amounts of old, dumped concrete from the site to further habitat enhancement.

Refuge Fencing and Boundary Sign Project

In 2011, a project was initiated to remove and/or repair existing fencing and to install new fencing within the McGinty Mountain and San Miguel Mountain areas of the Otay-Sweetwater Unit. This project was necessary to improve wildlife movement within the Refuge, as well as to secure the boundaries of the Refuge to minimize trespass and habitat damage. At the time that some of the parcels now incorporated within the Refuge were acquired, they included fencing used in the past to delineate property lines, contain livestock, and protect property. As part of this project, fencing located within the interior of the Refuge was removed to improve wildlife movement, and fencing located along the Refuge boundary was either repaired or replaced with new fencing. In total, the project removed approximately 37,400 feet of interior fencing and repaired and replaced approximately 1,800 feet of boundary fencing. Boundary signs were also installed, as necessary, along portions of the Refuge boundary. In addition, this project included the completion of cadastral surveys in two locations, near the confluence of Steele Canyon Creek and the Sweetwater River and the vicinity of a private parcel on the western slopes of Proctor Valley. These surveys were required to determine and define land ownership and boundaries at these locations. This project was completed in 2012.

Golden Eagle Nest Platforms

Golden eagle nesting platform installation (USFWS)

In 2007, a rock ledge on San Miguel Mountain that had supported golden eagle nesting collapsed. While eagles continued to be seen in the general area, potential nesting sites suitable for accommodating a golden eagle nest are extremely limited. To address this issue, in 2012 the Refuge working in partnership with BLM advanced a proposal to install artificial eagle nesting platforms in the area. Funding was subsequently secured through the Transnet Environmental Mitigation Program, and in 2013, a contractor fabricated and installed two metal mesh platforms: one on the Refuge on San Miguel Mountain and one on BLM land in the Jamul Mountains. Each platform was bolted into the rockface and braced. Branches and sticks will be added to encourage nesting. Refuge staff will monitor the sites for use by eagles or other raptors.

3.3.5 Ongoing and Future Refuge Management Actions and Programs

Refuge management will continue to involve maintaining, enhancing, and restoring native upland and wetland habitats, monitoring a variety of listed and sensitive species and plant communities, controlling non-native invasive upland and wetland plant species, providing fire protection and law enforcement, and posting Refuge boundaries. The Refuge Manager will also continue to be responsible for ensuring the protection of cultural resources; coordinating issues related to contaminants with the Service's Environmental Contaminants Program; and working cooperatively with other agencies, tribes, non-profit organizations, private landowners, and the public on a variety of Refuge-related issues.

Ongoing activities, as well as new activities to be implemented per the goals, objectives, and strategies previously addressed are described in the sections that follow. Figures 3-1 through 3-6 graphically depict the actions proposed for implementation over the next 15 years. More detailed information regarding trails is provided in section in 3.3.5.5 Public Use under Trails.

3.3.5.1 Wildlife and Habitat Management and Monitoring

The majority of the wildlife and habitat management and monitoring activities occurring on the Refuge prior to the completion of the CCP were implemented per the guidance provided in the Conceptual Management Plan for the San Diego NWR (USFWS 1997b) and the various planning documents associated with the San Diego MSCP (City of San Diego 1998a). Many of these activities, as presented below, will continue be implemented in accordance with the CCP.

The Refuge supports or has the potential to support at least 16 species listed as endangered or threatened under the Federal Endangered Species Act (ESA) (Table 3-1), and at least one candidate species, as well as at least 35 narrowly endemic, sensitive, or regionally important species covered under the San Diego MSCP (City of San Diego 1998a) (Table 3-2). A significant amount of staff time is dedicated to the management and monitoring of these species, with the majority of this effort occurring in the Otay-Sweetwater Unit. Refuge staff coordinates with the City of San Diego and other partners on the management of listed and sensitive species on the Del Mar Mesa Preserve, which includes the 60-acre Del Mar Mesa Vernal Pool Unit of the San Diego NWR.

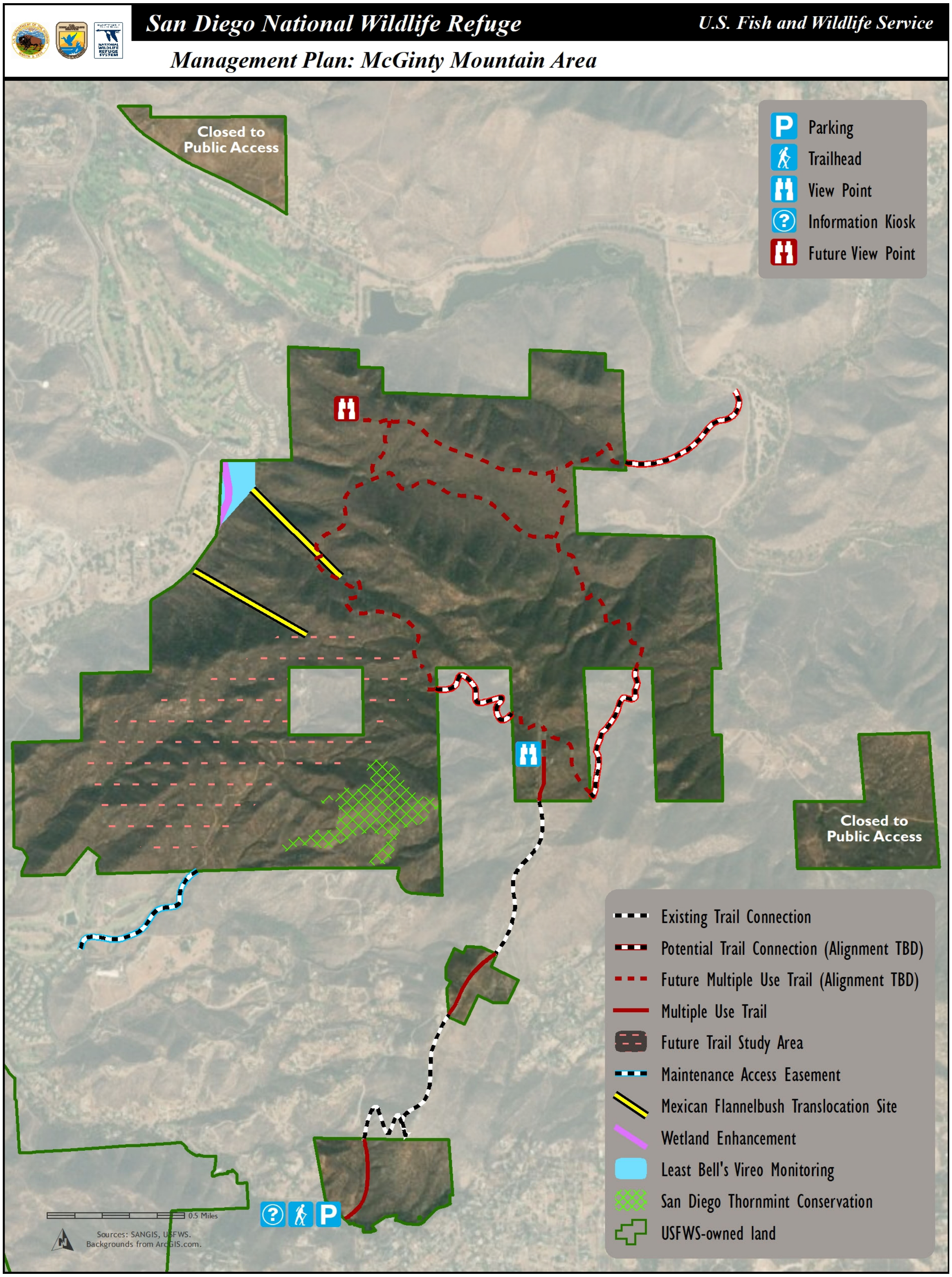

Figure 3-1. Management Plan - McGinty Mountain Area, Otay-Sweetwater Unit

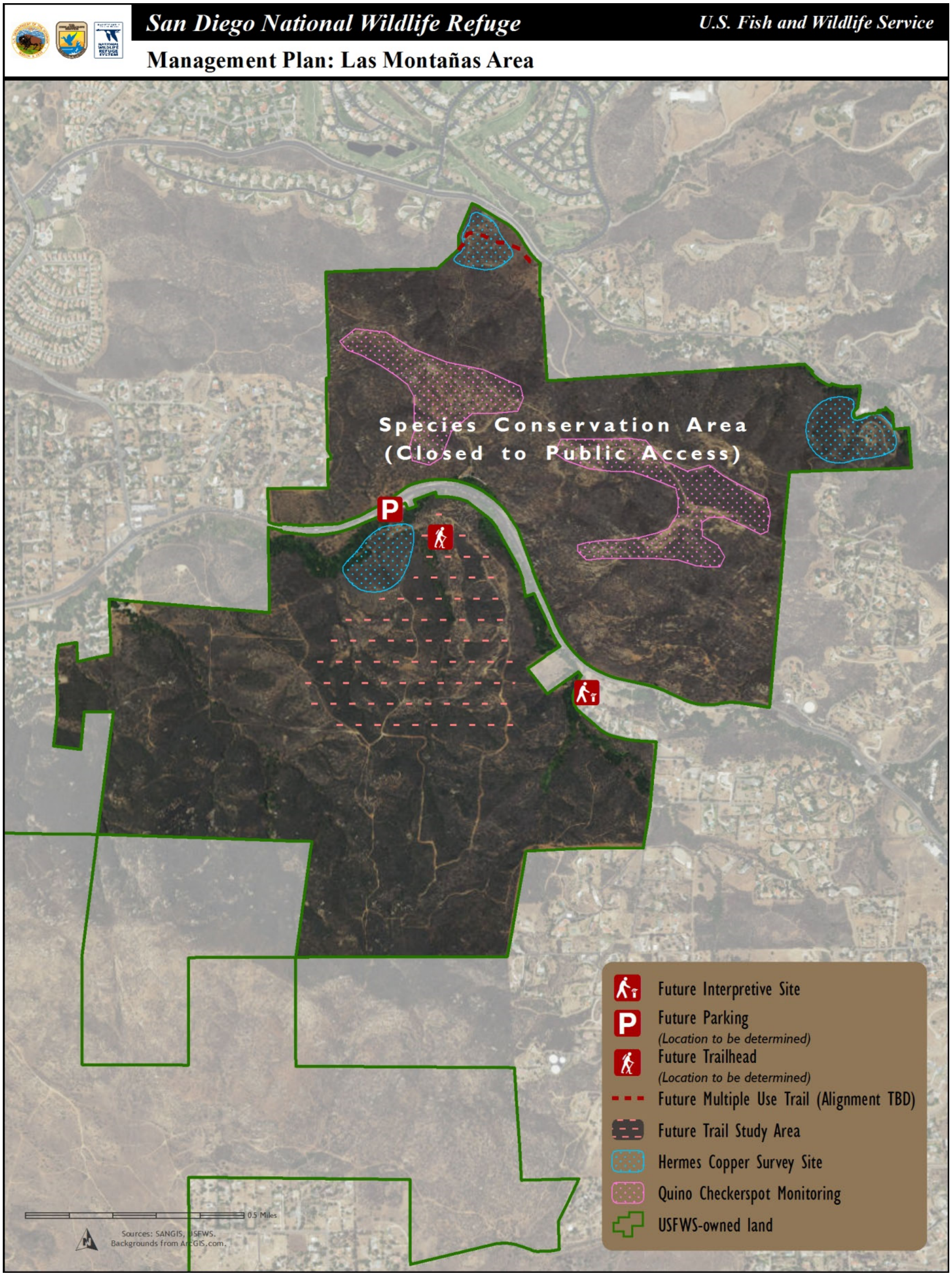

Figure 3-2. Management Plan - Las Montañas Area, Otay-Sweetwater Unit

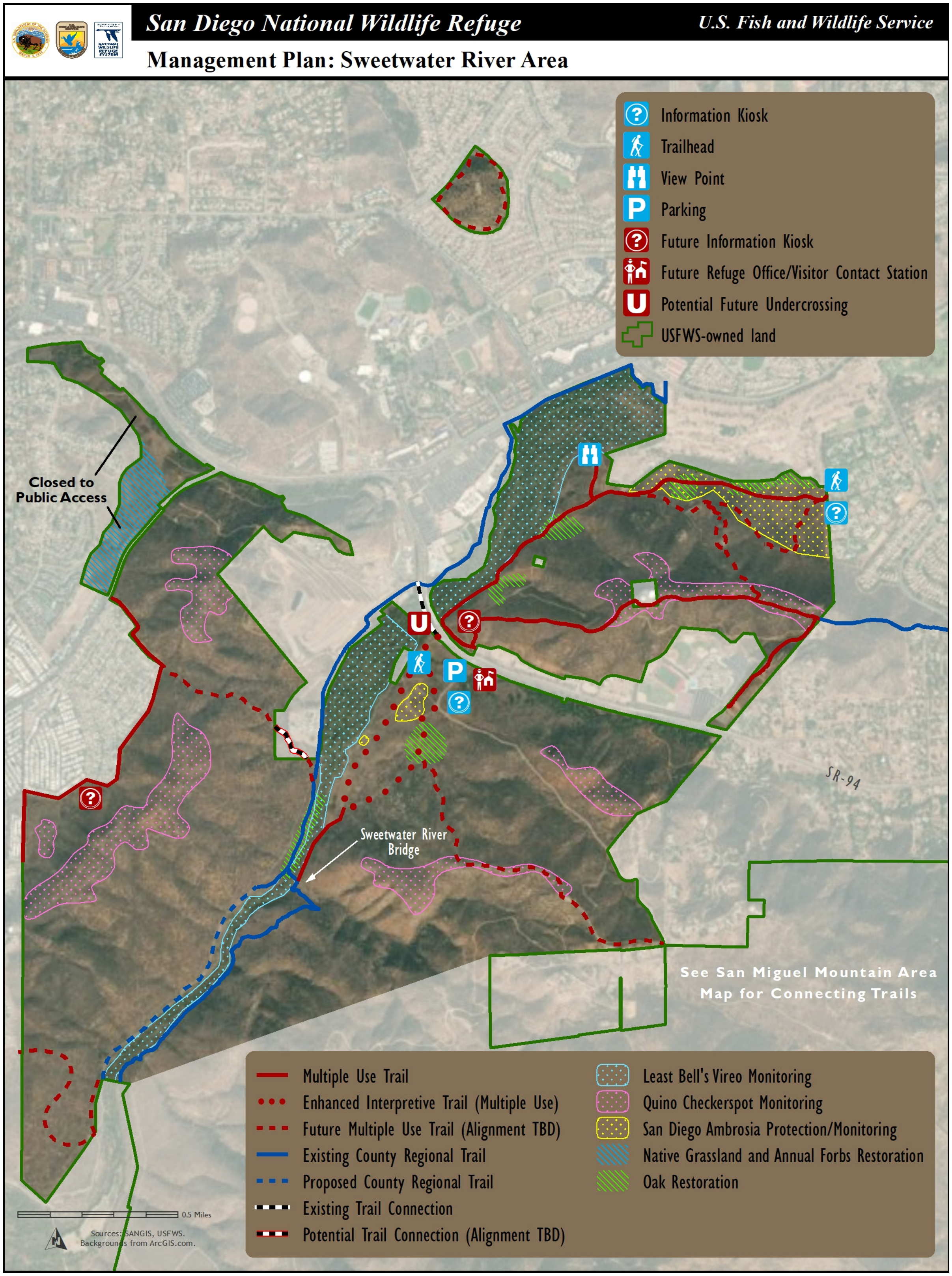

Figure 3-3. Management Plan - Sweetwater River Area, Otay-Sweetwater Unit

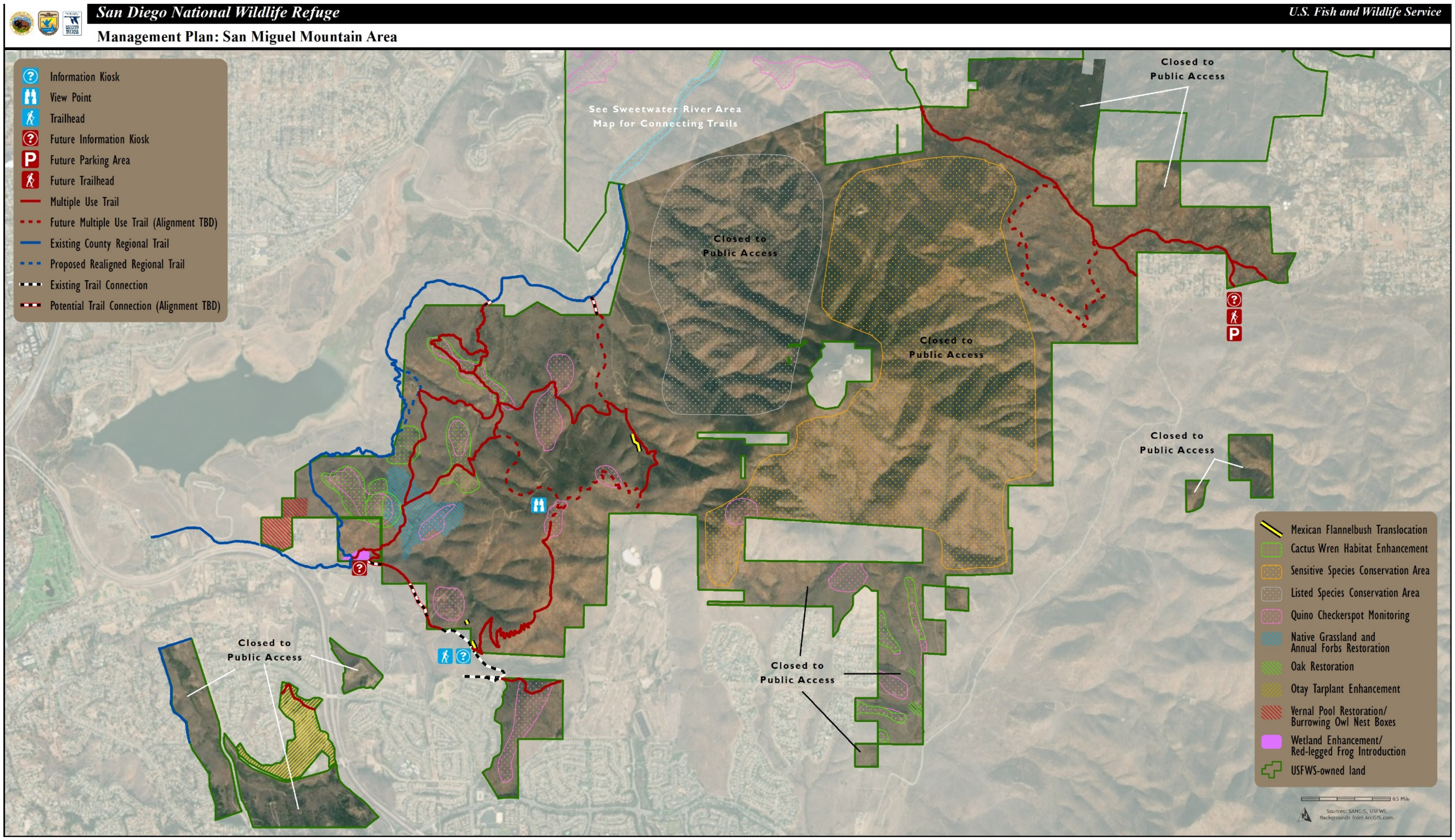

Figure 3-4. Management Plan - San Miguel Mountain Area, Otay-Sweetwater Unit

Figure 3-5. Management Plan - Otay Lakes and Mesa Area, Otay-Sweetwater Unit

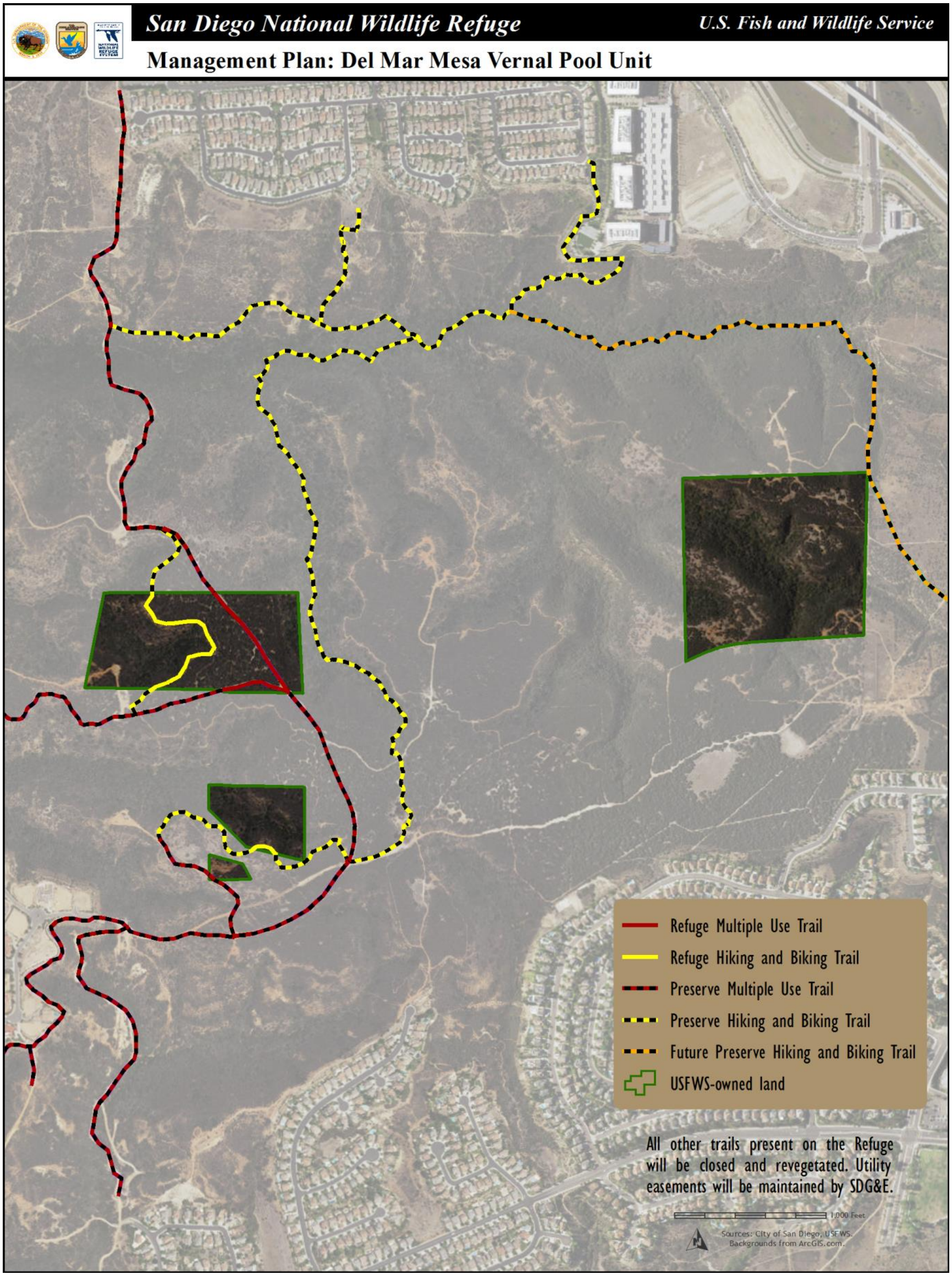

Figure 3-6. Management Plan – Del Mar Mesa Vernal Pool Unit

Table 3-1 Federal and State Listed Species Observed or Expected to Occur within the San Diego NWR			
Common Name	**Scientific Name**	**Status**	**Type of Organism**
Least Bell's Vireo	*Vireo bellii pusillus*	FE/SE	Bird
California Coastal Gnatcatcher	*Polioptila californica californica*	FT	Bird
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	FE/SE	Bird
Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	PT/SE	Bird
San Diego Ambrosia	*Ambrosia pumila*	FE	Plant
San Diego Thornmint	*Acanthomintha ilicifolia*	FT/SE	Plant
Otay Tarplant	*Deinandra conjugens*	FT/SE	Plant
Mexican Flannelbush	*Fremontodendron mexicanum*	FE/SR	Plant
Del Mar Manzanita	*Arctostaphylos glandulosa ssp. crassifolia*	FE	Plant
Encinitas Baccharis	*Baccharis vanessae*	FT/SE	Plant
San Diego Mesa Mint	*Pogogyne abramsii*	FE/SE	Plant
Otay Mesa Mint	*Pogogyne nudiuscula*	FE/SE	Plant
San Diego Button-celery	*Eryngium aristulatum var. parishii*	FE/SE	Plant
Spreading Navarretia	*Navarretia fossalis*	FT	Plant
California Orcutt Grass	*Orcuttia californica*	FE/SE	Plant
San Diego Fairy Shrimp	*Branchinecta sandiegonensis*	FE	Invertebrate
Riverside Fairy Shrimp	*Streptocephalus woottoni*	FE	Invertebrate
Quino Checkerspot Butterfly	*Euphydryas editha quino*	FE	Invertebrate
Hermes Copper	*Hermelycaena (Lycaena) hermes*	FC	Invertebrate (butterfly)
Arroyo Toad	*Anaxyrus (Bufo) californicus*	FE	Amphibian
California Red-legged Frog	*Rana draytonii*	FT	Amphibian

FE – Federally endangered; FT – Federally threatened; PT – Proposed for listing as federally threatened; SE – State endangered

Table 3-2 San Diego MSCP-covered Species Observed or Expected to Occur within the San Diego NWR		
Common Name	**Scientific Name**	**Type of Organism**
Otay manzanita	*Arctostaphylos otayensis*	Plant
Encinitas baccharis	*Baccharis vanessae*	Plant
Orcutt's brodiaea	*Brodiaea orcuttii*	Plant
Dunn's mariposa lily	*Calochortus dunnii*	Plant
Wart-stemmed ceanothus	*Ceanothus verrucosus*	Plant
Tecate cypress	*Cupressus forbesii*	Plant
Variegated dudleya	*Dudleya variegata*	Plant
Palmer's ericameria	*Ericameria palmeri*	Plant
San Diego barrel cactus	*Ferocactus viridescens*	Plant
Gander's pitcher-sage	*Lepichinia ganderi*	Plant
Felt-leaved monardella	*Monardella hypoleuca ssp. lanata*	Plant
San Diego goldenstar	*Muilla clevelandii*	Plant
Dehesa beargrass	*Nolina interrata*	Plant
Snake cholla	*Opuntia parryi var. serpentina*	Plant
San Miguel savory	*Satureja chandleri*	Plant
Gander's butterweed	*Senecio ganderi*	Plant
Narrow-leaved nightshade	*Solanum tenuilobatum*	Plant
Parry's tetracoccus	*Tetracoccus dioicus*	Plant
Thorne's hairstreak	*Callophrys gryneus thornei*	Invertebrate (butterfly)
Southwestern pond turtle	*Actinemys marmorata pallida*	Reptile
Orange-throated whiptail	*Cnemidophorus hyperythrusbeldingi*	Reptile
San Diego horned lizard	*Phrynosoma coronatum blainvillei*	Reptile
Northern harrier	*Circus cyaneus*	Bird
Cooper's hawk	*Accipiter cooperii*	Bird
Swainson's hawk	*Buteo swainsoni*	Bird
Ferruginous hawk	*Buteo regalis*	Bird
Golden eagle	*Aquila chrysaetos*	Bird
American peregrine falcon	*Falco peregrinus*	Bird
Burrowing owl	*Athene cunicularia*	Bird
Cactus wren	*Campylorhynchus bruneicapillus*	Bird
Western bluebird	*Sialia mexicana*	Bird
California rufous-crowned sparrow	*Aimophilia ruficeps canescens*	Bird
Tricolored blackbird	*Agelaius tricolor*	Bird
American badger	*Taxidea taxus*	Mammal
Mountain lion	*Felis concolor*	Mammal
Southern mule deer	*Odocoileus hemionus fuliginata*	Mammal

The design and implementation of management strategies on the Refuge incorporates regional strategies developed as part of the San Diego MSCP and adapts management practices as appropriate in response to new information and site-specific conditions. Management of listed and MSCP-covered species will continue to evolve based on the outcomes of research efforts related to species and habitat management that are ongoing in western San Diego County.

A Management Strategic Plan (MSP) (San Diego Management and Monitoring Program 2013) has been drafted for the San Diego Association of Governments (SANDAG) by the San Diego Management and Monitoring Program that outlines a comprehensive approach for managing multiple plant and animal species within western San Diego County. The MSP is intended to facilitate a coordinated effort among land managers in implementing management actions related to the conservation of listed and MSCP-covered species.

As drafted, the MSP categorizes and prioritizes species and vegetation communities, identifies geographic locations for management actions, provides specific timelines for implementation, and establishes a process for coordination and implementation. As a living document, the MSP will be revised over time to incorporate new information or to address changes in current conditions (e.g., wildfire). Refuge staff have and will continue to actively participate in the development of this effort, as well as the other regional efforts related to the adaptive management and monitoring of species and habitats within the MSCP preserve areas.

The Del Mar Mesa Vernal Pool Unit requires less active management than does the Otay-Sweetwater Unit due in part to the smaller size of the area, the nature of the habitats present in the area, and the cooperative management occurring in the area. The Service, City of San Diego, County of San Diego, and CDFW all own and manage property within the Del Mar Mesa Preserve. In 2001, the City of San Diego, recognizing the need to coordinate the resource management efforts and public uses occurring in this area, initiated the development of a management plan for approximately 980 acres on Del Mar Mesa Preserve. The Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015), which was adopted by the San Diego City Council in 2015, represents a cooperative effort with the other agency landowners in the preserve.

Although the logistics of day-to-day management responsibility for the lands within the Del Mar Mesa Preserve are still being considered, the management plan suggests several options for preserve management. These options include hiring an individual with biological resource management experience to oversee management activities; hiring a private or non-profit resource management organization to oversee management activities; deferring to the City of San Diego to act as the land manager; or having each landowner agency responsible for implementing the management strategies on their own properties. Under any option, a management committee comprised of representatives from each of the agency landowners would be formed to oversee preserve management.

Habitat and wildlife protection on the Del Mar Mesa Vernal Pool Unit will be implemented consistent with this approved Management Plan, which is incorporated by reference into this document. To review the City's approved management plan go to: https://www.sandiego.gov/sites/default/files/cm_dmm_nrmp_final_042015.pdf.

Endangered, Threatened, and Sensitive Species Monitoring

Monitoring and targeted studies of listed and MSCP-covered species are essential activities conducted on the Refuge and are intended to maximize habitat values and species protection to the extend feasible based on available funding. Depending upon the species or habitat, monitoring may be conducted by Refuge staff, Ecological Services staff, other Federal or State agencies (e.g., CDFW, USGS), non-profit organizations, volunteers, and/or private contractors. Species and habitat monitoring, conducted in accordance with established monitoring protocols when available, is implemented to assess the status and trends of conserved resources and the effectiveness of ongoing management actions.

The MSCP Biological Monitoring Plan (Ogden 1996) provided initial guidance for monitoring MSCP-covered species, with much of the work focused on presence or absence surveys, particularly with respect to rare plants (McEachern et al. 2007). The intent of the initial monitoring plan was to document the conditions of the habitats and species to be conserved under the MSCP, with recommended locations for monitoring specific habitats and regional wildlife corridor linkages and a list of monitoring priorities for plant and animal species.

The specific biological monitoring objectives of the initial MSCP Biological Monitoring Plan (Ogden 1996) included:

- documenting the protection of habitats and covered species;
- documenting changes in preserved habitats or preserved populations of covered species;
- describing new biological data collected, such as new species sightings and information on wildlife movements and corridors;
- evaluating impacts of human disturbance in and adjacent to preserved lands;
- evaluating management activities and enforcement difficulties; and
- evaluating funding needs and the ability to accomplish resource management goals.

The San Diego MSCP provides the authority for the Wildlife Agencies, in collaboration with the Permittees, to make changes in monitoring protocols and priorities, and as anticipated, the monitoring program has been evolving over time. In 2007, a new monitoring approach was developed that involved an adaptive management framework with clearly defined measurable goals and objectives. The development and refinement of new approaches to monitoring and adaptive management was done in a stepwise progression that resulted in a series of documents being produced with each document building on the previous ones. These documents are available for review on the San Diego Management and Monitoring Program website (http://www.sdmmp.com/monitoring/Monitoring_MainPage.aspx) and/or the CDFW Natural Community Conservation Planning website (http://www.dfg.ca.gov/habcon/nccp/publications.html).

Review and analysis of the San Diego MSCP Biological Monitoring Plan continues in an effort to improve the scientific robustness of the monitoring program and enhance the ability of the participating jurisdictions and agencies to determine if the biological goals of the MSCP are being met (Hierl et al. 2005). Through this review process, various program topics have been addressed including:

- assessing the original biological monitoring plan for the San Diego MSCP (Hierl et al. 2005);

- developing a revised rare plant monitoring framework (McEachern et al. 2007, Tracey et al. 2011);
- prioritizing species for monitoring (Regan et al. 2006);
- developing a step-by-step procedure for developing effective monitoring programs in an adaptive management context (Atkinson et al. 2004);
- grouping and prioritizing natural communities for monitoring (Franklin et al. 2006); and
- developing conceptual models to improve the biological monitoring plan (Hierl et al. 2007).

Refuge staff is actively participating in the development and review of updated monitoring programs and protocols, and as they are completed, appropriate changes to the monitoring procedures conducted on the Refuge will be made. The most recent monitoring protocols and monitoring results are maintained on and can be reviewed at the San Diego Management & Monitoring Program website (http://portal.sdmmp.com/).

Current monitoring efforts include for some species adhering to the protocols issued by the Service as part of the ESA Section 10(a)(1)(A) permit that was prepared in association with the approval of the San Diego MSCP, while monitoring other species using updated methods developed cooperatively with the Wildlife Agencies and jurisdictions participating in the MSCP. Still other species on the Refuge are monitored opportunistically, which may be of limited utility in rigorous quantitative estimation of population trends over time. However, such surveys are likely to contribute valuable information on presence or absence, seasonality, distribution, and threats to population persistence.

Monitoring-related activities currently occurring or proposed for implementation on the Refuge, per available funding and staffing, include:

San Diego thornmint (USFWS)

- targeted surveys for Quino checkerspot butterfly in areas of known historical occurrences and other sites with appropriate habitat;
- opportunistic surveys to determine if Hermes copper butterfly is present in appropriate habitat areas;
- targeted surveys of known occurrences of San Diego thornmint on McGinty Mountain;
- opportunistic inspections of the Jamacha and Trimark parcels and Mother Miguel grasslands to determine listed and sensitive species presence or absence;
- qualitative assessments of the status and threats to the naturally occurring and restored populations of San Diego ambrosia on the Refuge;
- monitoring of San Diego barrel cactus at established plots (Otay-Sweetwater Unit);
- annual inventories of the plant and animal species present in the Refuge's Otay-Sweetwater vernal pools; and
- monitoring of cactus wren habitat restoration sites on the Otay-Sweetwater Unit.

Another action proposed for implementation when funding is identified is a comprehensive Refuge-wide (Otay-Sweetwater and Del Mar Mesa Vernal Pool Units) survey to identify, map, and assess existing populations of sensitive plant species and establish baseline species data for the vernal pools present on each Unit.

The MSCP also addresses the need for wildlife corridor monitoring. The plan identified four regional habitat linkages on the Refuge: the portion of the Sweetwater River that extends from the McGinty Mountain area to the Sweetwater River area (Rancho San Diego); habitat connections between San Miguel Mountain, Proctor Valley, and the Jamul Mountains; the lands connecting the Jamul Mountains and the southeast side of Lower Otay Lake; and Little Cedar Canyon, which provides a linkage between the Jamul Mountains and the San Ysidro Mountains. The MSCP proposed that the presence of focal species within these linkage areas be determined through the detection of animal sign (tracks and scat) and visual sightings.

In 2011, the San Diego Tracking Team established tracking transects in the Las Montañas management area of the Refuge to obtain data that will improve our understanding of how and to what extent this area functions as a wildlife corridor. Also in 2011, the San Diego Management and Monitoring Group issued a Connectivity Monitoring Strategic Plan for the San Diego Preserve System that provides direction for connectivity monitoring that will facilitate an assessment of how the goals of ensuring the persistence of species across the MSCP preserve system and preserving ecosystem functions across the landscape are being achieved. The plan is available at http://www.sdmmp.com/ monitoring/ connectivity_monitoring.aspx). Monitoring consist with this plan will occur on the Refuge per available funding and in cooperation with others.

Herpetofaunal (i.e., reptiles, amphibians) monitoring on the Refuge began in 1995 as part of a larger USGS and San Diego State University project (Rochester et al. 2001) involving the autecological study of the herpetofauna of San Diego County. The goal of the study was to identify the reptile and amphibian species present, when they are active, and in which habitats they occur. The Refuge study site, where 10 pit-trap arrays were constructed, is located along both sides of the Sweetwater River just to the south of Highway 94. The monitoring effort as of 2001 involved 295 sampling days in which 30 species were identified.

Species and Habitat Management

Since the Refuge's establishment in 1996, many projects have been implemented to restore and/or enhance habitat for the primary purpose of supporting listed and MSCP-covered species. Some of these include:

- control of invasive plant species in burn areas and in restored/enhanced areas (e.g., cactus wren habitat restoration areas, vernal pool restoration on the Shinohara site, and Otay tarplant habitat enhancement on the Jamacha parcel);
- install fencing and/or signage to reduce disturbance and minimize direct impacts related to unauthorized off-trail activities;
- support the Center for Natural Lands Management in their research of effects on San Diego ambrosia of physical and chemical weed control techniques, as the results of this research can benefit future management practices for this species;
- coordinate with other agencies and organizations to investigate the potential effects to native species, particularly listed plant species, of various types of herbicides used to control non-native grasses and other invasive plants in natural areas; and
- inventory and repair or replace physical structures such as burrowing owl boxes and bluebird nesting boxes installed on the Otay-Sweetwater Unit in previous years.

Proposals for future actions that address specific species (to be implemented per available funding and staffing) include:

- Least Bell's Vireo – Evaluate data from ongoing monitoring efforts to identify any adverse population trends. If populations appear to be declining, investigate potential causes and implement those management actions that, if taken, could reverse these trends. Such management actions could include mosquito control to address West Nile virus (which would first require the preparation of a Mosquito Management Plan and accompanying Compatibility Determination), Argentine ant control, nest predator control, cowbird control to reduce nest parasitism, habitat manipulation, and/or permanent or seasonal trail closures or trail relocations to reduce disturbance during the nesting season.

- Burrowing Owl – Install additional nesting boxes in appropriate locations within the San Miguel Mountain area, and conduct annual burrowing owl breeding surveys in appropriate locations to determine where and how many owls are present on the unit during the breeding season. Release rehabilitated or relocated burrowing owls in appropriate habitat on the Refuge as opportunities occur.

- Mexican Flannelbush – Establish additional populations of this species on alluvial benches of low-gradient canyons within the McGinty Mountain area of the Otay-Sweetwater Unit. Implementation of this proposal, which is consistent with the recommendations of the *Fremontodendron mexicanum* (Mexican flannelbush) 5-Year Review: Summary and Evaluation (USFWS 2009c), will be coordinate with Ecological Services and other interested Federal, State, and local agencies.

- San Diego Ambrosia – Continue to examine various methods of effective physical and chemical weed control techniques that can be implemented to effectively control non-native grasses without adversely affecting existing populations of San Diego ambrosia. This would include supporting research into various herbicides that may be effective. If such an herbicide is identified, include this product as one of the methods to be used to control non-native grasses in areas that currently support or have the appropriate site and soil characteristics to support San Diego ambrosia and other sensitive plant species. Also, evaluate the effects of human disturbance (i.e., trampling) on this species, and implement management actions (e.g., trail fencing, trail realignments, signage) to avoid and minimize adverse effects from both on- and off-trail activity.

- Quino Checkerspot Butterfly – Seek funding to implement Quino habitat restoration and/or enhancement projects that will result in improved connectivity within and between known species occurrences. Such enhancement projects include the control of non-native invasive weeds in those areas that support potential Quino habitat. As part of the annual monitoring efforts for this species, sites for population augmentation have been identified and assessed and will be used to release Quino checkerspot butterfly larvae.

- Arroyo Toad – Enhance riparian areas along the Sweetwater River by removing exotic plant species and mimicking the natural disturbance regime in an effort to create shallow, sand- or gravel-bottomed sunny pools, suitable for supporting breeding arroyo toads. Concurrently, work with other property owners along the Sweetwater River to improve habitat linkages between appropriate arroyo toad habitat on the Refuge and existing populations of arroyo toads upstream of the Refuge to facilitate the natural recolonization of arroyo toads on the Refuge.

- Townsend's Big-eared Bat, Western Red Bat, and Other Bat Species – Seek funding to create and install artificial bat roosting habitats that provide conditions suitable for obligate cave-roosting species, and install bat boxes in suitable locations on the Otay-Sweetwater Unit to support other bat species. When closing abandoned mine shafts, include provisions for continued bat access where appropriate.

- Golden Eagle – Protect the areas surrounding the recently installed golden eagle breeding platforms from human disturbance during the nesting season.

- Southwestern Pond Turtle – Work with USGS and other partners to determine if suitable habitat is present on the Refuge in the vicinity of the Sweetwater River and Steele Canyon Creek to establish populations of this species on the Refuge.

- California Red-legged Frog - Working with USGS and/or other partners, initiate actions to re-establish the California red-legged frog on the Refuge, as the Sweetwater River watershed is identified in the Recovery Plan for the California Red-legged Frog as a priority watershed for focused recovery efforts (USFWS 2002c). Re-establishment would involve a multiple step process that begins with the selection of donor populations for translocation and habitat assessment of potential translocation sites. Donor populations would be identified using DNA fingerprinting techniques for up to 30 individuals from each of 16 different populations in the Sierra San Pedro Mártir Mountains of Baja California, where frogs have been tentatively identified as appropriate genetic sources. This strategy is critical to the success of re-establishment efforts, as frogs with similar genetic backgrounds have the highest probability for survival under a given set of environmental conditions. Site assessments would also be performed to identify appropriate translocation sites. One potential site identified on the Refuge is the Mother Miguel pond located in the San Miguel Mountain area of the Otay-Sweetwater Unit.

- Coast Live Oak – Periodically monitor oak stands for signs of goldspotted oak borer infestation and/or the presence of *Phytopthora ramorum*, an introduced plant pathogen responsible for sudden oak death, and work with the City of San Diego to conduct similar monitoring of Nuttall's scrub oak stands in the Del Mar Mesa Vernal Pool Unit.

In addition, we will seek funding to survey and map sensitive species on the Del Mar Mesa Vernal Pool Unit in an effort to establish a baseline for future monitoring and management efforts. The species and habitat management actions implemented on the Del Mar Mesa Vernal Pool Unit are consistent with the species and habitat management actions described in the City of San Diego's Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015), as presented in Table 3-3. (Activities related to the protection and recovery of vernal pool species on the Otay-Sweetwater Unit are addressed below under Habitat Restoration and Enhancement Activities.)

Table 3-3
Species and Habitat Management Actions for the Del Mar Mesa Vernal Pool Unit per the Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan[1]

Management Topic	Management Activities
MSCP Species Monitoring and Management	
Monitoring Protocols for Rare Plants	Monitor rare plants in accordance with the current rare plant monitoring protocols, which are based on the findings of a scientific review conducted by the U.S. Geological Survey, Western Ecological Research Center (McEachern et al. 2007) and revised as necessary per the San Diego Rare Plant Monitoring Plan (Tracey et al. 2011).
Del Mar Manzanita	Survey for and map any newly discovered locations of this species; control invasive weeds as necessary to reduce fuel sources near the ground, thereby reducing the effects of fire on seeds and plant crowns; control invasive weeds to improve the potential for expansion of the population beyond the limits of the current population; and implement measures to reduce the potential for trampling.
Orcutt's Brodiaea	Reduce edge effects along trails and roads through fencing and/or signage, monitor the effectiveness of these measures, and implement additional measures such as enforcement if necessary to protect the species; and implement weed control where necessary to restore habitat quality.
San Diego Button Celery	Reduce edge effects along trails and roads through fencing and/or signage or realign the trail or roads to avoid impacts; monitor the effectiveness of these measures and implement additional measures such as enforcement, if necessary, to protect the species; control invasive species as necessary; and restore and/or enhance vernal pool habitat (e.g., restore the natural hydrology to disturbed pools, remove exotic plants, and reintroduce plant propagules) to support this species as funding becomes available.
Coast Barrel Cactus	Reduce edge effects along trails and roads through fencing and/or signage or realign the trail or roads to avoid impacts; monitor the effectiveness of these measures and implement additional measures such as enforcement, if necessary, to protect the species; and implement aggressive weed control to reduce the effects fire could have on these plants.
San Diego Goldenstar	Reduce edge effects along trails and roads through fencing and/or signage or realign the trail or roads to avoid impacts; monitor the effectiveness of these measures and implement additional measures such as enforcement, if necessary, to protect the species; and implement weed control as necessary.
San Diego Mesa Mint	Reduce edge effects along trails and roads through fencing and/or signage or realign the trail or roads to avoid impacts; monitor the effectiveness of these measures and implement additional measures such as enforcement, if necessary, to protect the species; implement measures to maintain surrounding habitat for native pollinators, and protect and maintain vernal pool watersheds. Restore vernal pool habitat per available funding by restoring the correct hydrology, removing exotic plants, and repopulating the pools with appropriate vernal pool species.

Table 3-3 Species and Habitat Management Actions for the Del Mar Mesa Vernal Pool Unit per the Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan[1]	
Management Topic	**Management Activities**
San Diego Fairy Shrimp	Conduct surveys to determine the distribution of this species within the existing vernal pools; restore disturbed vernal pools; close or reroute roads and trails that are directly impacting vernal pool habitat; install fencing and signage around sensitive areas, and routinely patrol these areas to ensure their long-term protection.
Belding's Orange-throated Whiptail	Manage suitable habitat areas and linkages to off-site habitat area in a manner that will ensure good habitat quality (e.g., maintain woodpiles and natural leaf litter to attract native prey species, minimize the potential for edge effects, address issues related to domestic pets and invasive ants).
San Diego Horned Lizard	Maintain suitable habitat areas and linkages to off-site habitat area in a manner that will ensure good habitat quality; maintain native ant species and control Argentine ant populations; protect the species against detrimental edge effects; restore appropriate native habitat to support this species; and avoid the construction of new trails or roads in areas where this species is present.
California Gnatcatcher	Maintain or restore, per available funding, appropriate habitat to support this species; monitor nesting habitat for the presence of brown-headed cowbirds; and protect nesting areas from human and domestic animal disturbance.
Northern Harrier	Maintain appropriate foraging habitat for this species.
Southern California Rufous-crowned Sparrow	Maintain the native herbaceous component within the sparrow's habitat through prescribed burns or manual methods.
Western Bluebird	Protect occupied habitat and nesting areas from human and domestic animal disturbance.
Burrowing Owl	Monitor the preserve to identify occupied habitat areas and determine owl use and nesting success; implement predator control measures as necessary; and establish a 300-foot impact avoidance area around occupied burrows.
Mountain Lion	Monitoring to detect presence.
Southern Mule Deer	Monitoring to detect presence.

Table 3-3
Species and Habitat Management Actions for the Del Mar Mesa Vernal Pool Unit per the Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan[1]

Management Topic	Management Activities
Management of Sensitive Species Not Covered by the MSCP	
Plants	For sensitive plant species not covered by the MSCP, minimize the potential for trampling by redirecting activities to less sensitive areas; and reduce impacts related to competition with exotic weeds by implementing a weed management program per available funding.
Reptiles and Amphibians	Encourage herpetofaunal monitoring in conjunction with partners to better understand existing species diversity; and redirect recreational activity that could impact sensitive herptiles to less sensitive areas.
Birds	Enhance open foraging areas by implementing a weed control program; confine recreational activity to the designated trail system; and restore coastal sage scrub habitat where appropriate to support Bell's sage sparrow (*Amphispiza belli*) and other coastal sage scrub-dependent species.
Mammals	Maintain the integrity of natural open space areas to support the San Diego black-tailed jackrabbit.
Other Management Actions	
Native Species Introduction	Reintroduce native species whose historic range included the project site, provided there is prior consensus among the preserve owners and the agency(ies) with jurisdiction over that species.
Habitat Protection	Restrict activities in native habitat to: natural resource surveys and monitoring; emergency response; and hiking, biking, and equestrian activities on designated trails; and all such activities shall be conducted in a manner that avoids or minimizes impacts to native habitat and species.
Exotic Plant Control and Reestablishment of Native Species	Implement site-specific non-native plant removal strategies, as funding is available. Focus initial efforts on habitat patches that support sensitive species. Following removal of non-native species, reestablish native species by hand seeding or propagation off-site and outplanting.
Native Pollinator Population Enhancement	Provide adequate habitat for pollinator assemblages (e.g., restore and maintain areas of open ground within associated native vegetation to support ground nesting bees and other invertebrates, reintroduce nectar-producing plant species with overlapping flowering periods that extend throughout the Southern California growing season).
Exotic Animal Control	Monitor for impacts related to Argentine ants and non-native mammalian predators, including uncontrolled pets, and implement appropriate controls necessary to protect sensitive species.
Cryptogrammic/Microbiotic Crust Enhancement and Restoration	Promote conditions that are appropriate for the growth of cryptogrammic/microbiotic crusts in part by eliminating human-related disturbance and increasing soil stability.

[1]City of San Diego 2015

Habitat Monitoring

Researchers at San Diego State University, under the direction of Dr. Douglas Deutschman, have also undertaken a research project to refine the MSCP vegetation community monitoring program. The project uses a variance decomposition approach to examine the effects of number of sites, number and size of plots, sampling frequency, sampling methodology, and observer experience on accuracy, precision, and cost of estimating several variables associated with the structure and floristic composition of the chaparral and coastal sage scrub vegetation communities. The goal is to arrive at a monitoring program that will not only enable biologists to assess whether: 1) the MSCP is conserving the diversity and function of the ecosystem; and 2) the specific species covered by the MSCP are being conserved adequately to meet the take authorization issuance standards of the ESA and the NCCP, but can also achieve these goals at the lowest cost.

Avian Monitoring on the Otay-Sweetwater Unit

The establishment of Monitoring Avian Productivity and Survivorship (MAPS) stations is also proposed for the Otay-Sweetwater Unit. MAPS stations would provide monitoring data for listed and sensitive species, as well as other bird species present within the Unit. The Refuge will seek partners to develop two MAPS stations in this area—one located in oak woodland and the other within chaparral or coastal sage scrub habitat.

MAPS stations are designated bird banding stations operated by Federal and State agencies, private organizations, and individual bird banders. The MAPS program, which is coordinated through the Institute for Bird Populations, uses a standardized protocol of constant-effort mist netting at over 500 stations. MAPS is a valuable tool for providing information related to the ecology, conservation, and management of North American landbird populations and the factors responsible for changes in their populations.

The establishment of MAPS stations on the San Diego NWR was recommended by the Institute of Bird Populations (DeSante et al. 2004) in a study that looked at the current status and future direction of MAPS Stations on national wildlife refuges in Washington, Oregon, California, Nevada, and Idaho. This study was conducted to enhance the usefulness of MAPS data through thoughtful selection of target species and the siting of stations on refuges that include habitats of special concern, are located in an area that would fill a gap in the existing MAPS data, and support substantial numbers of individuals of the selected target species. The study concluded that new MAPS stations in several locations throughout the region would benefit the program, including stations on the San Diego NWR, particularly in oak woodland and chaparral habitats (DeSante et al. 2004).

3.3.5.2 Habitat Restoration and Enhancement Activities

In addition to the projects implemented for the primary purpose of supporting listed species, several other restoration and enhancement projects have been implemented on the Refuge to restore or improve habitat quality for a range of plant and wildlife species. These activities include controlling invasive non-native plants in recent burn areas; controlling invasive non-native grasses and forbs in other disturbed areas; removing non-native shrubs and trees from riparian areas; planting and maintaining oak seedlings in appropriate habitat throughout the San Diego NWR; and maintaining and monitoring restored cactus patches in recent burn areas.

The following additional actions are proposed and will be implemented per available funding and staffing.

- Vernal Pool Habitat – Design and seek funding to implement proposals for restoring or enhancing vernal pools habitat where appropriate site conditions (e.g., soils, topography) are present. Also seek funding to restore native upland habitat, including coast barrel cactus and native bulb plants, around restored vernal pools on the Shinohara site, including controlling non-native weed species.

- Isolated Wetlands – Maintain and enhance native habitat around the Refuge's various impoundments, particularly in the San Miguel Mountain management area, to improve habitat quality for a range of wildlife, including the tricolored blackbird (*Agelaius tricolor*), which does not regularly breed on the Refuge.

- Coastal Sage Scrub Habitat – Improve habitat quality in coastal sage scrub habitat through a variety of efforts, including controlling non-native weed species and revegetating weeded areas with a combination of appropriate native shrub species, sensitive native geophytes, and herbaceous flowering plants. In addition, per available funding, restore coastal sage scrub habitat on sites where conditions indicate this habitat type occurred in the past. Working with other partners, support the region-wide effort to develop and implement methods to reduce the percent coverage of exotic invasive species in coastal sage scrub habitat, and continue to support MSCP preserve-wide monitoring of coastal sage scrub habitat quality.

- In coastal sage scrub habitat where cactus species are present, manage these areas to maintain healthy stands of cactus to support cactus wrens. Reduce the effects of fire on these habitat areas by removing non-native vegetation such as annual grasses and mustard. Control tree tobacco (*Nicotiana glauca*) and other shrubs to reduce "predator ladders" in cactus wren nesting habitat.

- Riparian Habitat –Within the Sweetwater River corridor where riparian habitat has been lost or degraded, restore or enhance the degraded areas to support a range native plant and wildlife species. In addition, identify portions of the riparian habitat within the McGinty Mountain and Sweetwater River management areas where habitat could be managed to mimic the natural disturbance regime observed in unaltered riparian corridors. These actions would be taken to support listed and sensitive species such as the least Bell's vireo, southwestern pond turtle, and arroyo toad.

- Native Grasslands – Reestablish native grassland habitat, including a suite of appropriate annual and perennial forbs, in areas with suitable clay soils such as on the Jamacha parcel and on the gentle lower western slopes of San Miguel Mountain.

- Cryptobiotic Crust – In addition to minimizing disturbance to high quality cryptobiotic crust throughout the Refuge, encourage research related to its restoration and seek funding to implement restoration in select areas of the Refuge.

- Tree Planting – Expand the Refuge's current oak planting project to other areas of the Refuge and include the planting of a variety of appropriate tree species, including coast live and Engelmann oak, California sycamore, and Southern California black walnut.

- Invasive Species Rapid Response Program – Develop a program to assist in the identification of new invasive plant species on the Refuge in an effort to ensure quick control of these new species before they become a significant problem. This program could involve a collaborative effort with other landowners to implement a regional invasive species strategic plan and/or a combination of research, interagency coordination, public outreach, citizen science, and rapid response in the form of mechanical and/or chemical control. Under the latter program, Refuge staff would keep apprised of those plant species that have been identified as having significant potential for invading Refuge habitats, such as perennial pepperweed and Wards weed (*Carrichtera annua*). Pictures of problem plant species could be posted on the Refuge webpage and/or at trail kiosks with information provided for how to contact and provide information to Refuge staff about an observation of one of these species on the Refuge. Potential partnerships with Calflora and the Southern California Weeds Observation Hotline could benefit this program. Researchers and monitors would also be encouraged to record the location of any problem species. Potential infestation sites would be investigated, and new invasive plants would be promptly controlled to avoid further distribution on the Refuge. As a start to such an invasive plant detection and treatment program, the Refuge is establishing a partnership with Friends of San Diego Wildlife Refuges and Earth Discovery Institute to develop a volunteer "weed team" to map and treat weeds, and evaluate treatment effectiveness in the Par Four Trail area.

- Nest Boxes – Install nest boxes in appropriate locations on the Otay-Sweetwater Unit to provide additional nesting opportunities for secondary cavity-nesting birds such as western screech owl (*Otus kennicottii*), American kestrel (*Falco sparverius*), and western bluebird.

- Invertebrates – Obtain needed data regarding the diversity and abundance of terrestrial invertebrates present on the Refuge, including both native species and invasive species by designing and implementing an inventory and sampling plan for terrestrial invertebrates present in chaparral vegetation on the Otay-Sweetwater Unit, when adequate funding is identified.

Within the Del Mar Mesa Vernal Pool Unit, proposed actions related to restoration and enhancement include restoration of habitats to support sensitive bird species; control of invasive, non-native plant species; enhancement of habitat to support native pollinators; and restoration and enhancement of cryptobiotic crust (refer to Table 3-3).

Another habitat restoration effort that would be implemented on both units of the Refuge, per available funding, is the restoration of old roads and pathways that are not needed for Refuge maintenance and are not part of the designated trail system to appropriate habitat by restoring the natural contours and establishing a mix of appropriate native species. The habitats to be restored will be determined based on such factors as adjacent native vegetation, soil type, slope aspect, and site hydrology.

3.3.5.3 Habitat and Wildlife Protection

Various management actions are and will continue to be implemented on the Refuge to minimize the potential for disturbance to plants and wildlife and to reduce adverse effects to habitat and water quality from erosion, illegal encampments, off-trail activities, and dumping. These management actions include the installation and maintenance of fencing and other forms of barriers, as well as signage. General site surveillance, and, when necessary, the issuance of citations by Federal Wildlife Officers are also employed in areas where impacts are substantial. Gates, fencing, and/or signage are also used to delineate those areas of the Refuge that are closed to public use. Control of illegal motorized vehicle activity on the Refuge involves the use of gates, other types of barriers, and/or signs, as well as interagency patrol of vulnerable areas. The Refuge also partners with adjacent land managers and owners to find mutually agreeable ways of preventing motorized access onto the Refuge through adjacent parcels. Abandoned mine shafts are closed to human access using wildlife-friendly gates that allow bats and smaller wildlife to continue to use the shafts as habitat. The San Diego NWR fire crew assists in minimizing adverse effects to Refuge resources through the control of wildland fires both on and off the Refuge.

Additional actions to be implemented to protect wildlife and habitat on the Refuge include:

- Implementing a designated trail system that minimizes the potential for impacts to sensitive habitat areas and avoids locations known to support listed species;
- Requiring that all dogs on the Refuge be leashed and kept on designated trails;
- Installing fencing and gates behind the commercial development at Jamacha Road and Willow Glen Drive to reduce disturbance to riparian habitat from homeless activity and other unauthorized access;
- Working with adjacent landowners to keep goats and cattle from entering Refuge lands;
- Impounding domestic animals, such as goats and cattle, that are found on Refuge land and disposing of them in accordance with 50 CFR 28.42, which addresses notification procedures, public sale of unclaimed animals, expenses to owners for capture, impoundment, advertising, care, forage, and potential damage claims, when redeeming an animal;
- Coordinating with other agencies to determine the status of wild turkey and feral pig populations in the vicinity and conducting periodic surveys of the Otay-Sweetwater Unit to identify signs of the presence of these species on the Refuge;
- Coordinating with other agencies to determine the status of wild turkey in the Refuge vicinity and conducting periodic surveys of the Otay-Sweetwater Unit to identify signs of the presence of this species on the Refuge;
- If necessary, implementing action necessary to control of wild turkeys on the Refuge;
- Implementing a program to control non-native predators, including dogs and cats, when site monitoring indicates that such action is necessary to protect ground and shrub nesting birds, lizards, and other sensitive species from excessive predation;
- Installing signs and/or fencing around intact areas of cryptobiotic crust to minimize the potential for damage due to trampling;
- Completing the mapping of vegetation types on recently-acquired lands on the Otay-Sweetwater Unit and documenting the current status of non-native and pest plant species on these parcels;
- Reducing the potential effects of wildland fire on highly sensitive habitat areas, such as large concentrations of mature cactus and areas known to support host plants for the Quino checkerspot butterfly, by focusing invasive plant species control in these areas, as well as providing fuel breaks and thinning existing vegetation in strategic locations; and,
- Expanding invasive plant control to include mechanical and chemical control of invasive plants along trails, roads, and within other disturbed areas.

The control of non-native predators such as dogs and cats will be implemented on a case-by-case basis per available funding. The following guidelines will be followed in controlling non-native predators:

- Trapping of non-native predators will be limited to strategic locations where determined feasible to protect ground and shrub-nesting birds, lizards, and other sensitive species from excessive predation;
- Actions to control non-native predators will be implemented on a temporary, short-term basis and will only be implemented when potential for take or harm to listed or sensitive species has been identified;
- All control methods will be humane, providing adequate shade and water for any trapped animal;
- Traps set out overnight will be checked within two hours of sunrise, and traps left out during daylight hours will be monitored regularly and checked a minimum of four times per day;
- Prior to implementing trapping in a particular area, signs at trail access points will be posted to notify adjacent residents of the proposed activity and to provide information on where trapped animals can be retrieved;
- Domestic animals inadvertently trapped will be taken to an approved shelter facility operated by a cooperating local unit of government, humane society, or veterinary care facility;
- A public outreach campaign will be initiated to inform the public of the importance of controlling pets and the need for predator control on the Refuge to protect sensitive species; and
- In accordance with 50 CFR 28.43, dogs and cats running at large on the Refuge and observed by an authorized official in the act of killing, injuring, harassing, or molesting humans or wildlife may be disposed of in the interest of public safety and protection of wildlife.

Feral Pig Monitoring and Eradication

To avoid serious damage to Refuge resources from feral pigs, feral pig monitoring and, if necessary, the implementation of eradication efforts, will be implemented on the Refuge. The details of this program are provided in Appendix E (Feral Pig Monitoring and Eradication Plan). The Carlsbad Fish and Wildlife Office is already a participant in an inter-governmental group established by the Forest Service and BLM to address feral pig impacts, and the Refuge proposes to join this group. A number of State and local agencies are also participants in the Inter-Governmental Group on Feral Pig Impacts. This group has developed Principles of Understanding to work together to address feral pig impacts in San Diego County and to develop an "all-lands" approach to dealing with the feral pig population. A "Working Group" has also been established for key participants from multiple agencies in the area to come together to share knowledge and develop strategies for dealing with the feral pig population in the County across jurisdictional boundaries. In 2016, feral pigs were not present on the Refuge and county-wide efforts effectively reduced the County's overall feral pig population. The intent of these efforts is to eliminate the presence of feral pigs in San Diego County.

In accordance with the Feral Pig Monitoring and Eradication Plan, Refuge staff will monitor Refuge lands for evidence of feral pig activity; and if pigs are confirmed to be present on the Refuge, will have the pigs lethally removed from the Refuge by contracted sharpshooters, such as USDA Animal and Plant Health Inspection Service [APHIS], before they are able to establish a permanent population on Refuge lands.

Authority to control wildlife populations for management is governed by several sections of the Code of Federal Regulations. Title 50 CFR, Part 31, Section 14 states: (a) Animal species, which are surplus or detrimental to the management program of a wildlife area, may be taken in accordance with Federal and State laws and regulations by Federal or State personnel or by permit issued to private individuals, and (b) Animal species, which damage or destroy federal property within a wildlife refuge area, may be taken or destroyed by Federal personnel. Title 50 CFR, Part 30, Section 11(a) states that feral animals, including horses, burros, cattle, swine, sheep, goats, reindeer, dogs, and cats, without ownership that have reverted to the wild from a domestic state may be taken by authorized Federal or State personnel or by private persons operating under permit in accordance with applicable provisions of Federal or State law or regulation.

To avoid or minimize impacts to Refuge resources from feral pigs, the implementation of the Feral Pig Monitoring and Eradication Plan includes the following steps:

- Keep apprised of current trends in feral pigs dispersal and colonization within the region;
- Establish agreements for controlling feral pigs on the Refuge well in advance of determining that their presence on the Refuge is imminent;
- Periodically inspect Refuge lands for evidence of feral pig activity, adjusting the frequency of these inspections based on current sighting information in the area and regional survey results;
- Should pigs be identified on Refuge lands, rapidly identify the location(s) and extent of infestation and document the extent of resource (e.g., biological, cultural, watershed) damage;
- Implement feral pig removal by employing the following methods: 1) removal by trapping, which is expected to result in the removal of the majority of the pigs; 2) professional (e.g., USDA APHIS) ground-based sharpshooters to pursue "trap-averse" animals after trapping efforts have been implemented; and 3) aerial dispatch (shooting), which would only be implemented in remote locations that are difficult to access on foot;
- When deemed necessary to enhance the effectiveness of control, construct short spans of temporary fencing to restrict or funnel movement of feral pig populations during trapping and hunting activities;
- Implement an adaptive management process to ensure project objectives are practical and attainable; and
- Implement short and long-term monitoring to evaluate project success.

The Refuge's Feral Pig Monitoring and Eradication Plan is consistent with the plan developed by the participants of the Inter-Governmental Group on Feral Pig Impacts, which has drawn upon a large body of experience from many successful feral pig elimination and control efforts across the United States (USDA Forest Service 2013). On the Refuge, the implementation of feral pig monitoring and eradication is intended to avoid or minimize damage caused by feral pigs to listed and sensitive species, as well as other biological, cultural, and watershed resources.

<u>Integrated Pest Management</u>

The Refuge will implement an integrated pest management approach to the eradication, control, and/or containment of a variety of plant, animal, and insect pests on the Refuge. The details of the IPM Plan are provided in Appendix D. Implementation of integrated pest management practices will be coordinated with adjacent landowners, as well as upstream and downstream landowners, to ensure effective control of invasive wetland plants and aquatic animal species. In addition, all required measures will be taken to ensure that herbicide use will not affect downstream water quality, particularly within the Sweetwater watershed.

In accordance with 517 DM 1 and 569 FW 1, the IPM approach would use control methods based upon effectiveness, cost, and minimal ecological disruption, which considers minimum potential effects to non-target species and the Refuge environment. Control of pest species is necessary when these pests are resulting in 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. Environmental harm may be a result of direct effects of pests on native species, including preying and feeding on them; causing or vectoring diseases; preventing them from reproducing or killing their young; outcompeting them for food, nutrients, light, water, nest sites, or other vital resources; or hybridizing with them so frequently that within a few generations, few if any truly native individuals remain. Environmental harm also can be the result of an indirect effect of pest species. For example, decreases in native pollinator diversity and abundance may result from invasive plant infestations that reduce the availability and/or abundance of native upland plants that support native pollinator species.

Environmental harm may also involve detrimental changes in ecological processes. For example, invasive non-native plant species can outcompete and ultimately replace native species of forbs and shrubs, 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; such as invasions by fire-promoting non-native grasses that alter entire plant communities, increasing fire frequency and intensity, which in turn increases firefighting costs and threats to adjacent development.

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 here and presented in detail in Appendix D.

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. To this end, cultural control, as discussed here, consists of awareness of the ways seeds are transported, disposal of non-native and pest plant debris, and public and staff education.

Physical control involves the removal; destruction; disruption of growth; interference with pest reproduction using treatments that can be accomplished by hand, hand tools (manual), or 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.

Classical biological control involves the deliberate introduction and management of natural enemies (e.g., parasites, predators, or pathogens) to reduce pest populations. The Service strongly supports the development of and the 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 the San Diego NWR.

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 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 (or multiple species) would be used unless considerations of persistence or other environmental and/or biotic hazards would preclude it. In accordance with 517 DM 1, pesticide usage would be further restricted because only pesticides registered with the U.S. Environmental Protection Agency (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.

Throughout the life of the CCP, pesticides proposed for use on the Refuge would 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, would be documented in "Chemical Profiles." The product would also require approval through the PUPS process, which is described in Appendix D.

When a proposal is submitted requesting approval for the use of any new products on the Refuge, chemical profiles will be prepared for those products; it is based on the information provided by those chemical profiles that a decision to approve or disapprove a product will be made. 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 would be approved for use on the Refuge. In all cases, best management practices would 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.

Chemical profiles, provided in Attachment B of Appendix D, have already been completed for those pesticides currently being used or being considered for use on the Refuge. These pesticides are presented in Table 3-4, along with information regarding the pests to be targeted and the areas in which they may be applied.

When addressing the use of herbicide, it is also important to consider the method of application to be used. The application method chosen depends upon:

- treatment objective (removal or reduction);
- accessibility, topography, and size of the treatment area;
  characteristics of the target species and the desired vegetation;
- location of sensitive areas and potential environmental impacts in the immediate vicinity; anticipated costs and equipment limitations; and
- meteorological and vegetative conditions of the treatment area at the time of treatment.

Table 3-4
Pesticides Used or Considered for Use on the San Diego NWR

Active Ingredient	Common Product Names	Selective/Non-Selective	General Mode of Action	Target Pests	Potential Treatment Areas
Glyphosate (formulated as a water-soluble liquid containing surfactant)	Prosecutor RoundUp Pro	Broad-spectrum, non-selective, systemic herbicide (post emergent)	Prevents the production of several essential amino acids essential to growth	Non-native, invasive weeds/grasses	Upland habitats where invasive grasses and forbs are affecting listed and sensitive plants
Glyphosate (formulated as a water-soluble liquid for mixing with water or nonionic surfactant)	Rodeo, Aquamaster	Non-selective aquatic herbicide (post-emergent)	Prevents the production of several essential amino acids essential to growth	Emerged, non-native aquatic weeds and shrubs in aquatic areas	Sweetwater River floodplain, around man-made ponds
Fluazifop-P-butyl	Fusilade DX Fusilade II	Selective, systemic herbicide that targets grasses (post-emergent)	Stops meristematic activity by inhibiting the synthesis of lipids, which are essential to the new cell production	Non-native annual and perennial grasses	Upland habitats where invasive grasses are affecting listed and sensitive plants
Oryzalin	Surflan AS	Selective, annual grasses, broadleaf weeds, woody shrubs and vines (pre-emergent surface-applied herbicide)	Inhibits the growth of germinating weed seeds	Non-native, invasive broadleaf weeds and grasses (control or suppression depending upon the species)	Upland burn areas and other areas impacted by invasive grasses and annual weeds
Clethodim	Envoy Plus	Selective cyclohexenone herbicide used to control annual and perennial grasses (post emergent)	Lipid inhibitor damages the integrity of cell membranes and inhibits new plant growth	Annual Fescue (Vulpia myuros)	Upland burn areas and other areas impacted by invasive grasses and annual weeds

Table 3-4
Pesticides Used or Considered for Use on the San Diego NWR

Active Ingredient	Common Product Names	Selective/Non-Selective	General Mode of Action	Target Pests	Potential Treatment Areas
Chlorsulfuron	Telar XP	Selective, systemic herbicide that targets broadleaf weeds and undesirable grasses (pre-emergent or early post-emergent)	Acetolactate synthesis inhibitor that stops cell division in plant roots and shoots, causing plants to stop growing	Non-native, invasive onion weed	Upland habitats where onion weed is affecting listed and sensitive plants
Triclopyr, butoxyethyl ester with surfactants	Garlon 4 Ultra	Selective, systemic herbicide that targets woody and herbaceous broadleaf plants (little or no impact to grasses)	Mimics the plant growth hormone auxin, causing uncontrolled and disorganized plant growth and ultimately plant death	Invasive, woody vegetation (salt cedar, eucalyptus, ailanthus); primarily for cut-stump or drill applications	Upland areas infested with non-native woody species
Triclopyr, butoxyethyl ester	Pathfinder II	Selective, systemic herbicide that targets woody and herbaceous broadleaf plants (little or no impact to grasses)	Mimics the plant growth hormone auxin, causing uncontrolled and disorganized plant growth and ultimately plant death	Invasive, woody vegetation (salt cedar, eucalyptus, fennel)	Upland and wetland areas infested with non-native woody species

Herbicides can be applied with manual application devices or from vehicles such as all-terrain vehicles with a boom sprayer attachment. Manual applications of herbicides are used only in small areas, in areas inaccessible by vehicle, and/or to minimize potential impacts to non-target plants. Herbicides may be applied to green leaves with a backpack applicator or spray bottle, wick or gloves (wiped on), or wand (sprayed on).

Herbicides can be applied to trees around the circumference of the trunk on the intact bark (basal bark), to cuts in the trunk or stem (frill, or "hack and squirt"), to cut stems and stumps (cut stump), injected into the inner bark, or to the soil before the target species' seeds germinate and emerge (Tu et al. 2001).

There are several 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, or root leakage. Herbicides considered for use on the Refuge are regarded as posing relatively low risk for use in natural areas because they are unlikely to contaminate groundwater if used properly and are of low toxicity to animals (Tu et al. 2001).

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 would be combined with other control methods and could use any of the application methods listed here, depending on the situation. All applications would be conducted in accordance with the specifications described in the chemical profile and/or PUPS approval and would adhere to any special BMPs listed in the chemical profile.

Due to differences in species tolerance and the variety of habitats present on the Refuge, it is necessary to use a range of herbicides on the Refuge. Specific products are selected based on their effectiveness at controlling a particular species in a particular environment. Only certain products are approved for use in wetland areas, therefore, although a product may be effective in controlling a particular weedy species, if that weed is in a wetland, another product must be considered. Additionally, weeds have the potential to develop a resistance to a particular herbicide over time, therefore requiring the need for multiple herbicide options. Rotating the use of herbicides with different biochemical pathways can help delay the development of herbicide resistance.

Compounds referred to as adjuvants are often added to an 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 (not chemically inert) compounds. Some adjuvants have the potential to be mobile and pollute water. The Material Safety Data Sheet (MSDS) 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 used.

The extent of invasive plants known to occur on the Refuge necessarily requires some prioritization with respect to control, but also with respect to monitoring. In 2012, management priorities for invasive, non-native plants were outlined in a strategic plan for San Diego County prepared for SANDAG by the Conservation Biology Institute (CBI), Dendra, Inc., and Cal IPC (CBI et al. 2012). This strategic plan for managing invasive plants prioritizes on-the-ground projects based on invasive plant impacts along with considerations for regional management goals, feasibility of successful implementation, and the needs of narrow endemic species covered by NCCP programs. A total of 29 species were identified as priorities for near-term management and monitoring in this regional strategic plan. The strategic plan's recommendations, along with data gathered on the Refuge as part of the implementation of a national strategy for management of invasive species in 2011, will be used to identify priority species in need of control, as well as to develop monitoring and inventory priorities for various areas on the Refuge.

In addition to invasive, non-native plant control, the IPM Plan for the San Diego NWR also addresses the control of non-native aquatic pests. A variety of non-native aquatic and semi-aquatic organisms present on the Refuge have the potential to impact future proposals to reintroduce listed species that historically occurred along portions of the Sweetwater River and Steele Canyon Creek. These non-native species include largemouth bass, green sunfish, carp, bullfrogs, African clawed frogs, red swamp crayfish, North American crayfish, and red-eared sliders.

Although a variety of control methods are described in the IPM Plan (Appendix D) for controlling non-native aquatic species, the most common method is trapping using nets, traps, and spears. In the case of non-native fish, frogs, and crayfish, once these organisms are trapped, they would be euthanized and disposed of in an appropriate manner. Non-native turtles that are trapped would, if deemed in good health, be placed with the San Diego Turtle and Tortoise Society or comparable organization that has an established adoption program that adopts turtles to people who have demonstrated a commitment to their long-term care. Regular monitoring on Refuge lands is essential to detecting new non-native species and preventing their spread.

Another important aspect of managing aquatic invasive species is education and public outreach. The hazards (e.g., serious illness, starvation, death by predation) to an unwanted pet and the impacts to the native wildlife of releasing a pet "back into the wild" could be described in a brochure or on an information bulletin at a trailhead kiosk. Explaining to the public that their pet does not naturally occur in the habitats found on the Refuge is particularly important because all of the exotic animals that currently or potentially present problems for Refuge wildlife have been introduced intentionally.

It is unlikely that adequate funding and staff would be available to control the numbers of exotic aquatic animal species on the Refuge; therefore, the IPM Plan proposes to rank target species by the extent of the species ecological impact, current distribution and abundance, trend in distribution and abundance (e.g., rapidly increasing numbers), and difficultly of management. Impacts that are considered in this ranking include the threat to endemic and listed species, the threat to ecosystems that support listed species (e.g., reduced aquatic productivity), the threat to previous habitat restoration projects (i.e., the continued success of previous projects), and the level of effort needed to eradicate or contain the invasive species. The species that rank highest should receive the highest management priority; however, new infestations of non-native, invasive species should take precedence, as early action provides the greatest opportunity to contain and, ideally, eradiate the new species.

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.

The invasive species control currently implemented on the Refuge employs both chemical and physical/mechanical control methods. Some control is implemented by Refuge staff, while other control may be performed by contractors. Herbicides, which are chemicals that kill or injure plants, are widely used for controlling weeds and are generally considered an effective eradication tool, particularly when the size of the invasive plant infestation and/or the characteristics of the invasive plant species cannot be controlled solely by physical or mechanical methods. Herbicides are generally classified by their mode of action. Some include growth regulators, amino acid inhibitors, grass meristem destroyers, cell membrane destroyers, root and shoot inhibitors, and amino acid derivatives, all of which interfere with plant metabolism in a variety of ways (Bussan and Dyer 1999). Herbicides can be categorized as selective or non-selective. Selective herbicides kill only a specific type of plant. Some herbicides used for noxious weed control are selective for broad-leaved plants, leaving grasses unaffected. Other herbicides, such as glyphosate, are non-selective, affecting much of the vegetation; therefore, care is required when using this product around desirable, non-target plants (Rees et al. 1996).

All herbicides used on the Refuge must be reviewed and approved as part of the Service's Pesticide Use Proposal System (PUPS). The PUPS identifies specific pesticides approved for use on each Refuge and includes details on target pests, products applied, application dates and rates, method of use, number of applications, site description, sensitive habitats, and best management practices (BMPs) to avoid impacts to sensitive resources. The herbicides currently used on the Refuge are presented in Table 3-4. This table also provides information regarding target pests and application methods. When controlling invasive plants using chemical methods, Refuge staff applies herbicides to target plants or cut stumps by using spray bottles, backpack sprayers, or a tank and hose mounted on a gator or other type of all-terrain vehicle (ATV).

A variety of mechanical methods are used to remove invasive plants including pulling or digging the invasive plants out by hand, using a nylon filament trimmer (weed "whacker") or chain saw, and uprooting the plant with a "weed wrench." As part of controlling invasive weedy species, some areas on the Refuge have been mechanically de-thatched and the dead herbaceous material removed to facilitate subsequent herbicide treatment.

3.3.5.4 General Site Management

General site management includes activities such as fence and sign maintenance around trails and trail parking areas; working with partners to remove homeless encampments; and working with volunteers to implement small habitat restoration projects. Refuge staff will also continue to work with the appropriate agencies and Service personnel to secure existing mine shafts discovered on the Refuge.

Refuge staff will also continue to cooperate with and support partner agencies, organizations, and/or contractors in the implementation of region-wide projects that not only benefit the overall goals of multiple species conservation, but also the long-term management of the plant and wildlife resources on the Refuge. One such project involved the creation of a fine-scale vegetation map for approximately 450,000 acres of conserved lands in western San Diego County, including conserved lands within the boundaries of the San Diego NWR. This project, which began in 2009, was conducted in accordance with CDFW and national standards for field data collection, vegetation and mapping classification, and mapping of vegetation. This updated vegetation mapping will assist the Refuge in the planning and implementation of various projects, including habitat monitoring and restoration or enhancement. The Refuge will also continue to provide logistical and permitting support for research projects that have the potential to benefit Refuge resources. Such projects include the San Diego Natural History Museum's Plant Atlas project and several research projects being conducted by graduate student researchers from local and out-of-state universities.

Refuge staff will also seek funding to conduct periodic monitoring of surface and groundwater quality on the Otay-Sweetwater Unit, as well as for periodic monitoring of groundwater levels within the riparian and oak woodland areas of the unit.

Managing Habitat and Species Conservation Banks on the Refuge

During the initial years of Refuge establishment, the formation of conservation or mitigation banks was one tool used to acquire lands for incorporation into the Refuge. Three areas of the Refuge were acquired in association with the establishment of conservation banks (i.e., Rancho San Diego, San Miguel, and Singing Hills); in all three cases, the Refuge was identified as the party responsible for management and monitoring of sensitive habitats and covered species on the bank properties. The agreements for establishing the banks also required the development of management plans for those areas incorporated into the banks. The Final CCP serves as the management plan for these conservation banks, and the Carlsbad Fish and Wildlife Office is responsible for maintaining the accounting records for each bank. The three banks included within the Refuge are depicted in Figure 3-7 and described here.

Rancho San Diego Mitigation Bank. This mitigation bank was established in 1996 to offset impacts to sensitive habitats and species from transportation and other government sponsored projects, as well as development projects by others, occurring in western San Diego County below the 2000-foot elevation. Under this agreement, the 1,832 acres of land included within the bank were acquired by the Service to be managed as part of the National Wildlife Refuge System. The owners of the bank include the San Diego Association of Governments (SANDAG), Caltrans, and the County of San Diego. Percentage of credit available to each owner is allocated as follows: SANDAG 53 percent, Caltrans 23 percent, and the County of San Diego 24 percent. The bank permits the use of existing vegetation communities as mitigation for habitat impacts and includes a wetland mitigation component that permits the creation of wetland habitat, provided the habitat to be impacted approximates the existing wetland communities on the Bank.

Under the authorizing agreement, the Service was given the responsibility for preparing a management plan for the lands within the bank that addresses species monitoring in accordance with the requirements of the MSCP, habitat restoration, fire management, control of invasive plant species, and provisions for compatible public use. No endowment was provided to assist in the management of the lands within this conservation bank. As of 2013, the majority of the credits available from this bank had been expended.

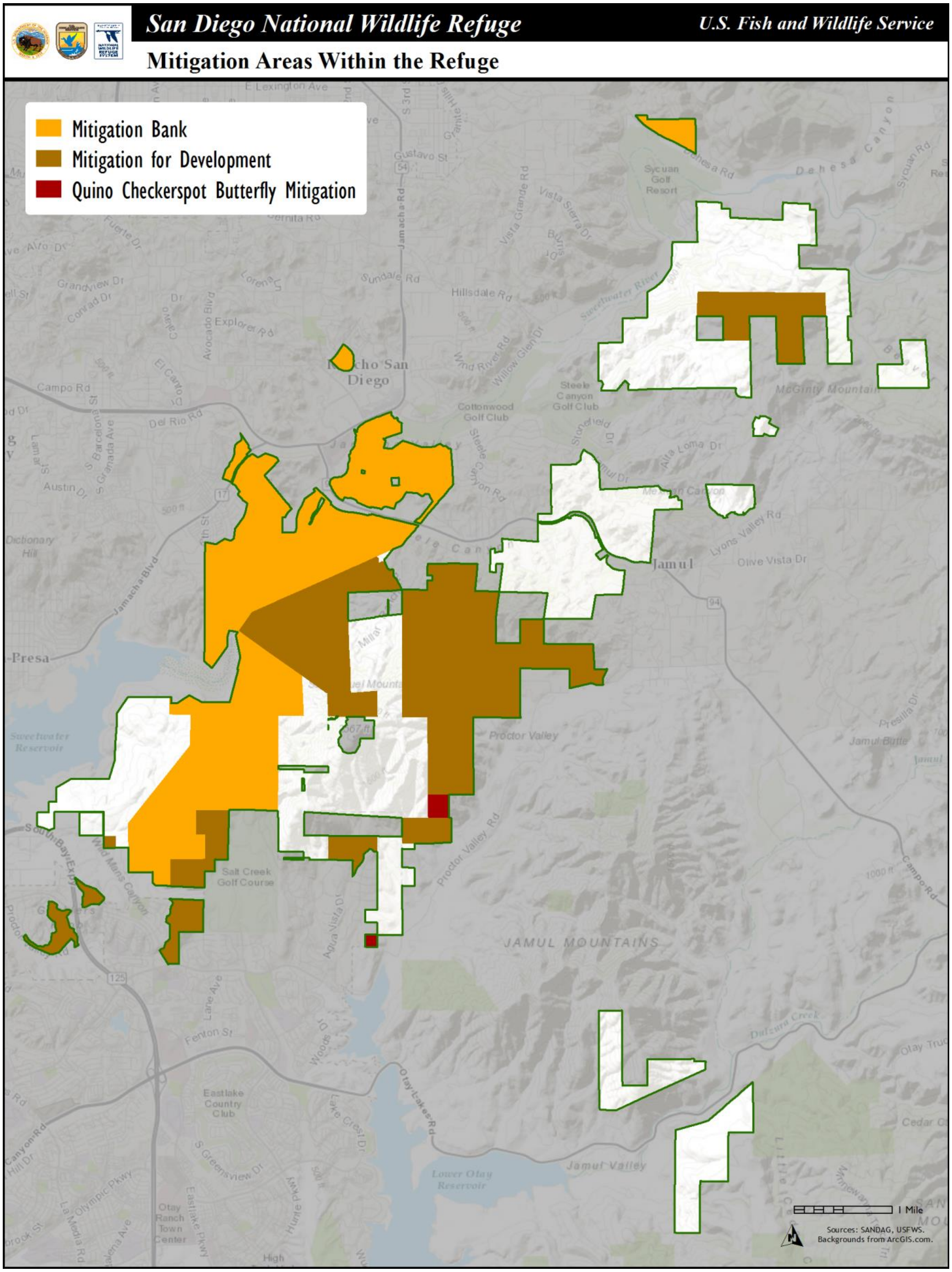

Figure 3-7. Lands Incorporated into the Refuge to Establish a Mitigation Bank or as Specific Mitigation for Development Impacts

San Miguel Conservation Bank. Established in 1997, the San Miguel Conservation Bank includes 1,186 acres on the western slopes of San Miguel and Mother Miguel Mountains. The lands within the bank support a variety of native plant communities, including "Very High Quality" (as defined by the MSCP) coastal sage scrub habitat, as well as lesser acreages of other habitats, such as chamise and mixed chaparral, perennial grasslands, and riparian scrub, all of which promote the multi-species values of the property. The desire to preserve these high habitat quality lands coupled with the landowner's need to mitigate for impacts to sensitive species on adjacent lands led to the formation of the conservation bank. The size of the bank was large enough to offset impacts associated with the development of the lands to the south of the bank and to provide additional credits that could be sold to third party purchasers in need of off-site mitigation.

The original conservation bank owner, Emerald Properties Corporation, sold the remaining credits in the bank to the San Diego County Water Authority in 2003. The Water Authority plans to use the remaining credits to mitigate for impacts to species covered by the San Diego County Water Authority Subregional Natural Community Conservation Plan/Habitat Conservation Plan (October 2010).

An endowment was established for San Miguel Conservation Bank that required an initial payment of $100,000 and $500 for each additional credit sold after the first 140 credits are sold. As of 2012, the endowment totaled $623,000.

Singing Hills Conservation Bank. Established in 1998, the Singing Hills Conservation Bank is located on a 79-acre property located on the north side of Dehesa Road, just to the east of the intersection of Dehesa Road and Willow Glen Drive. The County of San Diego is the owner of this bank, which included 69.7 credits when established. As of 2013, only 0.69 credits have been used. The primary intent of this conservation bank was to provide mitigation for County of San Diego Department of Public Works projects; however, the county does have the ability to permit the use of the existing credits for other projects. The credits serve as mitigation on a one-acre for one-acre credit basis for adverse impacts to like habitat within the western portion of San Diego County below the 2,000-foot elevation.

As with the other two banks, the Service, as the owner of the property, is responsible for managing and maintaining the property within the bank in perpetuity. Management requirements include the development of a habitat management plan and consideration of monitoring, habitat and species recovery, fire management, and appropriate public use activities. An endowment fund of $20,910 was created to assist with conservation and restoration of these lands.

In addition to these mitigation banks, various properties have been incorporated into the Refuge that were acquired as mitigation for impacts to species and/or sensitive habitats that occurred as a result of development (see Figure 3-7). In accordance with applicable agreements and/or court settlements, the sensitive biological resources on all of these properties must be protected in perpetuity.

3.3.5.5 Public Use

Of the various Federal land management agencies, the National Wildlife Refuge System is the only national network of public lands set aside for the conservation of fish, wildlife, and plants. As a result, unlike the Bureau of Land Management and U.S. Forest Service, which are administered for multiple use purposes, Refuge lands are managed first for wildlife. Only public uses that are compatible with Refuge purposes and the goals of the National Wildlife

Refuge System can be accommodated on a Refuge per the National Wildlife Refuge Improvement Act. Further, as described above, many of the lands included within the Refuge were acquired specifically as mitigation for impacts from development to sensitive biological resources. All of these factors have been taken into consideration and form the basis for the type and extent of public access to be permitted on the San Diego NWR.

Wildlife-dependent Recreational Use

Hunting. Following the completion of a hunt plan and processing of an opening package, hunting will be permitted on about 160 acres in the southeastern portion of the Otay Mesa and Lakes area; specifically, an area within the Refuge parcel located to the south of Otay Lakes Road (refer to Figure 3-6). Only the southern 160 acres of this parcel will be opened to hunting, because of the potential for the presence of endangered Quino checkerspot butterfly larvae and associated host plants within the northern portion of this parcel.

Hunting will generally occur in accordance with CDFW regulations for big game, resident small game, and resident and migratory upland game birds, although refuge-specific conditions may be applied for certain species. Specific details of the proposed hunting program for the Otay-Sweetwater Unit will be further defined in a step-down hunt plan, to be developed following the approval of the CCP. No public access would be permitted within the Otay Lakes and Mesa area outside of the designated hunt area, and only hunters with valid hunting licenses would be permitted within the designated hunt area.

The details of the step-down hunt plan will be addressed at a public meeting; and once drafted the hunt plan will be made available for public review and comment. The official opening of the Refuge to hunting requires that a notice be published in the Federal Register, which will be done as part of the Service's annual final rule on Refuge-Specific Hunting and Sport Fishing Regulations.

Currently, the southeastern parcel in the Otay Mesa and Lakes area cannot be accessed directly from Otay Lakes Road, because the parcel is separated from the street by intervening private and/or other public agency ownership. Refuge staff will work with adjacent landowners in an effort to improve access into the proposed hunting area. In the meantime, access into the Refuge hunting area will be provided through adjacent CDFW and BLM lands, where hunting is already permitted.

Fishing. Although the Refuge includes about 5.7 miles of the Sweetwater River, opportunities for fishing are limited both by minimal water depths along much of the River and the lack of the presence of native fish populations within the watershed. There are some deeper pools located along the river course that support non-native fish; but these locations also support habitat for the endangered least Bell's vireo, a species sensitive to human disturbance. Further, the CCP proposes to eradicate non-native fish from the Refuge to support the reestablishment of populations of southwestern pond turtle and the federally endangered arroyo toad along suitable segments of the Sweetwater River.

The general guidelines for wildlife-dependent recreation, as presented in 605 FW 1.6 of the Service Manual, provide a range of criteria to be considered when opening a refuge to a particular recreational experience. Some of these criteria include consideration of applicable laws and regulations, minimizing conflicts with fish and wildlife population and habitat goals, promoting accessibility and availability to a broad spectrum of the American people, promoting resource stewardship and conservation, providing reliable and reasonable opportunities to experience wildlife, and using visitor satisfaction to help define and evaluate programs. We develop and evaluate quality wildlife-dependent recreation programs based on these criteria, which necessarily involves considering the existing and projected future conditions on a refuge. Such conditions include the lack of native fish within the watershed and the projected future lack of non-native fish in accordance with the Integrated Pest Management Plan that accompanies the CCP.

The guidance also addresses the need to consider applicable laws and regulation, including the ESA, and minimizing conflicts with fish and wildlife population and habitat goals. The portion of the Sweetwater River that extends through the Refuge is designated as critical habitat for the least Bell's vireo and southwestern willow flycatcher, and allowing public uses along the banks of the river could result in disturbance to nesting vireos.

The opportunities to harvest fish from the Sweetwater River at present are low and will be essentially nonexistent in the future. Based primarily on the limited fishing opportunities available along the Sweetwater River, but also considering the potential for increased disturbance within habitat designated as critical for the recovery of the least Bell's vireo and southwestern willow flycatcher, we have determined that the Refuge would remain closed to fishing. There are however opportunities for fishing in the immediate vicinity of the Refuge, including at Sweetwater Reservoir and Lower Otay Reservoir.

<u>Wildlife Observation and Photography</u>. Opportunities for wildlife observation and photography will be available from numerous points along the designated trail system on both units of the Refuge. Within the San Miguel Mountain area, there is an opportunity to install a photo blind adjacent to the trail near one of the old cattle ponds on the site.

<u>Interpretation</u>. Interpretive programs will continue to be implemented on the Otay-Sweetwater Unit and we will work with partners to implement interpretive programs on the Del Mar Mesa Vernal Pool Unit, all in an effort to increase the public's understanding of the Refuge's contribution to the conservation of the sensitive resources that occur in southwestern San Diego County. Interpretive signs describing the endangered and threatened plants and animals occurring in and around the Sweetwater River are provided along a segment of the Sweetwater River Trail near the old steel bridge, and additional interpretation of Refuge resources occurs as part of various Refuge events and during periodic "Hike with a Ranger" outings.


Can you hear the vireo? (E.S. Cryer)

Interpretation is an important management tool that has been shown to reduce inappropriate behavior in park and open space users; therefore, additional opportunities for interpreting the Refuge's resources are proposed. The following interpretive projects, many of which will focus on the need to protect Refuge natural and cultural resources, will be considered for implementation on the Otay-Sweetwater Unit, as funding sources are identified:

- Design and construct a two-paneled kiosk for the Jamul Drive parking lot that interprets McGinty Mountain's rare gabbro soil-dependent southern mixed chaparral habitat with its associated endemic plant species, and also provides trail and regulatory information;

- Design and construct a two-panel visitor contact kiosk at the Barn at the Oaks that interprets the history of the barn and surrounding lands, as well as the native habitats supported in the area;
- Design and construct a two-panel visitor contact kiosk at the Par Four Drive trailhead to inform users that they are entering Refuge land and to introduce users to the listed species that occur in the area including San Diego ambrosia, Hermes copper butterfly, and California gnatcatcher;
- Design and construct a visitor contact kiosk with shade structure that can accommodate three to six interpretive/information panels to be installed near the convergence of the Sweetwater River and Steele Canyon Road to the south of Highway 94, with interpretive topics covering riparian, coastal sage scrub and chaparral ecology and the Refuge's role in conserving the rich diversity of native wildlife within western San Diego County;
- Develop a one- to two-mile interpretive trail near the old steel bridge (Sweetwater River area) that incorporates the existing interpretive elements already present in this area, and includes five additional interpretive elements to interpret the species and native habitats in the immediate area;
- Design, construct, and install interpretive elements for the Mother Miguel Mountain Trail that address the sensitive plants and wildlife that occur along the trail, as well as the need to stay on the designated trail;
- Design, construct, and install a two-panel visitor contact kiosk at the trailhead for the Sweetwater River Trail located in the County's Sweetwater Regional Park Summit site to introduce and interpret the habitats found on the Refuge to visitors embarking on hikes through the Refuge from this off-site public park and campground, and provide information about the existing partnership among Federal and State agencies and public utilities to manage and restore the habitats for threatened and endangered species; and;
- Develop as a component of the Refuge's interpretive program a geocaching program that uses EarthCache Sites or similar sites that do not use stored containers.

Interpretation on the Del Mar Mesa Vernal Pool Unit will be provided as part of the implementation of the City of San Diego's Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan. The City's plan does not provide any specific proposals; instead the plan recommends that interpretive signage be installed in proximity to particularly sensitive habitat areas, such as vernal pools, at trailheads, and at other opportune locations. The plan also recommends that one trail within the Del Mar Mesa Preserve be designated for interpretation, with signs to be placed at appropriate locations along the trail. An interpretive trail brochure is also recommended to provide more extensive interpretation of the area and the resources supported within the preserve. Finally, the plan recommends that a docent program be established to lead guided field trips, participate in presentations at the preserve, assist with public outreach, monitor trail conditions and use, and generally watch over the preserve.

<u>Environmental Education</u>. Environmental education activities, which are currently limited to occasional visits overseen by the San Diego Refuge Complex's education program and conducted in partnership with Earth Discovery Institute, would be expanded as staffing and funding permits to include the following:

- Increase the number of elementary school students who visit the Refuge and walk on the trails with teachers to fulfill a nature-based curriculum;

- Continue to partner with San Diego Audubon Society to identify and establish relationships with local elementary and high schools and consider incorporating their experiential OutdoorExplore! nature program and/or curriculum-based "Nearby Nature School Field Trips" program into existing Refuge-based nature programs;
- Expand or supplement the current educational programs to include Quino checkerspot butterfly recovery and/or vernal pool restoration and enhancement;
- Expand existing partnerships with nearby schools, as well as seek additional new partners, to create formal and informal environmental education programs that utilize the Refuge, including both the Otay-Sweetwater Unit and potentially the Del Mar Mesa Vernal Pool Unit, as outdoor classrooms;
- Assist participating schools in developing a "master teacher" program, which will reduce the administrative costs of the program; and
- Adopt a local school for the Del Mar Mesa Preserve and develop programs for that school that teach the students about the area's natural resources through presentations and walks, and possibly through hands-on experience in small habitat restoration projects, exotic species control, and habitat maintenance projects.

Refuge Trails

Designated Trail Plan. Public access onto the Refuge is provided via a designated trail system, as presented in Figure 3-8 and 3-9 for the Otay-Sweetwater Unit (see Figure 3-6 for the trail plan for the Del Mar Mesa Vernal Pool Unit). With one or two exceptions for short interpretive trails, all of the trails proposed on the Otay-Sweetwater Unit will be non-motorized multiple use trails, accommodating hikers, mountain bikers, and equestrians. Prior to the completion of the CCP, only two trails had been approved on the Otay-Sweetwater Unit through a formal planning and NEPA process, these included the Sweetwater River Regional Trail and Par 4 Trail. The remaining access routes consisted of private trails and old roads created by previous landowners; trails likely created by the Native Americans who lived within and/or traveled through the various properties that make up the Refuge; and trails and pathways created by users without regarding for ownership or land purposes.

The designated trail system has been designed to ensure compatibility with Refuge purposes and the mission of the National Wildlife Refuge System. It also takes into consideration of the specific purposes for which individual parcels have been included within the Refuge. Originally, a step-down trail plan was to be developed following completion of the CCP, however, as a result of considerable input from the public during the public review period for the draft CCP/EA, additional meetings were held with trail advocates to receive input on specific trail proposals and gather additional input on the desire for a more interconnected trail system. With this information in hand, Refuge staff hiked over much of the Refuge to evaluate site conditions. We examined the various routes indicated on the maps prepared by trail users at four trail user meetings conducted during the CCP public review process, as well as proposals for specific trail routes that were received in letters or emails during the public comment period.

Refuge staff walked these and essentially all of the trails, pathways, and old road cuts present on the Refuge. Some are very recent; some have obviously been used for a long time. Other access routes have not been used in many years. We considered these use patterns and site conditions during the process of determining how best to achieve a trail system that meets Refuge purposes and addresses the concerns raised by the public.

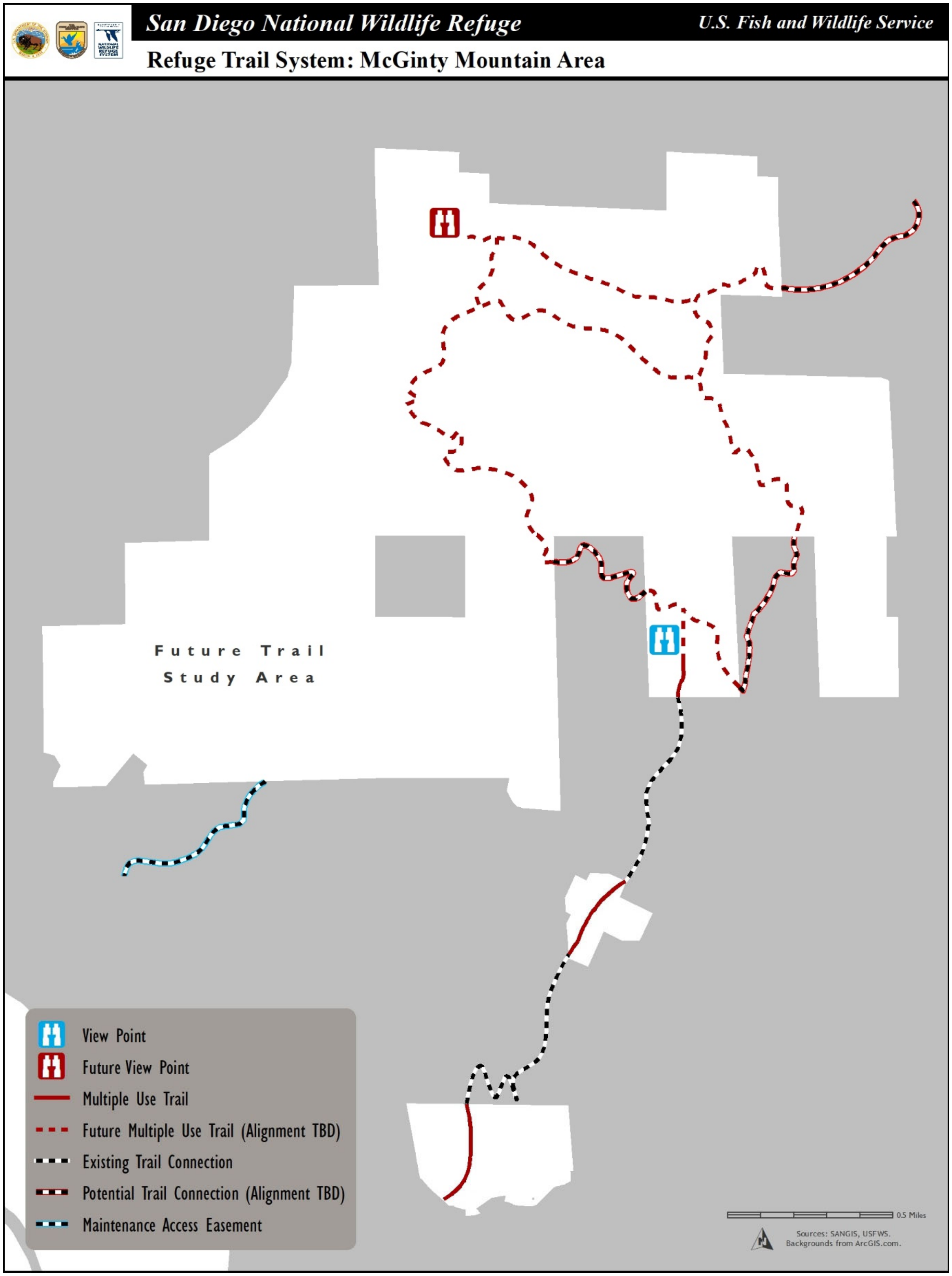

Figure 3-8. Refuge Trail Plan – McGinty Mountain Area

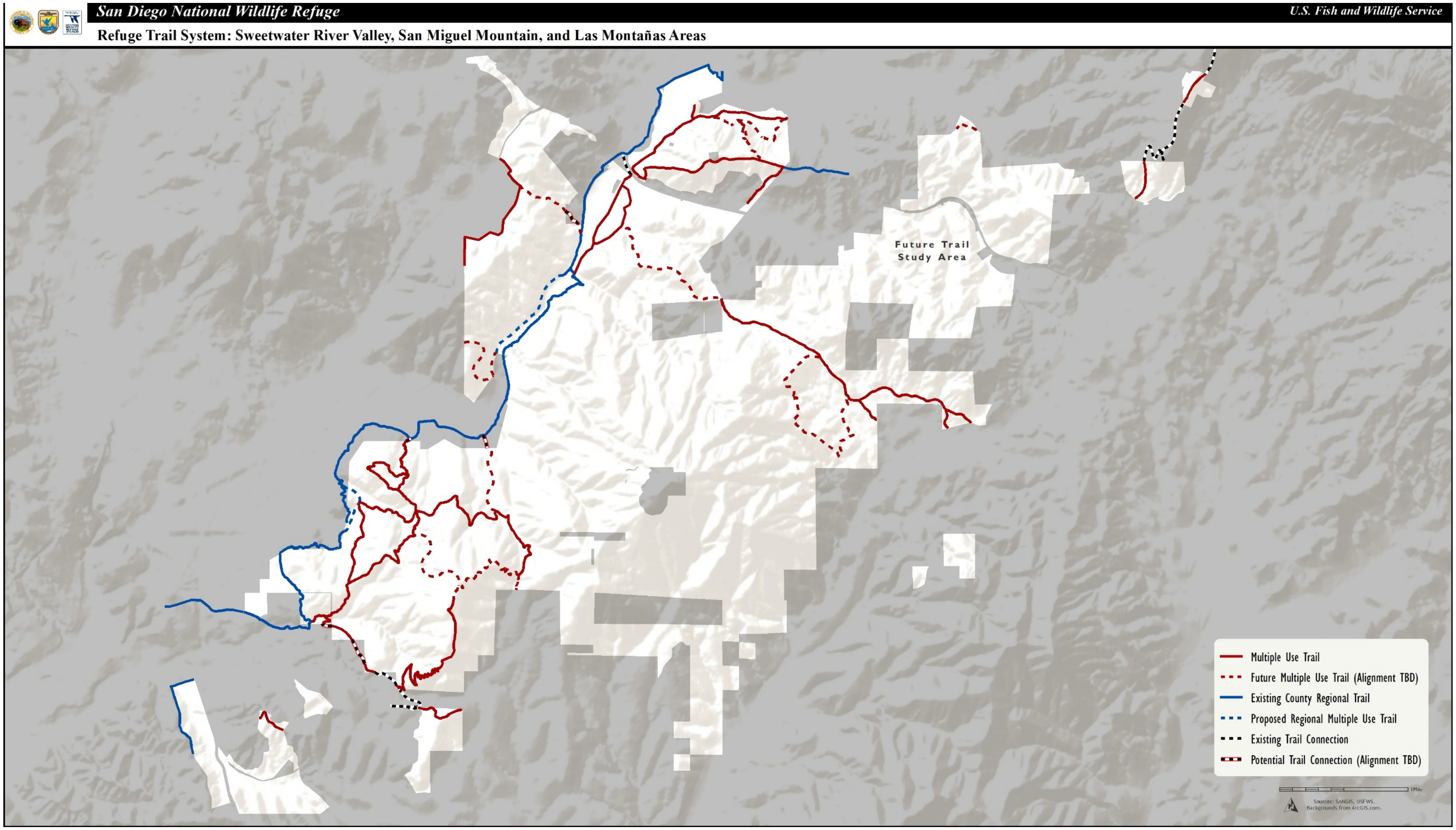

Figure 3-9. Refuge Trail Plan – Sweetwater River, San Miguel Mountain, and Las Montañas Areas

The final trail plan takes into consideration the results of on-site analysis, along with data related to listed and sensitive species occurrences and the locations of sensitive habitat types. We also considered issues related to legal access onto the Refuge and concerns expressed by adjacent property owners, land managers, and utilities. The final trail plan is intended to ensure the protection of listed and sensitive species and habitats, while also meeting the public's desire for an interconnected trail system within the Refuge and to the regional trail network where legal access is available.

The designated trail system also takes into consideration the County's trail plans for the area. Where ever possible we have provided the proposed alignment or a similar more appropriate alignment that considers biological resources and topography. There are however exceptions. Alignments are not included in the final trail plan if they impact listed or MSCP-covered species; alter the habitat quality of lands included within a mitigation bank or on land set aside as mitigation for impacts related to existing developments; and/or pass through or provide access to lands for which we have no legal access rights.

Examples include the portion of the Las Montañas area located north of Highway 94 (to protect habitat known to support the endangered Quino checkerspot butterfly), connections to properties located to the east and south of the southern Las Montañas area (to avoid directing trail users onto private property or private roads for which we have no access agreements); and the trail proposed to extend from the Sweetwater River east around San Miguel Mountain peak (to protect steep slopes and important golden eagle foraging areas).

During our site visits, conditions both on and off the various old roads, trails, and pathways within the Refuge were documented. Some of these routes follow the existing contours of the terrain and exhibit minimal erosion and relatively few off-trail impacts. We also observed many trails and old roads that travel down steep slopes instead of following the contours of the land. The result is deeply incised trail treads, pathways with serious cross-slope issues, and/or highly rutted trails with expanding footprints as users attempt to avoid disturbed sections. Use of these unsustainable trails has and will continue to result in excessive erosion, indirect impacts to sensitive vegetation from eroded soils, and direct loss of sensitive vegetation. We also observed evidence of recent vegetation removal to create bike jumps and user-created trails that extend through endangered plant habitat.

Those trails that are generally sustainable and provide opportunities for users to enjoy and appreciate the resources protected on the Refuge have been incorporated into the final trail plan. The final trail plan also includes proposals for rehabilitating some of the existing trails through improvements to the trail tread, incorporation of measures to effectively move water off the trail, and/or realignment of particularly bad sections. In addition, several new trail connections are proposed for construction with assistance from trail volunteers. To protect land and water quality, unsustainable access routes or routes that threaten habitat quality for listed and sensitive species will be closed.

Several new trails are proposed that will provide sustainable trail connections that do not currently exist. These include the construction of a sustainable trail between Hidden Valley and the Sweetwater River Trail, a trail that would provide access from Mother Miguel Mountain to the Sweetwater River Trail, and working in cooperation with the County, a trail connection from the Sweetwater River Trail to Jamacha Drive via The Pointe housing development. The specific alignments of these trails are yet to be determined and will require funding, staffing, and most importantly volunteer assistance. Working in partnership with the County and the Sweetwater Authority, a potential new route for the Sweetwater River Trail is under consideration that will avoid impacts to vernal pool habitat. The potential alignment would also replace a portion of the trail that is highly eroded.

We have also added to the final trail plan a trail to the top of Mother Miguel Mountain and are proceeding with the rehabilitation of the old switchback trail at that site. In the years following the development of the properties to the south, trail use in this area has increased exponentially and many users are taking a route that extends directly up the steep slopes. The result is loss of sensitive plants, severe erosion, and a disturbed path that in some places is more than 30 feet wide. Trail rehabilitation will occur in large part through the volunteer efforts of the San Diego Mountain Biking Association and Bonita Bikers.

Another consideration in the development of the final trail plan was the availability of legal access onto the Refuge and from the Refuge onto adjacent lands. Due to the Refuge's current ownership pattern, little of the Refuge abuts the public right-of-way. For instance, in the McGinty Mountain area, trail access onto the Refuge is available from a parking area located along the north side of Jamul Drive, approximately one-half mile west of Lyons Valley Road, but this access point is only possible because of existing easements that other landowners have provided along the route to enable the public to access this portion of the Refuge. There is currently no legal access onto McGinty Mountain from the southwest or west.

Although there is the potential for an access point onto the south Las Montañas area off Highway 94, it is unknown at this time if Caltrans would grant an encroachment permit for access from Highway 94 onto the property. At present, there are no other opportunities for legal access onto the site. Vista Sage Lane is a private road and no access is currently available through the properties to the south. Refuge staff will continue to explore access options in this area and once they have been resolved, additional trail planning for the area can proceed.

Discussions with adjacent land managers in the McGinty Mountain area have been initiated to identify one or more options for providing legal access into the area from the west and/or northeast. If legal access can be obtained, additional trail planning will be implemented on McGinty Mountain.

The final trail plan includes a trail connection that will allow access from the Par 4 area to Sweetwater Summit Park, from Sweetwater Summit Park up Mother Miguel Mountain and back down onto the Sweetwater River Trail, and ultimately from Sweetwater Summit or Par 4 to Proctor Valley. Loop trails will be provided on the lower western slopes of San Miguel Mountain and in the McGinty Mountain area. A future trail system is also proposed for the south Las Montañas area; however, until access can be provided to this area from the public right-of-way, the area will remain closed. We are also continuing to work with CDFW, the Sycuan Band of the Kumeyaay Nation, and the Kumeyaay-Diegueno Land Conservancy to identify a feasible access point onto McGinty Mountain from the east and/or the west.

Trail use in the Del Mar Mesa Vernal Pool Unit is proposed consistent with the City of San Diego's approved Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015).

Trail Staging Areas. At present, the only trail staging area located on Refuge property is a 17-space parking lot and trail staging area located off Jamul Drive approximately one-half mile west of Lyons Valley Road. A trail to the peak of McGinty Mountain can be accessed from this parking area.

Two additional staging areas are proposed on the Refuge including: a new staging area off Proctor Valley Road that will provide access to the Hidden Valley area and once a connector trail has been constructed, will provide access through Hidden Valley into the Sweetwater River area of the Refuge; and a staging area off Highway 94 to the west of Millar Ranch Road. Funding for the design and construction of the parking lot/staging area off Proctor Valley Road is not currently available. Design details will be developed in the future with input from adjacent landowners and the public, and compliance with NEPA will be required prior to construction.

The parking lot/staging area proposed for construction to the west of Millar Ranch Road and south of Highway 94 will be funded by the Federal Highway Administration's Federal Lands Access Program and the County of San Diego. The 2.4-acre parcel is to be donated to the Refuge by Caltrans and will provide access to the trails in the Sweetwater River area, and once a connector trail has been constructed, will provide access into the Hidden Valley area of the Refuge. Additional review in accordance with NEPA review will be conducted for these projects.

Preliminary construction drawings include improvements to Highway 94 for turning lanes and the development of a gravel parking lot. The project is anticipated to be completed in 2018. The parking lot will include a combination of standard parking spaces and several pull-through spaces to accommodate equestrian trailers and school buses.

Although no parking area has been established at Par Four Drive, a kiosk is maintained here on Refuge property that establishes an official entry point onto the Refuge from this public street. Access to this area is also available from Highway 94, via a trail that begins on County owned land; however, no parking is available and controlled access from the planned parking area on the south side of Highway 94 to this area is currently unavailable.

A potential solution for safely crossing Highway 94 is the construction of a fair weather undercrossing along the east side of the Sweetwater River below the Highway 94 bridge or the construction of an overcrossing or at-grade crossing in an appropriate location on the east side of the Sweetwater River near the Highway 94 bridge. This would permit trail users to safely access refuge trails on either side of Highway 94, as well as the northern and southern segments of the Sweetwater River Regional Trail. There is currently some trail use occurring under the bridge to gain access to the trails to the north, but there is no formal trail segment. As a result, impacts to vegetation and water quality are occurring within the Sweetwater River. This segment of the trail would not be located on the Refuge; therefore, it is likely the County of San Diego would have to take the lead on such a project. Construction of a trail connection in this area would require coordination with a variety of agencies, including but not limited to the County of San Diego, Caltrans, the Service, and CDFW.

Although a staging area is proposed for the southern portion of the Las Montañas Area, no funding is currently available and an appropriate location has not yet been identified. Access off Highway 94 would require approvals from Caltrans, and based on existing site distances, traffic volumes, and traffic speeds, safe access off the highway may be difficult to achieve. It may be necessary to explore access off Vista Sage Lane, although this roadway is not a County maintained road and would require agreements with the existing landowners.

Access and trail staging for the Del Mar Mesa Vernal Pool Unit is provided in accordance with the City of San Diego's Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015).

<u>Potential for Seasonal Closure of Specific Trail Segments</u>. Although the final trail plan has been designed to avoid important habitat for listed species, due to the number of listed species supported on the Refuge, it may be necessary to close one or more trail segments to protect listed species during nesting or other vulnerable stages of their life cycles. For instance, trails located within habitat known to support Quino checkerspot butterfly larvae could be subject to seasonal closure to protect the larvae while they are vulnerable to trampling. Additionally, if golden eagles are observed making preparation for or tending a nest, a disturbance avoidance area would be established around the nest site with a radius of approximately 4,000 feet (1,220 meters). If a trail is located within the disturbance avoidance area, the trail would be closed until the eagle chicks have fledged or the nest is no longer occupied. Seasonal closures would be posted on Refuge kiosks and the affected segment signed as temporarily closed to all trail use.

<u>Trail Wayfinding</u>. Another component of this designated trail system is the development and implementation of a trail wayfinding program. This program would include:

- Design, printing, and distribution of a Refuge trail map;
- Installation of kiosks at trailheads;
- Placement of trail maps at trailheads and directional/mileage signs at major trail intersections;
- Installation of regulatory signs to inform users to stay on the designated trail system and keep all dog's on a leash; and
- Installation of fencing or other barriers where necessary to better direct users down the appropriate pathway and away from sensitive resources.

<u>Trail Volunteers</u>. The existing volunteer trail patrol on the Refuge would be expanded to assist the Refuge staff in monitoring trail use and updating the staff on potential hazards, maintenance issues, and inappropriate trail activities. In addition, new partnerships would be developed and existing partnerships expanded to ensure that all of the trails proposed throughout the Refuge are maintained in a manner that minimizing impacts to resources and maximizes the trail user's experience.

<u>Trail Accessibility</u>. Several actions are proposed to improve trail accessibility for all users. These actions, which would be implemented per available funding, include:

- Retrofitting the approach ramps of the Sweetwater River Trail Bridge to comply with the Accessibility Guidelines for Outdoor Developed Areas;
- Ensuring that accessibility is maximized to the extent possible when creating new trails, implementing trail improvements, and rerouting a trail segment; and
- Repairing or realigning degraded segments of the Sweetwater River Trail.

Other Public Uses

Geocaching. In general, the placement of geocaches on national wildlife refuges is prohibited. This is due in part to Federal regulations that prohibit the abandonment of property (50 CFR 27.93) on any national wildlife refuge, but also because such activity can result in disturbance to or destruction of refuge resources. As a result, all caches found on the Refuge are removed. Other forms of geocaching, such as virtual geocaching, which do not involve the placement of a physical object on the Refuge or the need for off-trail activity, as well as the placement of caches by Refuge staff in association with wildlife-dependent recreational uses (e.g., environmental education, interpretation) may be permitted but must first be found appropriate and compatible with the purposes of Refuge establishment. Additionally, as described under Interpretation above, EarthCaches may be developed by Refuge staff as part of the Refuge's interpretive program.

Research. The Refuge supports a variety of research and resource survey work conducted in association with graduate work at various universities and/or implemented by other public (e.g., USGS, CDFW), private, and non-profit researchers (e.g., California Native Plant Society, Center for Natural Lands Management, San Diego Natural History Museum, Conservation Biology Institute). 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 may only be conducted after a Special Use Permit (SUP) has been issued by the Refuge Manager that documents the purpose(s) of the work to be conducted and includes specific conditions intended to protect trust resources and ensure adherence to applicable Refuge regulations and policies.

Potential future research projects on the Refuge include but are not limited to:

- studying the mechanisms of type conversion in coastal sage scrub habitat;
- developing appropriate methods for the successful reversal of type conversion;
- conducting studies related to the life history of the Quino checkerspot butterfly;
- identifying the factors that may be contributing to Quino population declines;
- using genetic data to determine patterns of demography and gene flow within and among populations of coastal California gnatcatcher; and
- developing a strategy to address productivity and survivorship for species populations determined to be declining.

Other potential cooperative research projects may include working with researchers at USGS to facilitate genetic, demographic, and movement studies of southwestern pond turtles; partnering with researchers to study eagle activity on the Refuge, information that will contribute to the conservation of eagles on a larger geographic scale; and encouraging research related to the restoration of cryptobiotic crust.

The Refuge will also continue to support research related to the control of invasive non-native grasses and annual forbs in an effort to identify controls methods that are both effective and avoid any adverse effects to native plant and animal species. Such research could include field studies to identify appropriate herbicides for controlling non-native grasses in areas supporting San Diego ambrosia and studies to evaluate the merits of using grazing as a tool for controlling invasive plants in some portions of the Refuge.

Research suggests that a well-regulated program of rotational grazing may have the potential to reduce cover of exotic annual grasses, thus reducing competition for native annual forbs, and improving habitat conditions for Quino checkerspot butterfly and other sensitive species found in grasslands, coastal sage scrub, and the grassland/coastal sage scrub ecotone (Weiss 1999, Hayes and Holl 2003, Vulliamy et al. 2006). Another study conducted by Kimball and Schiffman (2003) concluded that grazing harmed native species and promoted alien plant growth.

While grazing is not currently a habitat management tool used on the Refuge, an experimental grazing program that evaluates the beneficial and potentially harmful effects of grazing as a management tool may be warranted in areas of the Refuge where exotic annual grasses are problematic. If this research demonstrates that grazing is effective in controlling invasive grasses and improving habitat quality for sensitive species in coastal southern California, a carefully regulated and monitored grazing program could be implemented on portions of the Refuge in the future.

3.3.5.6 Refuge Operations

Staffing and Facilities

The staff positions at the San Diego NWR currently include a Refuge Manager, Refuge Operations Specialist, and Wildlife Biologist. The CCP suggests that the number of staff needed to support management of the San Diego NWR should be increased by five full time equivalent positions and two other positions shared with the Complex. These positions include, in order of priority:

1. Fish and Wildlife Biological Technician (GS 5/7/9);
2. Community Outreach (GS 11); this position would be shared within the Refuge Complex, with half of the time devoted to the San Diego NWR;
3. Fish and Wildlife Biologist (GS 11);
4. Park Ranger (GS 5/7/9);
5. Maintenance Worker (WG 8);
6. Environmental Education Specialist (GS 11); and
7. GIS Technician (GS 7/9/11); this position would be shared within the Refuge Complex, with a quarter of the time devoted to the San Diego NWR.

3.3.5.7 Refuge Facilities

Until funding is identified to move the Refuge office onto Refuge land, the Refuge office will continue to be collocated with CDFW on the Rancho Jamul Ecological Reserve. This facility, which is not easily accessible to the public, is located off Highway 94 approximately five miles driving distance from the nearest Refuge lands.

Assuming funding is identified, a Refuge office and permanent visitor contact station would be constructed on a portion of the 2.4 acres of the land currently owned by Caltrans, but proposed for transfer to the Service, located to the west of Millar Ranch Road and south of Highway 94. Site features would include an approximately 2,500-square-foot, permanent Refuge office and visitor contact station, as well as parking for Refuge staff and Refuge vehicles.

The construction of this facility would enable Refuge staff to have a permanent presence on the Refuge; provide Refuge visitors with the opportunity to interact with Refuge staff, ask questions, and learn more about the Refuge; and allow Refuge staff to monitor more closely public use activities occurring on the Refuge. Relocation of the Refuge office onto Refuge land would also reduce miles traveled to manage wildlife, habitat, and public use on the Refuge. The implementation of this proposal would be subject to NEPA compliance, and would be presented to the public for review and comment prior to project approval and implementation.

Other facilities proposed for construction on the Refuge, per available funding include:

- Construct a Native Plant Nursery – This facility, which would be constructed at the Refuge office at Rancho Jamul Ecological Reserve, would enable the Refuge to propagate native plants for use in Refuge restoration and enhancement projects. The facility would include a greenhouse, potting shed, outdoor growing areas, seed cleaning area, and seed, plant, tool and supply storage. To the maximum extent practicable, the nursery would utilize low energy use technology, such as solar panels, to minimize energy consumption. The siting and design of this facility would be coordinated with CDFW.

- Relocate an Existing Storage Building – The storage facility (Rice Barn) located on San Miguel Mountain would be relocated to a more convenient location on the Refuge.

- Construct Firefighter and Volunteer Staff Barracks – Temporary housing for seasonal firefighters and incidental and transient staff would be constructed at the Refuge headquarters site in Rancho Jamul. This facility would consist of a modular, four-bedroom, two-bath, "green" residence powered by photovoltaic panels.

3.3.5.8 Operational Access

A series of access routes are used to accommodate Refuge operations, maintenance, fire management, law enforcement, and other Refuge-related purposes. These access routes are gated and, depending upon where these access routes are located, are either posted as closed to all unauthorized motorized vehicles or closed to all public access.

To ensure the continued accessibility of these access routes, an assessment of the existing road network within the Otay-Sweetwater Unit is proposed. As part of this assessment, a road plan will be developed for maintaining those roads necessary to accommodate Refuge operations, fire management, law enforcement, Department of Homeland Security, and/or utility companies. It will also identify areas where new gates or other barricades are required to limit or prohibit access onto Refuge property; identify and post Refuge boundaries that are not adequately marked; and identify those roads and access points that are not needed to support Refuge or other authorized entities operations. Several existing dirt roads within the Otay-Sweetwater Unit have been identified as necessary to maintain for fire and maintenance vehicle access. These access routes, which include portions of existing access roads in the McGinty Mountain and Hidden Valley areas, have been rehabilitated. The access road to former San Miguel Ranch property is in need of rehabilitation. Funding will be sought to close, recontour, and restore to appropriate native habitat all existing roads and access points that are not considered necessary for management or public use activities.

3.3.5.9 Maintenance

The primary maintenance activities on the Refuge include maintaining gates, fencing, and boundary signs; removing illegally discarded materials ranging from trash to tires to large household items; working with the County Sheriff's Office to remove and clean up homeless campsites; maintaining the parking area off Jamul Drive; keeping kiosks, interpretive and informational signage, and the trail bridge at the Sweetwater River in good repair; and addressing serious trail tread issues as funding allows. The Refuge also assists in maintaining the lower portion of Millar Ranch Road and a portion of upper San Miguel Road.

In addition to current maintenance activities, the following additional activities are proposed per available funding:

- Repair Saddle Road Dam – The erosion and existing seepage problems on the outside of the dam face would be repaired. Repair work, which would affect an area of approximately 6,500 square feet, would require the removal of some native vegetation.

- Remove Water Tanks – Several water tanks are present on an old dairy site near Mother Miguel Mountain. These tanks, which were present on the land when it was acquired, have become traps for small wildlife and need to be removed. The project would involve removal of the tanks, footings, and piping.

- Remove Pumphouse, Well, and Tanker Trailer – This non-operational facility, located to the south of Jamacha Road, was present on the property at the time of donation to the Refuge. The required action will involve removing the pumphouse and tanker trailer and plugging the existing well.

- Demolish Sweetwater River Pumphouse Ruins – Due to public safety issues, the ruins of this old pumphouse are proposed for demolition following a cultural resource evaluation of the structure and the implementation of any required mitigation should the facility be deemed eligible for listing on the NRHP.

- Remove Internal Fencing and Rehabilitate Boundary Fencing in Hidden Valley – The Hidden Valley property acquired in 2012 requires the removal of hundreds of feet of internal t-post and wire fencing to benefit wildlife movement, as well as the repair of boundary fencing to minimize the potential for trespass onto sensitive Refuge lands.

The CCP also acknowledges the need to close known mine shafts, wells, and any previously unknown wells or mineshafts discovered on the Refuge. For example, after the wildfire in 2007, evidence of mining in the form of several scrapes and four openings were discovered in the vicinity of Mother Miguel Mountain. The openings are not protected, representing a safety hazard to the public and wildlife. In addition, the previous closure at Peg Leg Mine is in need of repair. Remedies proposed for open shafts include the installation of bat-compatible steel gates into horizontal openings and the insertion of polyurethane foam into vertical shafts and smaller openings to fill and seal these safety hazards. Three wells have been located on the Hidden Valley property and one well is known to be present in the Las Montañas area that require closing in a manner consistent with State guidelines.

3.3.5.10 Utility Easements

Refuge staff will continue to work with the various utilities that maintain utility easements and other facilities on the Refuge or on inholdings surrounded by Refuge land to ensure that these facilities and access to these facilities are not affected by Refuge actions, nor are Refuge resources and the safety of Refuge visitors affected on actions implemented in association with these utilities.

3.3.5.11 Fire Management

Fire management on the Refuge is implemented consistent with the direction and procedures outlined in the approved Fire Management Plan for the San Diego National Wildlife Refuge Complex. In accordance with the Complex's current Fire Management Plan (USFWS 2004a), the primary strategy for fire management on the San Diego NWR is full fire suppression. Successful fire management under this strategy involves hazardous fuels reduction, interagency fire response, and community fire preparedness.

To assist in the protection of Refuge lands and resources, the San Diego NWR Complex (NWRC) includes a Service-funded fire crew that operates as part of the Southern California Fire Management Zone. In addition to providing fire management services to the Refuges on the San Diego NWRC (i.e., Seal Beach NWR, San Diego Bay NWR, Tijuana Slough NWR, and San Diego NWR), the Zone also provides fire management services to the Blue Ridge, Bitter Creek, Guadalupe-Nipomo Dunes, Hopper Mountain, Coachella Valley, and Sonny Bono Salton Sea NWRs. The Zone also supports interagency fire suppression and fuels management efforts in southern California. Interagency partners include San Diego Rural Fire Protection District, California Department of Forestry and Fire Protection (Cal Fire), San Miguel Consolidated Fire Protection District, the Fire Safe Council of San Diego County, the San Diego Forest Area Safety Taskforce, and the Border Agency Fire Council.

The Southern California Fire Management Zone maintains two fire crews (Engines 56 and 58) consisting of one engine captain and two crew members at Fire Station 36 in Jamul; two additional firefighters for each engine are typically hired during fire season. The Service's fire staff is collocated with the San Diego Rural Fire Protection District at Fire Station 36, which is located at 14024 Peaceful Valley Ranch Road just off Highway 94 in Jamul. The crews assist in fire protection activities on and off the Refuge, including providing interagency fire response for wildfires in the San Diego community and throughout the Southern California Fire Management Zone, as well as participating in out-of-area wildland fire assignments.

Another component of the Service's wildland fire protection strategy has been the Wildland-Urban Interface Program. The wildland-urban interface (WUI) is defined as the line, area, or zone where structures and other human developments meet or intermingle with undeveloped wildland or vegetative fuels. Most Refuge lands in San Diego County are surrounded by developed areas that meet this definition. The Refuge fire staff work closely with neighboring communities to reduce future wildfire risks to homes, businesses, and critical infrastructure. This is accomplished primarily by reducing fuels in the wildland-urban interface and collaborating with local, State, and Federal partners.

Fuels reduction in the WUI has focused on high-risk communities and adjacent natural resources that are inherently important to social and/or economic stability. These projects increase public and firefighter safety, reduce risk of unwanted fire, protect recreational opportunities on Service lands, strengthen rural economies, and increase public understanding of fire management. Fuel reduction projects funded and implemented by the Refuge have included construction and maintenance of fuel breaks, invasive species removal, and a residential chipping program. In most cases, projects are accomplished through contracts with local businesses or cooperative agreements with local fire agencies.

Through the Fire Safe Council of San Diego County and several local fire safe councils, the Service emphasizes the importance of homeowner responsibility for maintaining property according to local fire safety standards. The Refuge also assists local communities with the development of Community Wildfire Protection Plans, which prioritize local fuel reduction treatments and address ways in which a community can work to reduce structural ignitibility and keep homes safe from wildfires.

As described earlier, the WUI Program has provided funding to support a partnership with San Diego Rural Fire Protection District in which local landowners have received assistance with chipping vegetation and removing debris piles around their homes and structures. This community chipper program has treated up to 2,000 acres annually around homes in the wildland-urban interface (USFWS website, http://www.fws.gov/ cno/fire/socal/, accessed on 6/13/11). Unfortunately, reduced fire program budgets in fiscal years 2012 and 2013 resulted in insufficient funds to support the community chipper program. Unfortunately, reduced fire program budgets in fiscal years 2012 and 2013 resulted in insufficient funds to support the community chipper program.

Through existing Federal, State, and local fire management partnerships in San Diego County, between 1,600 and 2,500 acres per year of San Diego NWR lands and adjacent public and private lands have been treated over the past few years to provide community protection, reduce hazardous fuels, and enhance native habitat. The activities implemented to accomplish these objectives have emphasized mechanical, chemical, and biological treatment. Mechanical treatment involves the physical removal of flammable materials such as invasive woody species growing in natural riparian zones, the thinning of native shrub vegetation in fire management zones, and chipping vegetation that has been removed from fire management zones.

Chemical treatment is used to control non-native invasive plants which when present in natural areas have the potential to increase fire frequency and intensity, as well as extend the traditional fire season (Zouhar et al. 2008). Biological treatment would include seeding recent burn areas with a site-appropriate native seed mix and/or actively planting native container stock in burn areas in an effort to reduce the potential for invasion by non-native weedy species. The Service's contribution to these efforts would continue to occur per available funding.

The actions described are implemented to reduce long-term fire suppression costs. Other actions taken by the Refuge in an attempt to reduce these costs include control of illegal motorized off-road vehicle activity, timely response to illegal dumping, and continuous surveillance for and rapid closure and cleanup of illegal encampments. All of these activities would continue per available funding.

Unfortunately, the potential for wildland fire increases when native vegetation is replaced with non-native woody and annual species. Excessively frequent wildland fire tends to shift vegetation communities from native shrub-dominated to non-native annual-dominated. With respect to the San Diego NWR, this is occurring in areas within and adjacent to the Refuge that are subject to repeated fires over relatively short time intervals. Approximately 4,200 acres of the Refuge's coastal sage scrub and chaparral habitats have burned in past fires, including the Harris Fire of 2007, the Millar Fire of 2007, and the Otay Fire of 2003. The Harris and Otay Fires also impacted significant areas of native vegetation outside the boundaries of the Refuge.

The disturbance to habitat and soil as a result of these fires has favored the proliferation of non-native weedy species in various locations and as such has altered the natural fire regimes in these areas. A major effort has been untaken on the Refuge to reduce the extent of non-native vegetation present, but additional work remains unfunded.

Even with the steps being taken by the Refuge to reduce the effects of wildland fire on sensitive resources (e.g., removal of highly flammable invasive weeds, active community involvement in the WUI program), factors such as climatic trends and residential and commercial development within the WUI continue to have a direct effect on fire suppression costs (Strategic Issues Panel on Fire Suppression Costs 2004). Costs associated with fire suppression activities on the Refuge, as well as rehabilitation costs following recent fires, have increased in recent years on the Refuge. This is particularly true of the costs associated with the Harris Fire of 2007, which burned almost 50 percent of the Otay-Sweetwater Unit, as well as significant areas of other Federal, State, and local agency-owned lands and private properties.

Refuge fire management plans are periodically updated to ensure consistency with current fire management practices, as well as to appropriately describe current conditions on the Refuges it addresses. As a result, fire management on the Refuge may change over time to be consistent with the most current Fire Management Plan for the Refuge Complex.

3.3.5.12 Law Enforcement

Law enforcement on the Refuge is the primary responsibility of the Service's Federal Wildlife Officers. Currently, the Refuge Complex has one supervisory Officer and two Refuge Officers assigned to the San Diego NWR Complex. A zone Federal Wildlife Officer who serves other southern California Refuges is also stationed at the Complex. These 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.

As necessary, Federal Wildlife Officers also work with other Federal law enforcement agencies that have overlapping jurisdiction within the Refuge, as well as with State, tribal, and local law enforcement agencies that have responsibility for law enforcement on lands adjacent to the San Diego NWR. Law enforcement activities would also include coordination with CDFW in the management of the hunt program on the Otay Mesa and Lakes area of the Refuge.

3.3.5.13 Land Acquisition

The Service will continue to work with willing sellers to acquire additional lands within the Refuge acquisition boundary per available funding. The focus of future acquisitions will be on acquiring parcels that support the creation or expansion of large contiguous blocks of undisturbed habitat within MSCP-designated core areas, as well as on parcels that if acquired would provide a functional link between habitat areas to improve connectivity between core areas, minimize problems associated with habitat fragmentation, provide pathways for genetic and demographic interchange, and accommodate species movement in response to wildland fire, climate change, and other stressors.

3.3.5.14 Cultural Resources

It is the policy of the NWRS to identify, protect, and manage cultural resources located on Service lands and affected by Service undertakings for the benefit of present and future generations and in accordance with applicable laws and regulations.

Cultural resources, including both archaeological and historic sites, are known to be present within the Refuge boundaries. Some of these 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 highly likely that additional sites occur on the Refuge that have not yet been detected and/or recorded. Because cultural resources are known to be present on the Refuge, any Refuge project that would result in subsurface ground disturbance or would affect 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 Historic Preservation Act.

The Cultural Resources Review process involves the preparation of a Request for Cultural Resources Compliance (Appendix J), which is submitted to the Regional Cultural Resources Office for review. The Cultural Resources Office will use the project location and project description, along with other available information about cultural resources in the area to determine the initial steps necessary to protect potential cultural resources. Most often, a site evaluation will be required, and in all cases involving ground-disturbing activities, tribal consultation in accordance with Section 106 of the National Historic Preservation Act will be required. Projects that would are not likely to affect subsurface materials could fall under the Service's programmatic agreement with the SHPO, while other projects could require SHPO review and concurrence. When there is a potential for disturbance to cultural resources, consultation with federally recognized tribes, interested parties, and the SHPO is required.

The CCP also proposes to seek the funding necessary to update record searches for the Refuge, conduct record searches for newly acquired parcels, and evaluate known cultural resources to determine if measures are required to ensure their protection. This could include rerouting a trail to avoid adverse effects to a site, capping a site to protect its integrity, and/or installing fencing or signage intended to keep the public out of sensitive areas while not drawing attention to the presence of any cultural resources.

The San Diego NWR Complex will continue to work with the Kumeyaay Cultural Repatriation Committee in the development of procedures, to be formalized through a Memorandum of Understanding, which would be implemented in the event of a NAGPRA-related discovery on the Refuge.

3.3.5.15 Environmental Contaminants Coordination

The Service's Contaminants 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 Contaminants Program at the Carlsbad Fish and Wildlife Office has assisted in addressing potential contaminants issues on the San Diego NWR on several occasions. The Refuge Manager will continue to consult with the Contaminants Program on potential contaminants issues.

3.3.5.16 Volunteers and Partners

The Refuge's volunteer program has grown over the years with the help of many partners, including the Conservation Biology Institute (CBI) that supported a Community Outreach Coordinator for south San Diego County with grant funding from the San Diego Foundation, The Nature Conservancy, and the Transnet Environmental Mitigation Program (Transnet). In 2013, the Earth Discovery Institute (EDI) stepped in to assist using funding from Transnet. EDI continues to assist the Refuge, along with partner agencies (e.g., CDFW, BLM) and others to involve the public in stewardship projects and interpretive events. In FY 2016, over 240 volunteers participated in stewardship projects, such as weeding endangered plant habitat and planting native plants, as well as trail maintenance. This work represented about 1,100 volunteer hours. Other partners, including the San Diego Mountain Biking Association and

Bonita Bikers, will provide over 2,000 volunteer hours implementing various trail projects on the Refuge during the initial years of CCP implementation.

The South County Land Managers group is a partnership forged by the Refuge with CDFW, BLM, CBI, TNC, and other State and local conservation landowners. The group meets quarterly to discuss management and monitoring actions, share successes, and coordinate on mutual challenges. The partnership has resulted in coordinated efforts to control illegal off-road activity in Proctor Valley, development of a matrix of sensitive species distribution and threats to those populations, and a study on behalf of the managers by CBI, funded by the Environmental Mitigation Program under Transnet, to understand methods to restore habitat to benefit Quino checkerspot butterfly, Otay tarplant, and burrowing owl.

The Refuge will continue to develop partners and work with volunteers to benefit Refuge management and resources. In addition, existing programs, such as volunteer trail maintenance crews and the volunteer trail patrol, will be expanded. Per available funding, a Community Outreach Coordinator for the Refuge Complex will be hired to assist the San Diego NWR in coordinating the training, support, and scheduling of these volunteers.

4 Refuge Resources

This chapter presents relevant information about the physical, biological, cultural, and socioeconomic environment within and surrounding the San Diego NWR.

4.1 Environmental Setting

4.1.1 Location and Property Description

The San Diego NWR, including the Otay-Sweetwater Unit and Del Mar Mesa Vernal Pool Unit, is located in southwestern San Diego County (refer to Figure 1-1). The largest unit within the Refuge boundary is the Otay-Sweetwater Unit, which as of May 2016 consisted of 11,810 acres of several noncontiguous blocks of undeveloped land (refer to Figure 1-3). For planning and environmental assessment purposes, we have grouped these blocks of land into five distinct management areas: McGinty Mountain, Las Montañas, Sweetwater River, San Miguel Mountain, and Otay Mesa and Lakes (refer to Figure 1-6). These management areas are characterized by a striking diversity of landforms associated with the southwestern terminus of the Peninsular Range. The Sweetwater River extends through northern and western portions of the Otay-Sweetwater Unit, while the eastern and southern boundaries of this Unit are border by the rolling foothills and incised canyons of Sycuan Peak, Jamul Mountains, and Otay Mountain.

The 60-acre Del Mar Mesa Vernal Pool Unit is located approximately 20 miles north of downtown San Diego and four miles east of the Pacific Ocean (refer to Figure 1-5). These parcels include areas of level mesa top and deeply eroded canyons with steep slopes.

4.1.2 Regional Context

The lands included within the San Diego NWR are identified as core biological resource areas in the MSCP Plan (City of San Diego 1998a) prepared for a 900-square-mile area in southwestern San Diego County. This regional habitat conservation planning effort is anticipated to result in the creation of a regional habitat preserve network that includes approximately 172,000 acres of conserved lands (City of San Diego 1998a) managed by a variety of agencies and non-governmental organizations. The large expanses of undeveloped land that have been preserved to date include much of the remaining intact coastal lowland southern California habitats that support significant populations of endangered, threatened, and sensitive plants and wildlife.

Conservation of the lands, major watercourses, and smaller drainages within the Refuge boundary is an essential component of the regional effort to protect the water quality in San Diego County's bays and estuaries. The Del Mar Mesa Vernal Pool Unit is located within the Peñasquitos Watershed, with water from this area draining into Los Peñasquitos Lagoon. The lands within the Otay-Sweetwater Unit are included within the Sweetwater River and Otay River watersheds, both of which are included within the greater San Diego Bay watershed.

4.2 Physical Environment

Elements of the physical environment include topography, visual quality, geology and soils, agricultural resources, mineral resources, paleontology, hydrology and water quality, climate and climate change, air quality, greenhouse gas emissions, and contaminants.

4.2.1 Topography and Visual Quality

The landforms that currently characterize southwestern San Diego County are the result of millions of years of geological processes ranging from erosion and sediment deposition to crustal uplifting and seismic and volcanic activity (Walawender no date). Two of the three distinctive geographic regions of San Diego County are represented within the Refuge: the low-lying coastal plain and the mountainous Peninsular Range (County of San Diego 2011). The flat mesa and steep canyon formations common along the coastal plain characterize the Del Mar Mesa Vernal Pool Unit, while the Otay-Sweetwater Unit is characterized by the broad floodplain created by the Sweetwater River and rolling to steep and often rocky foothills of the Peninsular Range.

Elevations on Del Mar Mesa range from about 320 feet above mean sea level (MSL) in the canyon bottoms to about 400 feet above MSL on the mesa. Within the more topographically diverse Otay-Sweetwater Unit, the elevations range from 300 feet above MSL along the Sweetwater River floodway to just over 2,300 feet above MSL near the top of San Miguel Mountain.

4.2.1.1 Site Topography

Topography of the McGinty Mountain Area

The McGinty Mountain area includes approximately 2,205 acres in the northern portion of the Otay-Sweetwater Unit. The major topographic feature within this area is, of course, McGinty Mountain, but there are other topographic features that help define this portion of the Refuge. The northernmost property included within the Refuge's McGinty Mountain area is located to the north of Dehesa Road and east of Willow Glen Drive, near a major bend in the Sweetwater River (Figure 4-1). This 74-acre parcel preserves a portion of the lower southwestern slopes of Dehesa Mountain. These generally steep, south-facing slopes, which support southern mixed chaparral vegetation, range from 1,100 feet above MSL at the northern property line to about 480 feet above MSL at the edge of Dehesa Road.

Just to the south, along the southern edge of the Sweetwater River floodplain, are the steep lower slopes of McGinty Mountain. McGinty Mountain, the most prominent feature in this area, is fairly steep with a major north-south trending ridge reaching a peak elevation of 2,183 feet above MSL. The McGinty Mountain area is generally bordered on the north and west by the Sweetwater River, on the east by Sloane Canyon and Beaver Hollow, and on the south by Jamacha Valley and residential development within the community of Jamul. Another prominent feature in this area is a nearly level mesa that occupies the northwestern portion of the mountain at about 1,100 feet above MSL. McGinty Mountain is transected by several north-south and northwest-southeast oriented seasonal drainages that ultimately flow into the Sweetwater River. The steepest slopes in this area tend to be located at the lower elevations of the mountain, about 800 to 900 feet above MSL, in an area adjacent to the Sweetwater River drainage. The slopes drop quickly to about 400 feet above MSL at the edge of the floodplain.

Following south, down the ridge from the peak of McGinty Mountain, is a small 19-acre parcel (the Peg Leg parcel) that includes the northern end of a narrow ridge with an elevation of about 1,500 feet above MSL. This ridge is flanked by relatively steep slopes to the east and west. To the south of the Peg Leg parcel is another Refuge parcel located adjacent to Jamul Drive. The drainages on this parcel ultimately merge downstream to form Mexican Canyon.

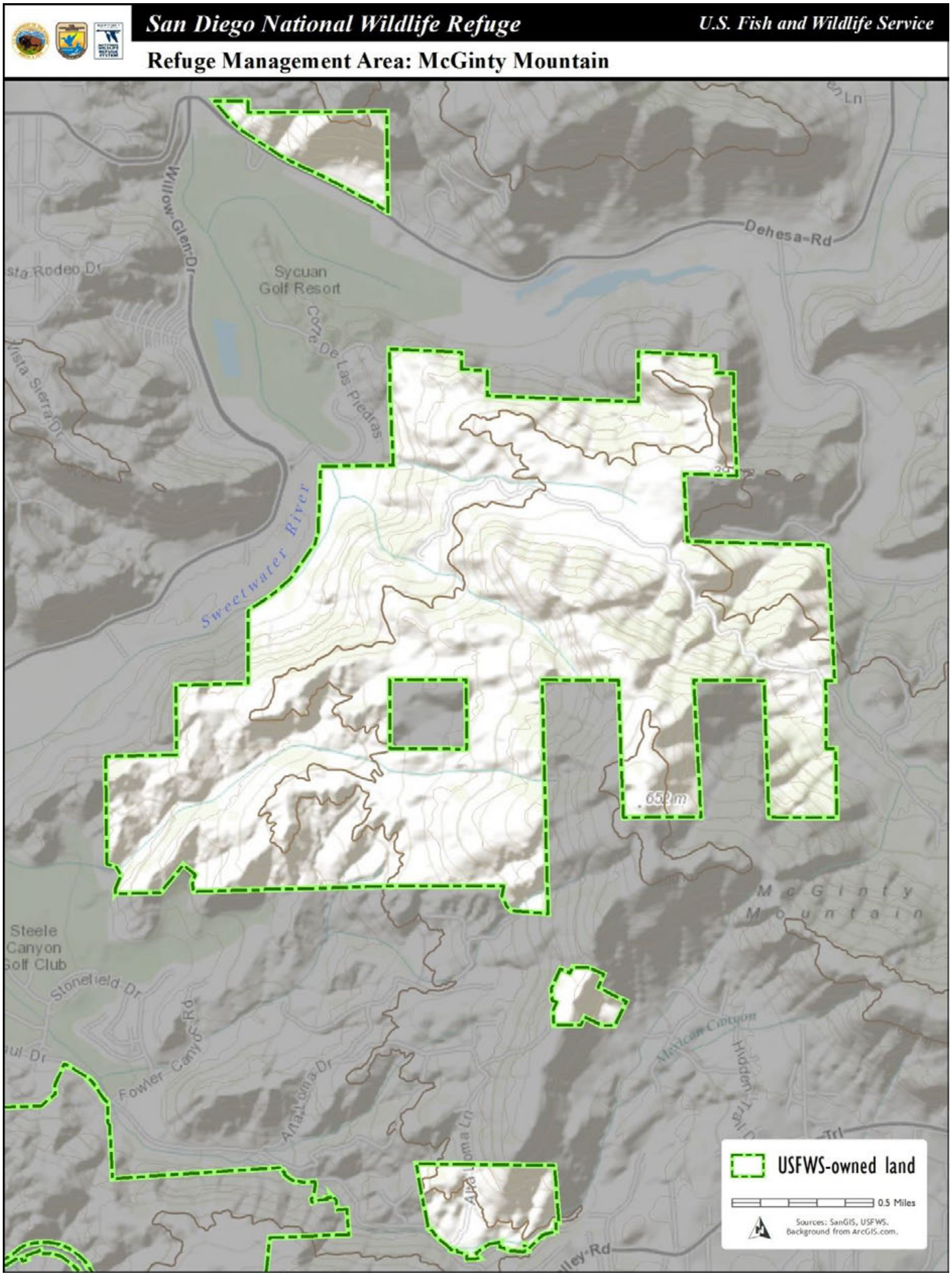

Figure 4-1. Topographic Character of the McGinty Mountain Area

Topography of the Las Montañas Area

To the south and separated from the McGinty Mountain area by Jamacha Valley and Mexican Canyon is the Las Montañas area. This part of the Refuge is bisected by Highway 94 (Figure 4-2). The northern portion of this 1,035-acre management area is characterized by predominately west-facing, steeply sloping terrain that extends down to Mexican Canyon. Elevations range from just over 1,200 feet above MSL in the east to about 700 feet above MSL in the west.

The terrain in the southern portion of Las Montañas consists of a series of rocky hillsides that extend down to a prominent drainage, Steele Canyon Creek, that flows along the south side of Highway 94. Another steep drainage that extends through this area begins at the south end of the property, flowing northwest through the parcel until it joins Steele Canyon Creek.

More than half of the Las Montañas area consists of slopes with gradients in excess of 25 percent. The area with the highest percentage of slopes exceeding a 50 percent slope gradient is located to the north of Highway 94 (Dudek & Associates 1996). Rock outcrops are common in the steeper portions of the site, and stands of coast live oak are present along some of the major drainages. Prior to acquisition by the Service, portions of the site to the south of Highway 94 were graded in accordance with county-approved plans for a golf course. Natural recruitment of native vegetation has occurred in many of these areas, but evidence of prior grading activity remains.

Topography of the Sweetwater River Area

Near the western terminus of Steele Canyon is the Sweetwater River area of the Otay-Sweetwater Unit (Figure 4-3). This portion of the Refuge encompasses about 1,955 acres and is located to the north and south of Highway 94 along the Sweetwater River drainage. The 475 acres located to the north of Highway 94 are characterized by an east to west trending ridge that extends to about the center of the property where it reaches a high point of 836 feet above MSL. The steep north, south, and west-facing slopes of the ridge are also included within the Refuge. To the north and west of these steep slopes, the Refuge includes portions of the Sweetwater River floodplain (an area often referred to as Jamacha Valley).

The Sweetwater River area located to the south of Highway 94 is characterized by steep sloping terrain that is bisected by the Sweetwater River. The slopes to the east of the river, the lower slopes of San Miguel Mountain, range from about 800 feet above MSL at the high point down to about 300 feet above MSL at the base of the slope. The terrain to the west of the river is characterized by a narrow ridge surrounded by steep slopes to the northwest and southeast. The elevations along the ridge vary from a high point of about 780 feet above MSL to about 600 feet above MSL in the eroded saddles between the high ridge tops. Elevations in the Sweetwater River drainage range from 300 feet above MSL at Highway 94 to about 280 feet above MSL at the upper end of the Sweetwater Reservoir.

Also in this area is a 28-acre parcel located to the northwest of Jamacha Boulevard and to the south of Highway 94. The parcel consists of east facing slopes that extend from about 600 feet above MSL down to about 500 feet above MSL at the edge of Jamacha Boulevard. Further to the north, in an area of the county referred to as Monte Vista Ranch, is an isolated 25.88-acre area of the Refuge (referred to as Lot 707) that consists of a knoll that, at its peak, measures approximately 600 feet above MSL.

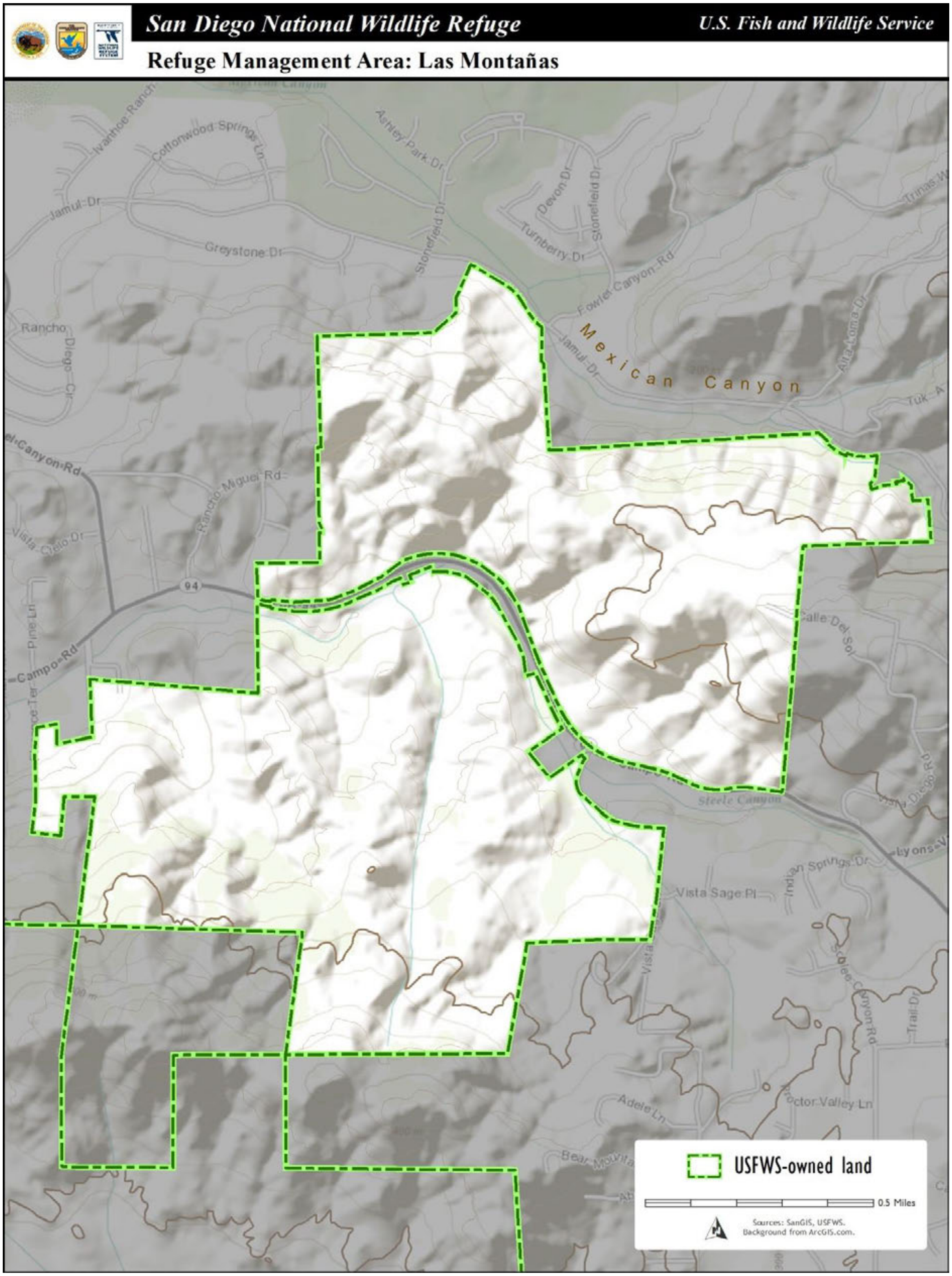

Figure 4-2. Topographic Character of the Las Montañas Area

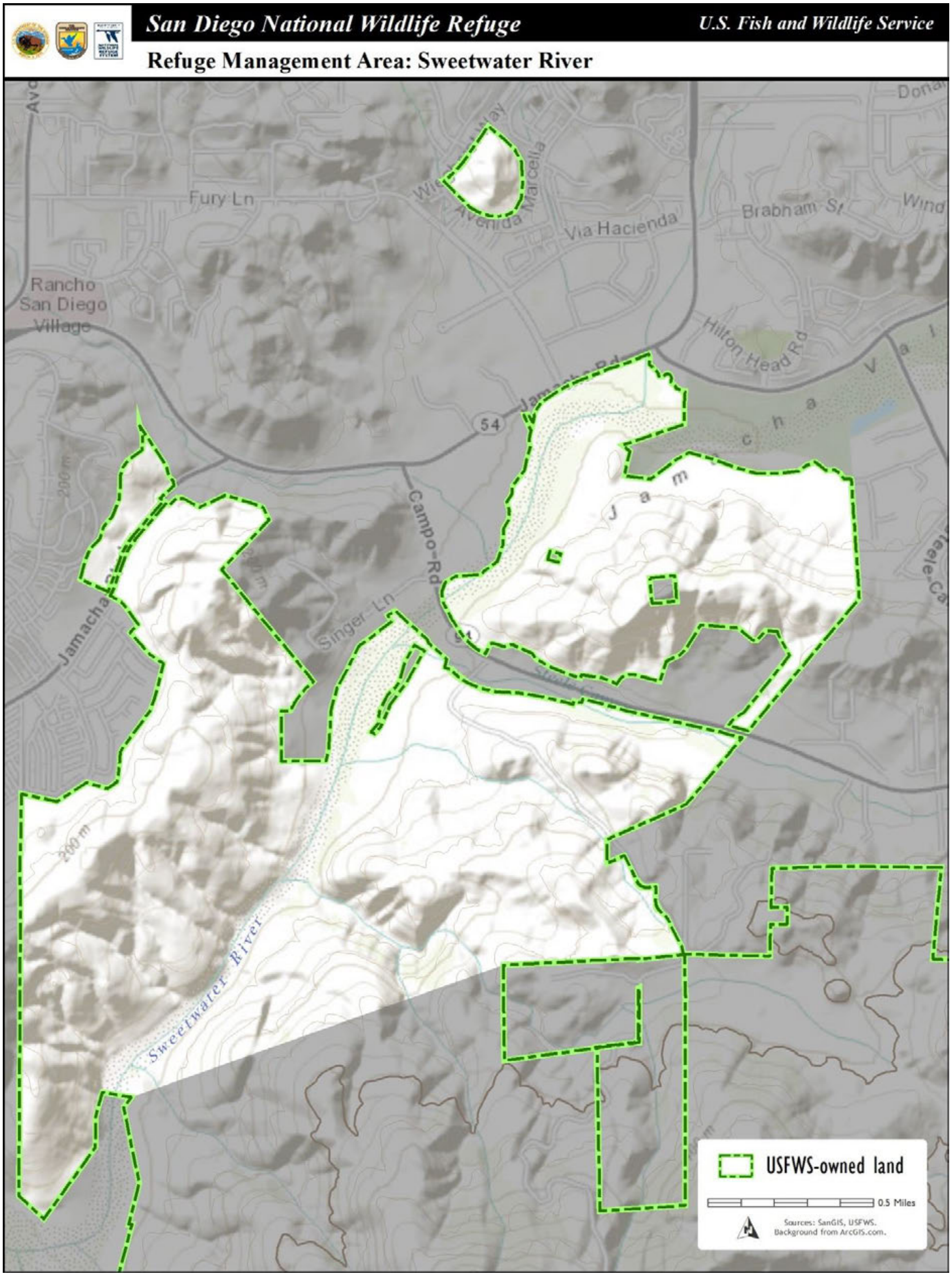

Figure 4-3. Topographic Character of the Sweetwater River Area

Topography of the San Miguel Mountain Area

To the south and east of the Sweetwater River area is the largest management area within the Otay-Sweetwater Unit—the San Miguel Mountain management area (Figure 4-4). This part of the Otay-Sweetwater Unit, which as of May 2016 included approximately 5,975-acre, is generally characterized by the steep, rugged slopes of both San Miguel and Mother Miguel Mountains, with some very gently sloping hillsides present along the area's western boundary, which is flanked by the Sweetwater Reservoir. Although a significant portion of the western slopes and portions of the north-, south-, and east-facing slopes of San Miguel Mountain are included within the Refuge, the peak of the mountain, situated at about 2,565 feet above MSL, has been retained in private ownership. The areas of the mountain within the Refuge range in elevation from about 2,400 feet above MSL down to 300 feet above MSL near the Sweetwater Reservoir. Mother Miguel Mountain is situated in the southeast corner of this area, with a peak elevation of approximately 1,527 feet above MSL.

Portions of San Miguel Mountain's southernmost slopes, which extend down into Proctor Valley, are also included within the Refuge. Here, the elevations range from about 920 feet above MSL to about 570 feet above MSL within the main drainage in Proctor Valley.

Approximately 1,900 acres of land including some very steep north- and east-facing slopes of San Miguel Mountain were added to the Refuge in 2012. This area is referred to as Hidden Valley because of the narrow valley that extends northwest out of Proctor Valley along the northeastern base of San Miguel Mountain. The highest elevation in this area measures about 2,300 feet above MSL near the peak of San Miguel Mountain, while the floor of Hidden Valley ranges from about 900 to 1,000 feet above MSL.

Topography of the Otay Mesa and Lakes Area

As of August 2016, the Otay Mesa and Lakes Area includes two non-contiguous blocks of Refuge land totally approximately 640 acres, including lands on the southern slopes of the Jamul Mountains, to the north of Dulzura Creek, and lands located to the south of Jamul Creek on the foothills of Otay Mountain (Figure 4-5). The Jamul Mountains parcel conserves the steep slopes that surround the southernmost extent of a north to south trending ridge. Elevations range from 1,900 feet above MSL in the north to about 700 feet above MSL at the southeastern and southwestern corners of the parcel. The area to the south of Dulzura Creek within the Otay Mountain foothills is characterized by steep hillsides in the western portion of the site and gentler slopes throughout the remainder of the site. Little Cedar Canyon extends through the northeastern corner of the site.

Additional parcels currently managed by Caltrans and located to the northeast of Brown Field are expected to be added to this area in the future (refer to Figure 1-4). These areas include about 200 acres in and around Johnson Canyon that consist of steep canyon slopes and mesa top with distinctive mimamound microtopography. The mesa averages about 500 feet above MSL, while the bottom of the canyon is about 300 feet above MSL. Another 162 acres, located on Otay Mesa, include relatively flat lands situated at about 510 feet above MSL.

Topography of the Del Mar Mesa Vernal Pool Unit

Within the Del Mar Mesa Vernal Pool Unit there are four noncontiguous parcels totaling about 60 acres (Figure 4-6). These parcels, located just south of Deer Canyon and north of Los Peñasquitos Canyon, are characterized by mesas, steep slopes, and major drainages. Covering portions of the mesa are undulating mimamounds (hummocks) and intervening depressions that support rare vernal pool habitat (City of San Diego 2011). Elevations range from 440 feet above MSL on the mesa to just under 300 feet above MSL within the major drainages.

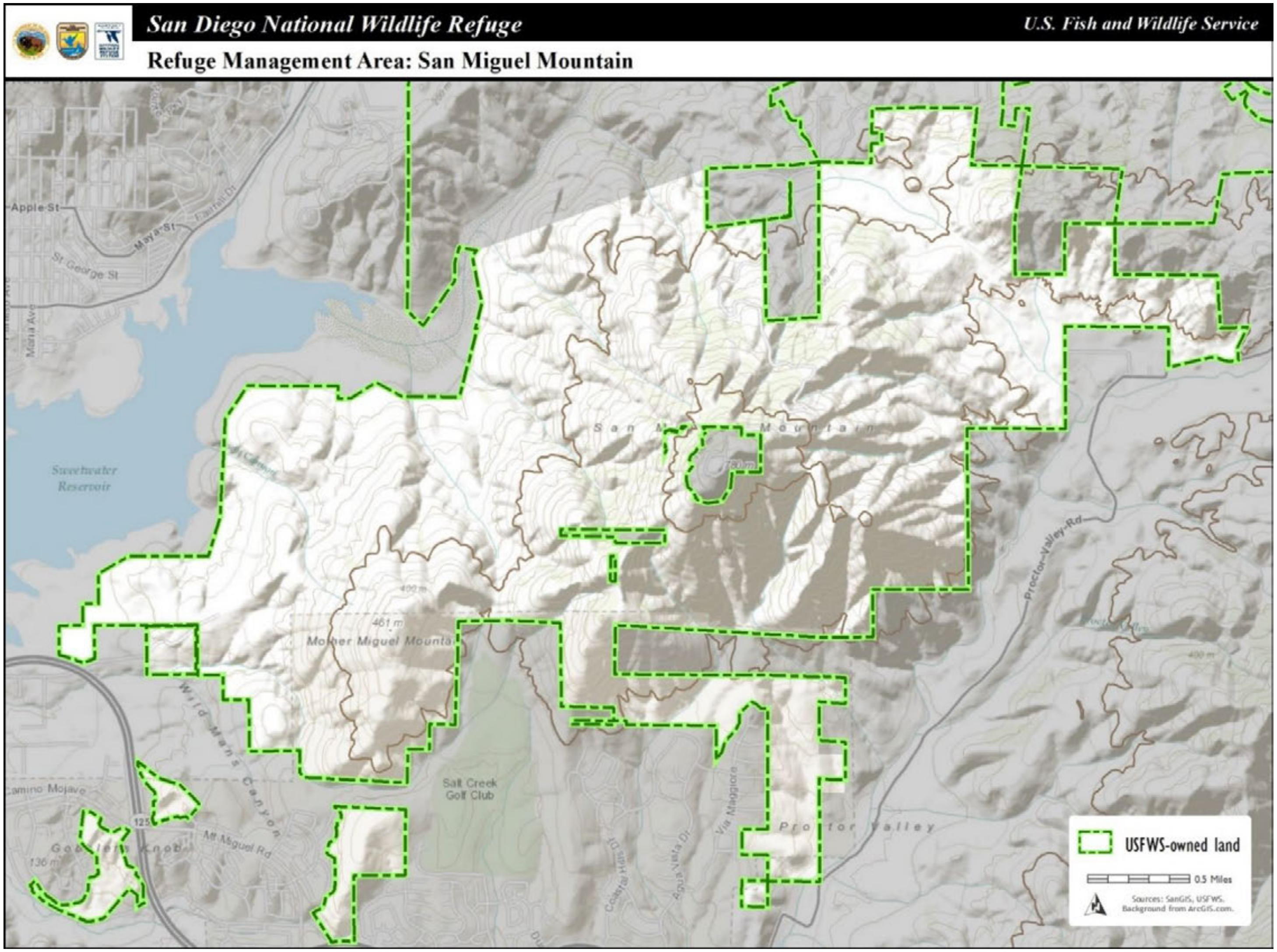

Figure 4-4. Topographic Character of the San Miguel Mountain Area

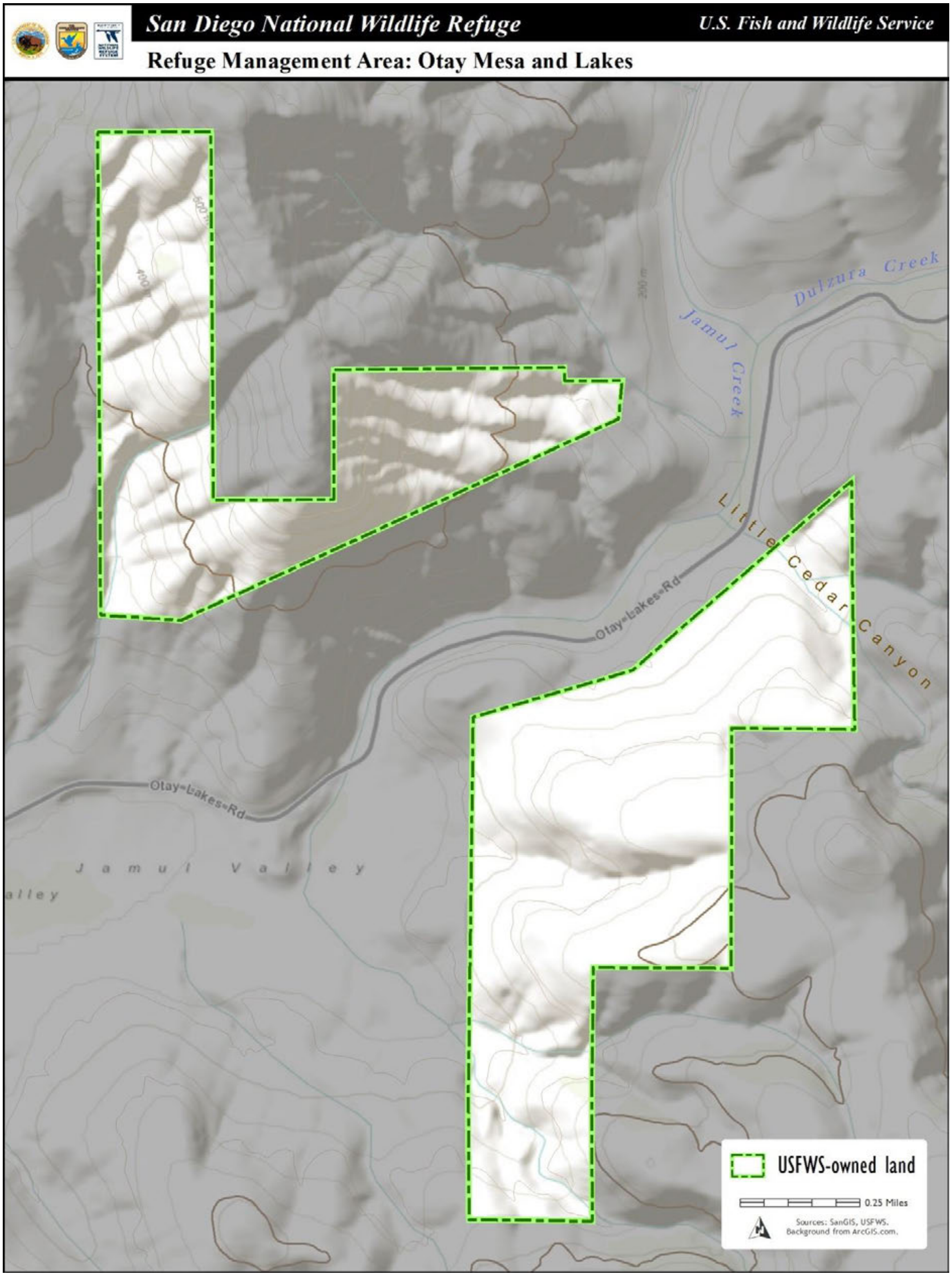

Figure 4-5. Topographic Character of the Otay Mesa and Lakes Area

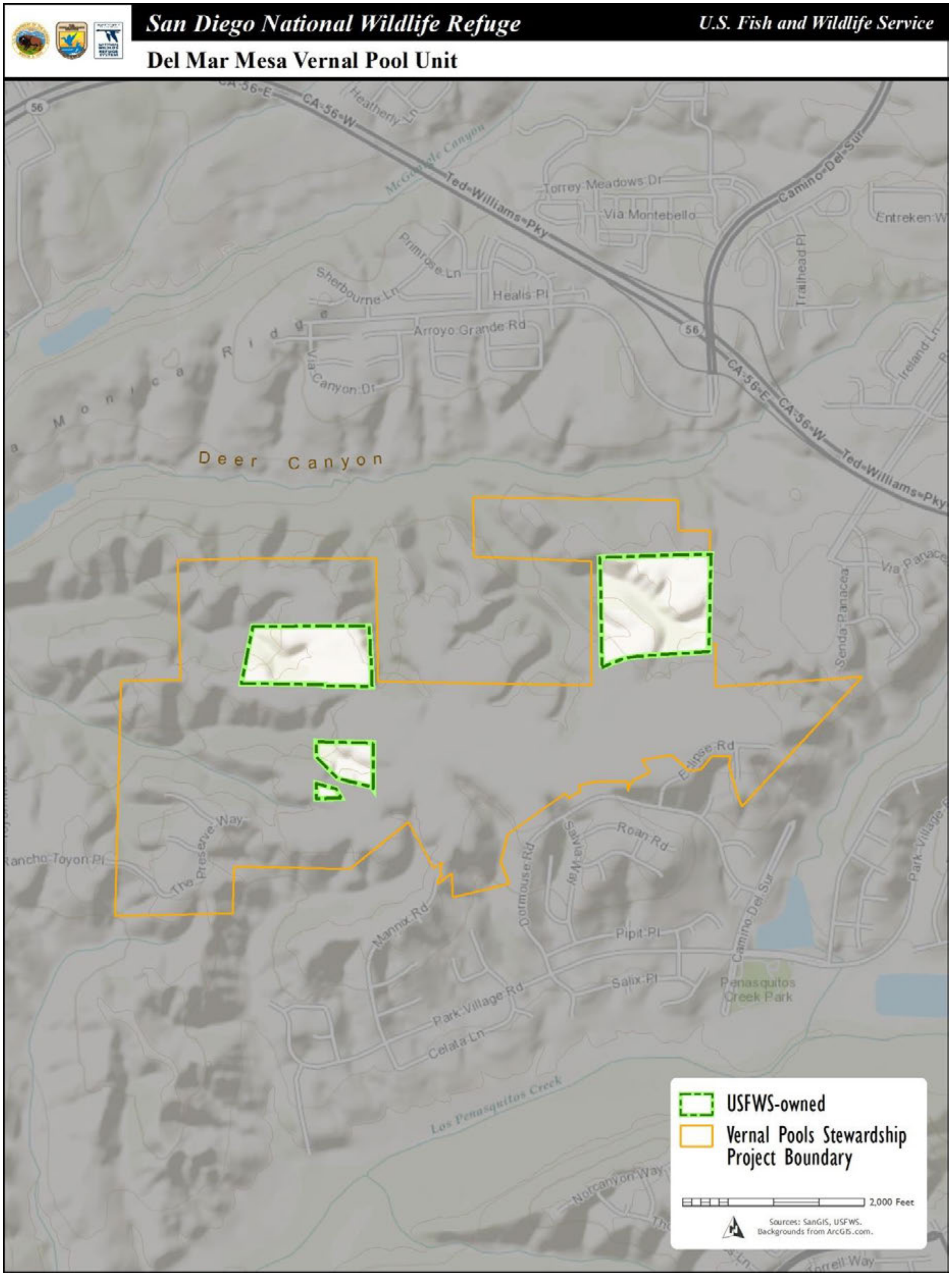

Figure 4-6. Topographic Character of the Del Mar Mesa Vernal Pool Unit

4.2.1.2 Site Visibility

The higher portions of the Otay-Sweetwater Unit are visible from great distances, with the upper slopes of San Miguel Mountain visible from the coastal areas of southern San Diego County. Other portions of the Otay-Sweetwater Unit are visible from Highway 94, Jamacha Boulevard, Dehesa Road, Proctor Valley Road, Otay Lakes Road, and several adjacent residential areas. Views of the Del Mar Mesa Unit are more limited, with glimpses of the land available from a portion of SR-56, as well as from some of the surrounding residential developments located in the Rancho Peñasquitos community of the City of San Diego.

4.2.1.3 Designated Scenic Highways

Portions of the San Miguel Mountain area form the backdrop of the long views across the county that are often available from the southern end of SR-75, a highway that travels along the Silver Strand between the cities of Coronado and Imperial Beach. SR-75 is one of two officially designated State Scenic Highways in the county, and the view over San Diego Bay to San Miguel Mountain is one of the factors that contributed to the highway's scenic designation. The portion of Highway 94 that extends from SR-125 to Interstate 8 is also considered by Caltrans to be eligible for designation as a State Scenic Highway, but no action to officially elevate this segment of highway to State Scenic Highway status has been taken. As described by the County of San Diego, "A highway may be designated as 'scenic' depending upon how much of the natural landscape can be seen by travelers, the aesthetic quality of the landscape, and the extent to which development intrudes upon the traveler's enjoyment of the view. A highway's status changes from 'eligible' to 'officially designated' when the local jurisdiction adopts a scenic corridor protection program, applies to Caltrans for scenic highway approval, and receives notification from Caltrans that the highway has been designated as an official State Scenic Highway" (County of San Diego 2011).

Portions of Highway 94 are included within the county Scenic Highway System and views of the Otay-Sweetwater Unit are available along this stretch of highway. Parts of the Otay-Sweetwater Unit are also visible from three other county scenic highway segments:

- Willow Glen Drive (scenic highway designation from Jamacha Road to Dehesa Road),
- Otay Lakes Road (scenic highway designation from the Chula Vista city limits to Highway 94), and
- Proctor Valley Road (scenic highway designation from the Chula Vista city limits to Highway 94) (County of San Diego 2011).

4.2.2 Geology and Soils

Understanding the variety of soils present within the San Diego NWR and where they occur is important when making decisions related to the siting of facilities, as well as when making habitat management decisions, including where and how to protect, enhance, and restore sensitive plant species. Soils can influence the type of vegetation present in a given area and, in some cases, the presence of a particular soil (e.g., gabbro soils, Linne clay) indicates a potential for rare plants.

Soil properties such as erodibility and runoff potential must be considered when designing trails or siting facilities such as a trail bridge, parking lot, or visitor contact station.

4.2.2.1 Otay-Sweetwater Unit

The majority of the lands within the Otay-Sweetwater Unit occur within the Peninsular Ranges geomorphic region of San Diego County, which is underlain by granitic rocks formed during the cooling of magmas generated between 140 and 90 million years ago (Deméré no date).

McGinty Mountain Area

Within the McGinty Mountain area, the majority of the land is underlain by Mesozoic granitic rock of the Southern California Batholith. A number of different soil types have been identified in this area, with the majority of the area overlain with soils of the Cieneba series. This soil series is characterized as excessively drained, very shallow to shallow coarse sandy loam that has been formed in place from granitic rock (Bowman et al. 1973). The erosion hazard for this soil type is high to very high. Soils of the Vista series, which are weathered from granodiorite or quartz diorite, also occur throughout the site (Bowman et al. 1973). The erosion hazard for these soils ranges from moderate for the flatter areas to very high in steep areas.

In the southeast end of the McGinty Mountain area, soils of the Las Posas series are present. These soils, which have a moderate to very high erosion hazard, are formed in place from weathered igneous (gabbro) rocks (Bowman et al. 1973) and usually have a clay subsoil. Because of the chemical and physical composition of this soil series, these soils often support a unique assemblage of native plants.

Las Montañas Area

The majority of the Las Montañas area is also underlain by Mesozoic granitic rocks of the Southern California Batholith. The soils in the northern portion of this area generally consist of silty sands of the Cieneba series soils and much of the remaining area overlain with Vista series soils. The erosion hazard associated with these soil types ranges from moderate for 15 percent slopes to very high for slopes exceeding 50 percent.

The two primary soil types on the south side of Highway 94 include Vista course sandy loam with 30 to 65 percent slopes and Cieneba very rocky course sandy loam with 30 to 75 percent slopes. The erosion hazard of both of these soil types is high to very high.

Sweetwater River Area

The portion of the Sweetwater River area to the north of the Highway 94 is dominated by Mesozoic granite rocks of the Southern California Batholith, while the majority of the area to the south of Highway 94 is underlain with Santiago Peak metavolcanic rocks. The latter geologic formation consists of a collection of mildly metamorphosed (altered by heat and pressure) volcanic and volcanoclastic rocks (sedimentary units derived from volcanic rocks) with minor amounts of sedimentary material (Ogden 1992). Santiago Peak volcanics are generally hard and extremely resistant to erosion. The Jamacha parcel located to the west of Jamacha Boulevard is underlain by Santiago Peak volcanic rock in the northern end of the parcel and Pleistocene non-marine sediments to the south. Both sides of Highway 94 within and adjacent to the floodplain of the Sweetwater River and its tributaries are underlain by Quaternary alluvium and colluvium.

The Sweetwater River area is overlain with a variety of soil types, including Tujunga sand in the floodway of the Sweetwater River and Riverwash within the streambed near the northern end of the Sweetwater River area. On the north side of Highway 94, Vista, Cieneba, Friant, and Fallbrook series soils overlay the site.

To the south of Highway 94 and west of the Sweetwater River, the area is overlain with Friant rocky fine sandy loam. This soil, which occurs on steep slopes, demonstrates rapid to very rapid runoff velocities with high to very high potential for erosion (Bowman et al. 1973). The majority of the Jamacha parcel is overlain with Diablo clay, which is well drained and consists of moderately deep to deep clays derived from soft, calcareous sandstone and shale (Bowman et al. 1973). The erosion hazard is moderate to high, with the higher hazard occurring on the steeper slopes.

The upland soils on the area to the south of Highway 94 and east of the Sweetwater River are overlain with Vista, Cieneba, San Miguel-Exchequer series soils. About 10 to 20 percent of the surface in these areas is covered with rock outcrops and large granodioritic boulders.

San Miguel Mountain Area

The majority of the San Miguel Mountain area is underlain by Jurassic Santiago Peak volcanics, although the lands in the area located closest to SR-125 are underlain by Otay Formation. The predominant soil type is San Miguel-Exchequer rocky silt loams, with a runoff potential that is medium to rapid, and the erosion hazard is moderate to very high. Linne clay loam, a moderately deep clay loam derived from soft calcareous sandstone and shale, occurs in an area along the western edge of the Refuge boundary near Sweetwater Reservoir (Bowman et al. 1973). The majority of the steep slopes on the northeastern edge of the Refuge are overlain with Cieneba very rocky coarse sandy loam, while sandy loams (i.e., Visalia sandy loam, Placentia sandy loam, Escondido sandy loam) are present within the gently rolling valley floor of the Hidden Valley area.

The soil types in the areas at the base of the west and south-facing slopes of San Miguel and Mother Miguel Mountains consist primarily of clays, clay loams, and cobbly loams. The areas closest to the Sweetwater Reservoir from north to south are overlain with Linne clay loam, Diablo clay, and Olivenhain cobbly loam. Because of the gentle slopes in vicinity of the vernal pool parcel in the extreme northwest corner of this management area, it may be more appropriate to classify the soils as Olivenhain cobbly loam, which is described as including microrelief of broad-based mimamounds (Bowman et al. 1973 [Sheet No. 64]*)*. Although some of the original mimamound topography remains in this area, many of the mounds were eliminated due to soil disturbance associated with farming and other human activities. On these soils, runoff is medium, and the erosion hazard is slight to moderate (Bowman et al. 1973). In the extreme southwest corner of this management area, soils consist of the Diablo clay and Linne clay loam series soils.

Otay Mesa and Lakes Area

The majority of the parcels in this area are underlain by Jurassic Santiago Peak volcanic rock. The exception is the northern portion of the parcel lying to the south of Proctor Valley Road, which is underlain by Otay Formation.

The northern parcel in this area is overlain primarily by Friant rocky fine sandy loam, a soil type characterized as shallow to very shallow, well-drained sandy loam (Bowman et al. 1973). Runoff is rapid to very rapid, and the erosion hazard is described as high to very high. The soils present on the southern parcel are considerably more diverse, consisting of soils in the series Friant, San Miguel-Exchequer, Olivenhain, and Visalia.

4.2.2.2 Del Mar Mesa Vernal Pool Unit

This unit occurs within the Coastal Plain geomorphic region of San Diego County, which is characterized by layers of marine and non-marine sedimentary rock units (Deméré no date). The uppermost geological formations within the Del Mar Mesa area consists of middle to early Pleistocene marine and marine terrace deposits, sometimes referred to as Linda Vista Terrace. This formation is underlain by Stadium Conglomerate, one of three conglomerate formations that make up the Poway Group, an Eocene geologic formation that formed 35 to 50 million years ago.

The mesas within the Del Mar Mesa Vernal Pool Unit are overlain with Redding gravelly loam soils. The surface topography in these areas typically consists of broad, low mimamounds that are moderately to well drained with intervening poorly drained areas that can be almost impervious. The erosion hazard on these soils is slight to high depending upon the slope gradient, and erosion can best be controlled by maintaining a permanent vegetation cover (Bowman et al. 1973).

The steep canyon slopes that cut through the western three parcels in this area are overlain by Redding cobbly loam. The erosion hazard is moderate to high, and runoff is medium to rapid. The steep and very steep slopes located on the eastern parcel are identified in the Soil Survey (Bowman et al. 1973) as terrace escarpments. These areas typically support 4 to 10 inches of loamy or gravelly soil over soft marine sandstone, shale, or gravelly sediments. Runoff is rapid, and the erosion hazard is high.

4.2.3 Geological Hazards

4.2.3.1 Faults and Seismicity

The following discussion of the faulting and seismicity affecting the properties within the San Diego County region is taken from the discussion provided by the County of San Diego in the Draft Final Environmental Impact Report prepared for the County of San Diego General Plan Update (County of San Diego 2011):

> "The faulting and seismicity of southern California is dominated by the compressionary regime associated with the "Big Bend" of the San Andreas Fault Zone. The San Andreas Fault Zone separates two of the major tectonic plates that comprise the earth's crust. West of the San Andreas Fault Zone lies the Pacific Plate, which is moving in a northwesterly direction relative to the North American Plate, which is located east of the San Andreas Fault Zone. This relative movement between the two plates is the driving force of fault ruptures on the west coast of California. The San Andreas Fault generally trends northwest to southeast and is located to the northeast of San Diego County. A series of sub-parallel faults are located to the west of the San Andreas Fault Zone including the active San Jacinto, Elsinore, and Rose Canyon Fault Zones, which each traverse through San Diego County. North of the Transverse Ranges Province, located generally between Santa Barbara and Joshua Tree, the San Andreas fault trends more in an east to west direction (the Big Bend), causing the fault's right-lateral strike-slip movement to produce north-south compression between the two plates. This compression has produced rapid uplift of many of the mountain ranges in southern California. This crustal shortening is accommodated by faulting (mainly reverse faulting) and causes a large potential for seismicity throughout most of southern California."

The location of the major active fault zones in the general vicinity of the San Diego NWR, including the Rose Canyon Fault Zone, Elsinore Fault Zone, and San Jacinto Fault Zone, are illustrated in Figure 4-7. The nearest of these active fault zones is the Rose Canyon Fault Zone which trends northwest to southeast and is located approximately six miles from the Del Mar Mesa Vernal Pool

Unit and about 15 miles to the northwest of the Otay-Sweetwater Unit. It is estimated that the maximum probable earthquake expected to occur on the Rose Canyon Fault would be of a magnitude 6.25 (Dudek & Associates 1996). The other active fault in the region is the Elsinore Fault, which occurs between 30 and 35 miles from the Otay-Sweetwater Unit. The maximum probable earthquake expected to occur on this fault would be of a magnitude 6.75. The La Nacion Fault Zone, which lies approximately six to eight miles to the west of the Otay-Sweetwater Unit, is considered potentially active. Smaller localized faults, most of which are older than 1.6 million years, are also illustrated in Figure 4-7. Within the Otay-Sweetwater Unit, a northwest to southeast trending localized fault extends through the McGinty Mountain area and an east-west trending localized fault occurs in the general vicinity of the Del Mar Mesa Vernal Pool Unit (California Department of Conservation 2010a).

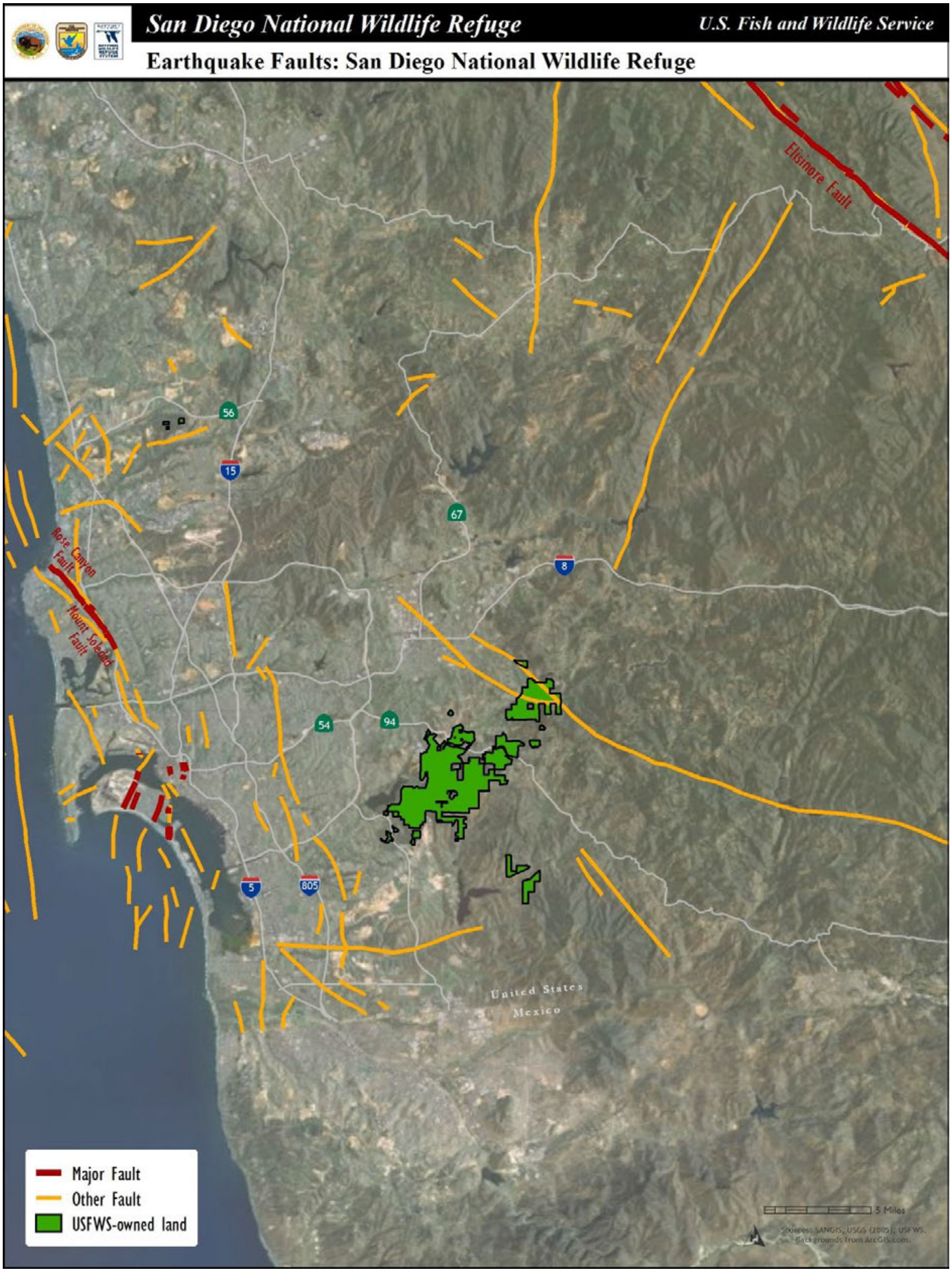

Figure 4-7. Earthquake Faults in the Vicinity of the San Diego NWR

Although the primary effects of earthquakes can include violent ground motion and, on occasion, permanent displacement of land associated with surface rupture, there is also the potential for secondary effects, including landslides, falling rocks, soil liquefaction, tsunamis, and seiches. It is the ground shaking associated with an earthquake that generally produces the greatest damage. When surface rupture occurs, it can occur at or below the surface, potentially causing large vertical and/or horizontal displacement of the ground along the fault (County of San Diego 2011).

Areas overlain with saturated, loose, fine- to medium-grained soils where the groundwater table is generally 50 feet or less below the surface are the areas most prone to soil liquefaction. During an earthquake, these sediments can experience a sudden increase in pore water pressure causing the soils to lose strength and behave as a liquid. There are three types of lateral ground displacement that can occur as a result of liquefaction: 1) flow failure, which generally occurs on steeper slopes; 2) lateral spread, which generally occurs on gentle slopes; and 3) ground oscillation, which occurs on relatively flat ground (County of San Diego 2011). Historically, seismic shaking in San Diego County has not been sufficient to trigger liquefaction, but there are areas within the county, including within the Refuge boundaries, that are considered susceptible to liquefaction from ground shaking during larger seismic events. The areas within the Refuge with a potential for liquefaction include the portions of the Sweetwater River and San Miguel Mountain areas in the vicinity of the Sweetwater River floodplain.

4.2.3.2 Landslides

Landslides, the down slope movement of soil and/or rock, may occur as a result of a seismic event, excessive water on a slope, or disturbance at the top or toe of a slope. Landslides can occur rapidly or very gradually (County of San Diego 2011). Although much of the Otay-Sweetwater Unit includes slopes with slope gradients in excess of 25 percent, soil slip susceptibility is considered low within this area. Boulder-strewn steep hillsides, however, are present in portions of the McGinty Mountain and Las Montañas areas. These hillsides can pose a falling rock hazard in association with an earthquake or due to the gradual loosening of their contact with the surface. Actions such as ground disturbance (i.e., excavation, filling), removal of vegetative cover, and changes in drainage patterns that introduce increased water onto a slope may contribute to the instability of a rocky slope, increasing the potential for rockfall.

4.2.3.3 Seiches

A seiche, which is a standing wave in a completely or partially enclosed body of water, is not likely to occur because the adjacent Sweetwater Reservoir and Otay Lakes are considered too small to pose a significant threat to public safety. Although unlikely, a seiche generated by an earthquake could result in localized flooding or damage to low lying areas adjacent to these reservoirs. Trails and/or other facilities located along the shoreline would be susceptible to inundation should a seiche be generated (County of San Diego 2011).

4.2.4 Paleontological Resources

The Code of Federal Regulations defines paleontological resources as 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(16 U.S.C. 470aaa(4)). Materials associated with an archaeological resource or any cultural items are not considered paleontological resources. Similarly, the County of San Diego (2009) defines paleontological resources as "the remains and/or traces of prehistoric life, exclusive of human remains, and including the localities where fossils were collected and the sedimentary rock formations from which they were obtained or derived. The defining character of fossils is their geologic age. Fossils or fossil deposits are generally regarded as older than 10,000 years, the generally accepted temporal boundary marking the end of the last late Pleistocene glacial event and the beginning of the current period of climatic amelioration of the Holocene. Fossil remains commonly include marine shells, bones and teeth of fish, reptiles, and mammals, leaf assemblages, and petrified wood. Fossil traces include internal and external molds (impressions) and casts. Trace fossils (i.e., ichnofossils) include evidence of past activities of fossil organisms, such as footprints and trackways, burrows and boreholes, coprolites, nests and (packrat) middens."

Paleontological resources, which occur in geologic deposits of sedimentary rock such as sandstone, siltstone, mudstone, claystone, or shale may be exposed at the surface in valley slopes and road cuts, but are typically buried under surficial soil deposits. The geologic deposits contain fossils of extinct organisms; as a result, they are considered limited and non-renewable (County of San Diego 2009). Paleontological resources are managed to preserve their scientific and educational values. When these resources are removed by laypersons, they can be damaged and/or precise information on the original location, rock type, or other conditions of a paleontological resource occurrence can be lost along with much of their scientific value for research purposes.

On March 30, 2009, the Paleontological Resources Preservation Act became law as part of the Omnibus Public Land Management Act of 2009, Public Law 111-011. This law requires the Secretaries of the Interior and Agriculture to manage and protect paleontological resources on Federal land using scientific principles and expertise. This law prohibits the casual collecting of fossils on lands administered by the Service.

There is a direct relationship between fossils and the geologic formations within which they are found; therefore, it is possible to reasonably predict where fossils might or might not be found (County of San Diego 2009). The County of San Diego has prepared a map that indicates the potential for paleontological resources throughout the county. Areas are identified as having a high, low, marginal, moderate, or no potential for paleontological resources. Since fossils form in sedimentary rocks, most of the fossils in the southwestern San Diego County region would likely be expected to occur in the Coastal Plain. In the Peninsular Ranges, fossils may occur in valleys and other environments where material eroded from the mountains was transported downhill and deposited. Jurassic metasedimentary rocks mapped as the Santiago Peak Volcanics have also produced rare but important marine invertebrate fossils (County of San Diego 2009).

Based on the information compiled by the County of San Diego (2009), there is a high potential for the presence of paleontological resources in the northern and western portion of the Sweetwater River area and in the western portions of the San Miguel Mountain and Otay Mesa and Lakes areas of the Otay-Sweetwater Unit. The potential for these resources in the floodway of the Sweetwater River is low; within the remaining portions of the Sweetwater River and San Miguel Mountain areas, as well as the eastern portion of the Otay Mesa and Lakes area, the potential is marginal. There is no potential for paleontological resources within the McGinty Mountain and Las Montañas areas of the Otay-Sweetwater Unit.

A number of well-preserved paleontological resources have been recovered from the Stadium Conglomerate formation in the vicinity of Del Mar Mesa, which occurs within the boundaries of the Del Mar Mesa Vernal Pool Unit. The Del Mar Mesa area is considered of high paleontological resource sensitivity by the City of San Diego. The same is true for the marine and/or non-marine terrace deposits present on the mesas within the Refuge's Del Mar Mesa Vernal Pool Unit (City of San Diego 2011).

4.2.5 Mineral Resources

Mineral resources of importance in San Diego County include construction materials, industrial and chemical mineral materials, and historically, precious metals and gemstones. Mineral resources are defined as the concentration or occurrence of natural, solid, inorganic or fossilized organic material in or on the earth's crust in a form and quantity and of a grade or quality that provides reasonable prospects for economic extraction (County of San Diego 2011). In general, construction materials include sand, gravel, and crushed rock. Industrial and chemical mineral materials include limestone, dolomite, and marble (except where used as construction aggregate), as well as specialty sands, clays, phosphate, borates, gypsum, feldspar, talc, building stone, and dimension stone. Precious metals include gold and silver, as well as iron and other ferro-alloy metals, copper, lead, and zinc. Various semi-precious gemstones have been located and, in some instances, mined in San Diego County.

Historical mining activities in and around the Refuge have included a feldspar mine and ceramic grade clay mining in the vicinity of McGinty Mountain, the Peg-Leg Mine to the southeast of McGinty Mountain, a limestone quarry near the current site of Bright Valley Farms, and a granite quarry site near the southwest corner of Jamacha Road and Highway 94. A few occurrences of semi-precious gemstones are also recorded from San Miguel Mountain and nearby Lyons Peak (Weber 1963).

Construction aggregate, including sand, gravel, and crushed rock, are the primary ingredients in concrete and asphalt, products essential to development in San Diego County (SANDAG 2011). Today, aggregate is considered the county's most important mineral resource. Although there are large amounts of these resources in San Diego County, some are no longer accessible because urban development has eliminated access to these resources. Other areas supporting construction aggregate also support sensitive biological resources that would be adversely affected by mineral extraction (County of San Diego 2011). As a result, there is currently a shortage of quality (PCC-grade) sand in the San Diego area. PCC-grade aggregate is aggregate that has been naturally sorted, rounded, and polished in rivers and creeks. It is used primarily in finished concrete work because the rounded material allows for a smoother finish, requires less cement and water than crushed stone, and is easier to mix, pour, and place. According to the California Department of Conservation (1996), aggregate deposits that are acceptable for use as PCC-grade aggregate are the rarest and most valuable of aggregate resources.

The California Department of Conservation (2006), Geological Survey estimates that the 50-year demand for aggregate resources for the western San Diego County production/consumption (PC) region (essentially the developed western portion of San Diego County) as of January 1, 2006, is 1,164,000,000 tons. The total amount of aggregate resources permitted for extraction as of January 1, 2006, was 198,000,000 tons, representing only 17 percent of the demand over the next 50 years. More importantly, the amount of permitted aggregate resources in the western San Diego County PC region decreased by 28 percent between January 1, 2001, and January 1, 2006, while the projected 50-year demand increased by six percent (California Department of Conservation 2006).

This discrepancy between supply and demand, particularly for PCC-grade sand, has resulted in San Diego having the highest priced aggregate in the State. In 2006, sand was being imported from Mexico in an effort to meet the demand. Another source of aggregate material, particularly class II base used in constructing roadbeds, is recycled construction and demolition waste material (California Department of Conservation 1996).

In 2011, SANDAG, in cooperation with Caltrans District 11, prepared *The San Diego Region Aggregate Supply Study*, which examined the current and future aggregate supply and demand issues in San Diego County. As part of this study, a regional aggregate database and GIS analysis tools were developed to identify potential sources within the county for aggregate. In this study, the sites within the county that were identified as potential aggregate supply sites are at least 20 acres in size, located in areas identified by the California Department of Conservation as not developed, do not meet the definition of a developed land use type, have not been conserved for environmental reasons nor identified for conservation at the 90 percent level, and are not located in areas the California Department of Conservation has identified as having no significant mineral deposits. Using these criteria, 1,159 sites of 20 acres or more were identified in the county as potential aggregate supply sites (SANDAG 2011). Figure 4-8 illustrates the proximity of the potential aggregate supply sites to the San Diego NWR.

One of the resources utilized in SANDAG's aggregate supply study was the California Department of Conservation's mineral land classifications for western San Diego County (California Department of Conservation 1996). These classifications are presented in the form of Mineral Resource Zones (MRZ), and each zone is defined as follows:

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;

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

MRZ-3 Areas containing mineral deposits the significance of which cannot be evaluated from available data; and

MRZ-4 Areas where available information is inadequate for assignment of any other MRZ zone.

Due to the demand for PCC-grade aggregate will likely exceed the amount available in areas currently classified as MRZ-2, it is likely that areas currently designated as MRZ-3 may be further evaluated as potential resource sites. Sites in these areas have the potential to contain crushed granitic and metavolcanic rocks or alluvial deposits that could be economically minable. Operations involving the crushing of large granitic boulders could also be initiated, as these types of granitic deposits are common in San Diego County. However, large quantities of weathered granitics typically must be mined in order to obtain the larger boulders needed for crushing; therefore, mining these types of areas for PCC-grade aggregate could be costly. If there is a market for the lesser material, then retrieving the larger boulders for crushing could be more feasible (California Department of Conservation 1996).

Within the McGinty Mountain area of the Otay-Sweetwater Unit, only the westernmost portion of this area is located within the western San Diego County PC region, and that area has been classified as MRZ-3. Areas outside this region have not been classified.

The Las Montañas area and a majority of the Sweetwater River area are classified as MRZ-3. There is, however, a portion of the Sweetwater River area that is classified as MRZ-1, as indicated in Figure 4-8. This area is generally located within the floodway of the Sweetwater River extending from about 4,000 feet south of the old steel bridge to about 3,000 feet to the east of

Steele Canyon Road. Although the boundaries of this MRZ-1 designation extend north and east beyond the Refuge boundary, the areas outside of the Refuge have been developed and are now occupied by Cuyamaca College and various commercial developments to the north and a golf course to the east. Also within the Sweetwater River area is a site classified as MRZ-2. This site occurs at the northernmost end of the Sweetwater Reservoir with only the northernmost portion of the MRZ-2 site included within the Refuge. The majority of this site is located within lands owned by the Sweetwater Authority.

The western and northeastern portions of the San Miguel Mountain area are located within the western San Diego County PC region and these areas are designated as MRZ-3. Currently (as of 2013), the parcels within the Otay Mesa and Lakes area are located outside the western San Diego County PC region. Within the Del Mar Mesa Vernal Pool Unit, the mesa tops and some of the less incised canyons have been classified as MRZ-2, while the deeper canyons are classified MRZ-3.

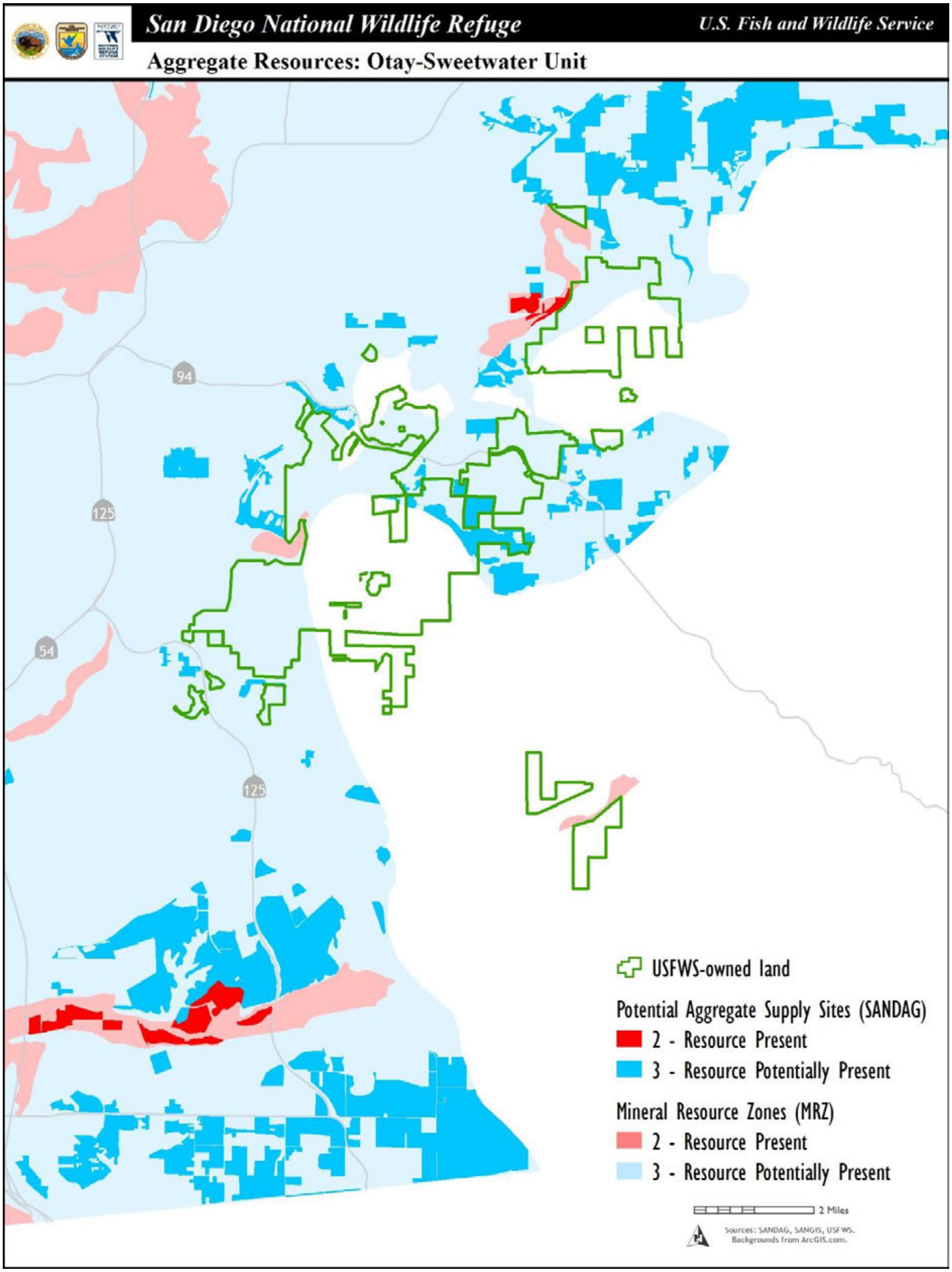

Figure 4-8. Potential Aggregate Materials in the Vicinity of the Otay-Sweetwater Unit

4.2.6 Agricultural Resources

Historical Prospective. Various areas within the Refuge, including Jamacha Valley and Proctor Valley, have been influenced by agricultural practices conducted initially by Native Americans and later by early Europoean settlers. Farming and grazing continued into the mid 1900s.

According to historical records, in the early 1800s, sheep and horses, which belonged to Mission San Diego de Alcalá, grazed on lands within the Jamacha Valley (Van Wormer 1984). The Mission also used Jamacha Valley for grazing cattle. In the early 1830s, the missionaries at San Diego gave a large portion of their grazing lands to Doña Apolinaria, who planted wheat and corn in the valley along the east side of the Sweetwater River. She also set other portions of the land aside for grazing sheep and goats (Van Wormer 1984). Illustrated in Figure 4-9 are the historical boundaries of Rancho Jamacha, which were formalized in 1840. As indicated, portions of the San Diego NWR now occupy some of the area originally included within the 8,881-acre Mexican land grant.

Rancho Jamacha was sold to four partners in 1853, who cultivated wheat, barley, oats, rye, and vegetables on the land. They also raised sheep, horses, cattle, mules, and hogs. This ranch, which is credited as being the first successful large-scale agricultural enterprise in San Diego County (Van Wormer 1984), operated until about 1860, when farming in this area ceased to be economically viable.

Near the end of the 1800s, interest in farming within the valley was renewed and in 1892, the lands to the east of the Sweetwater River in the northern third of what was originally Rancho Jamacha were purchased and later became known as Monte Vista Ranch. Although ownership of Monte Vista Ranch changed several times over the years, the land supported a success corporate farming operation until about 1945. A variety of crops were cultivated, including olives, oranges, grapes, walnuts, alfalfa, hay, melons, and a variety of vegetables (Van Wormer no date). Other portions of the valley were also once again used for grazing.

Cultural resource surveys of the areas to the west of Mother Miguel Mountain, on land now owned by the USFW, have identified evidence of ranching and farming activity dating back to the early 1900s. In addition, a dairy farm complex constructed between the 1930s and the 1940s operated on the ridge to the west of Mother Miguel Mountain prior to the establishment of the Refuge. According to the 1943 USGS map, another ranch identified on as the Williams Ranch was located on what is now Refuge land further down slope from the dairy site near the eastern edge of the current Sweetwater Reservoir. In 1975, when the Williams Ranch site was recorded as a historical site, citrus trees were noted as present on the property (Brian F. Smith and Associates 1992).

Agricultural activity and cattle grazing also occurred in Proctor Valley, which extends through a portion of the Otay Lakes and Mesa area of the Refuge. Historic farming sites have been identified to the north of Proctor Valley Road, where household fragments and structures date to between the late 1800s and the early 1900s.

Evidence of early ranching activities is also present further to the east within the Las Montañas area of the Otay-Sweetwater Unit. Historic records for the site referred to as the "Barn at the Oaks" indicate that a ranch operated at this site between 1893 and 1928 (Dudek & Associates 1996). Of the structures present on the site at that time, only the barn remains.

Historical agricultural activity on the Del Mar Mesa Vernal Pool Unit appears to have been limited to cattle grazing, although some of the mesas and gentle slopes in the general vicinity have been used over the years to raise tomatoes and other truck crops.

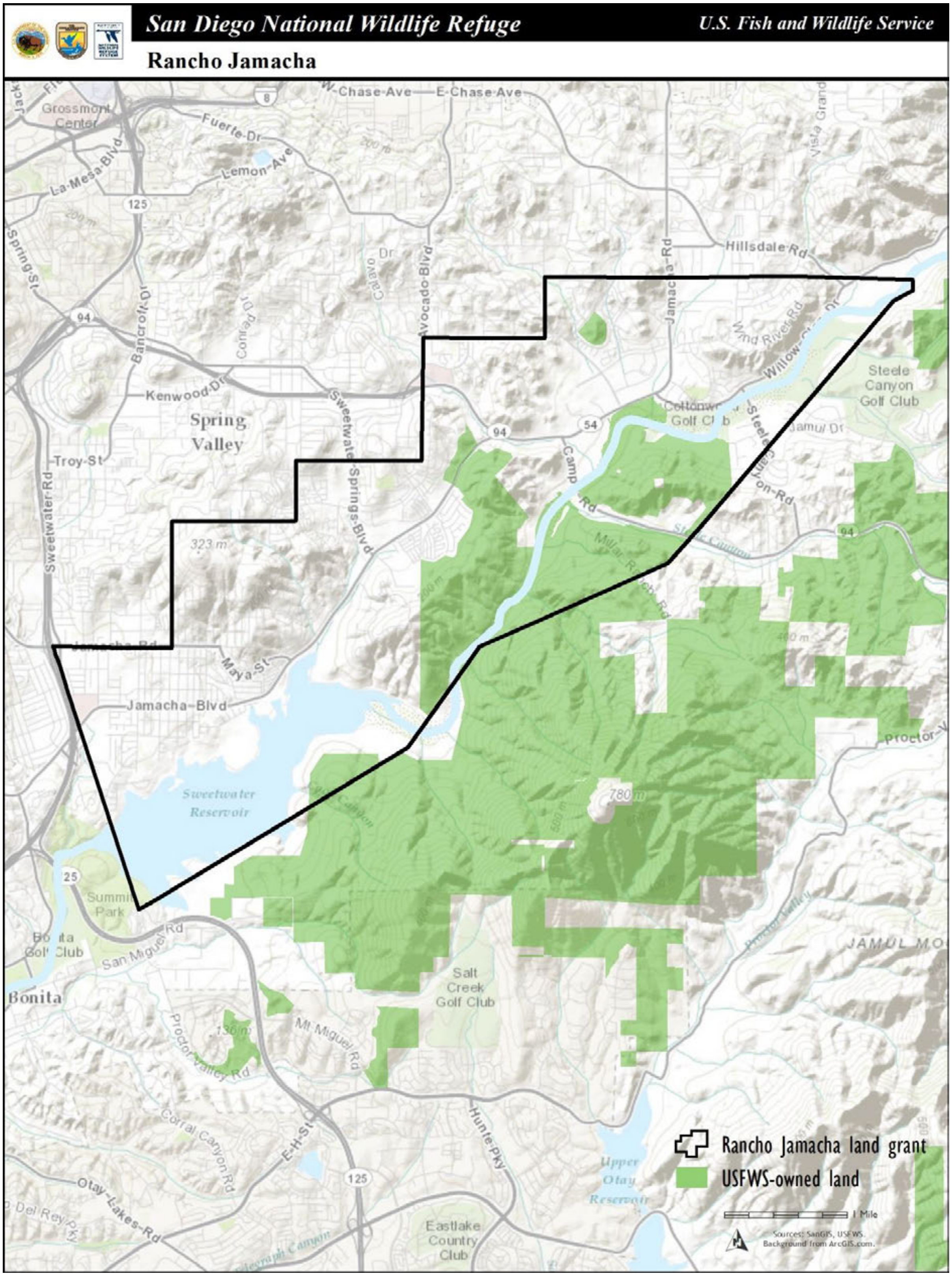

Figure 4-9. Boundaries of the Historic Rancho Jamacha Land Grant

Today, only a few areas surrounding the Otay-Sweetwater Unit are used for agricultural purposes, and these uses are generally limited to grazing of cattle, goats, and horses. At present, there are no agricultural activities occurring on Del Mar Mesa.

California Farmland Mapping and Monitoring Program. The California Department of Conservation's Farmland Mapping and Monitoring Program produces maps and statistical data used for analyzing impacts on California's agricultural resources. Agricultural land is rated according to soil quality and irrigation status; the best quality land is called Prime Farmland. The maps are updated every two years with the use of a computer mapping system, aerial imagery, public review, and field reconnaissance. According to the San Diego County Important Farmland 2008 map (California Department of Conservation 2010b), the majority of the lands within the Otay-Sweetwater Unit represent lands suitable for the grazing of livestock. As illustrated in Figure 4-10, none of the lands included within the San Diego NWR are identified by the State as Farmland of Statewide Importance or Prime Farmland. The San Diego County Important Farmland 2008 map also indicates that some of the mesas in and around the Del Mar Mesa Vernal Pool Unit are suitable for grazing, with the remaining areas depicted as not suitable for agricultural uses.

Areas that the State has determined are not suitable for agricultural uses include the steeper slopes around McGinty Mountain, the south side of the Las Montañas area, and the steeper slopes around San Miguel Mountain. Some of the flatter portions within the McGinty Mountain area to the north and west of the McGinty Mountain peak, portions of Hidden Valley in the northeastern corner of the San Miguel Mountain area, and the parcels in the southwest corner of the San Miguel Mountain area, are designated by the State as Farmland of Local Importance. Farmland of Local Importance is defined as land with a good combination of physical and chemical characteristics for agricultural production but is limited because of the need for irrigation (California Department of Conservation 2010b). The soil types in these areas are suitable for truck crops and orchard crops. No other areas within the Otay-Sweetwater Unit are identified as suitable for farming.

4.2.7 Hydrology and Water Quality

4.2.7.1 Hydrology

Watersheds and Surface Water

The lands included within the Otay-Sweetwater Unit occur within two watersheds, the Sweetwater River and Otay River watersheds (Figure 4-11). Both watersheds drain into San Diego Bay.

The McGinty Mountain, Las Montañas, and Sweetwater River areas are located entirely within the Sweetwater River watershed, while only the areas to the west and southwest of the San Miguel Mountain area are included within this watershed. The Sweetwater River watershed encompasses about 230 square miles and extends from the Laguna Mountains to San Diego Bay. The primary tributary within this watershed is the Sweetwater River, which has undergone significant changes over the past 100 years. These changes began in 1888 with the construction of the Sweetwater Reservoir. This was followed in 1945 by the construction of the Loveland Reservoir near the eastern end of the drainage. The construction of this dam resulted in a significant reduction in the intensity and volume of freshwater flows through the portion of the Sweetwater River that extends through the Refuge.

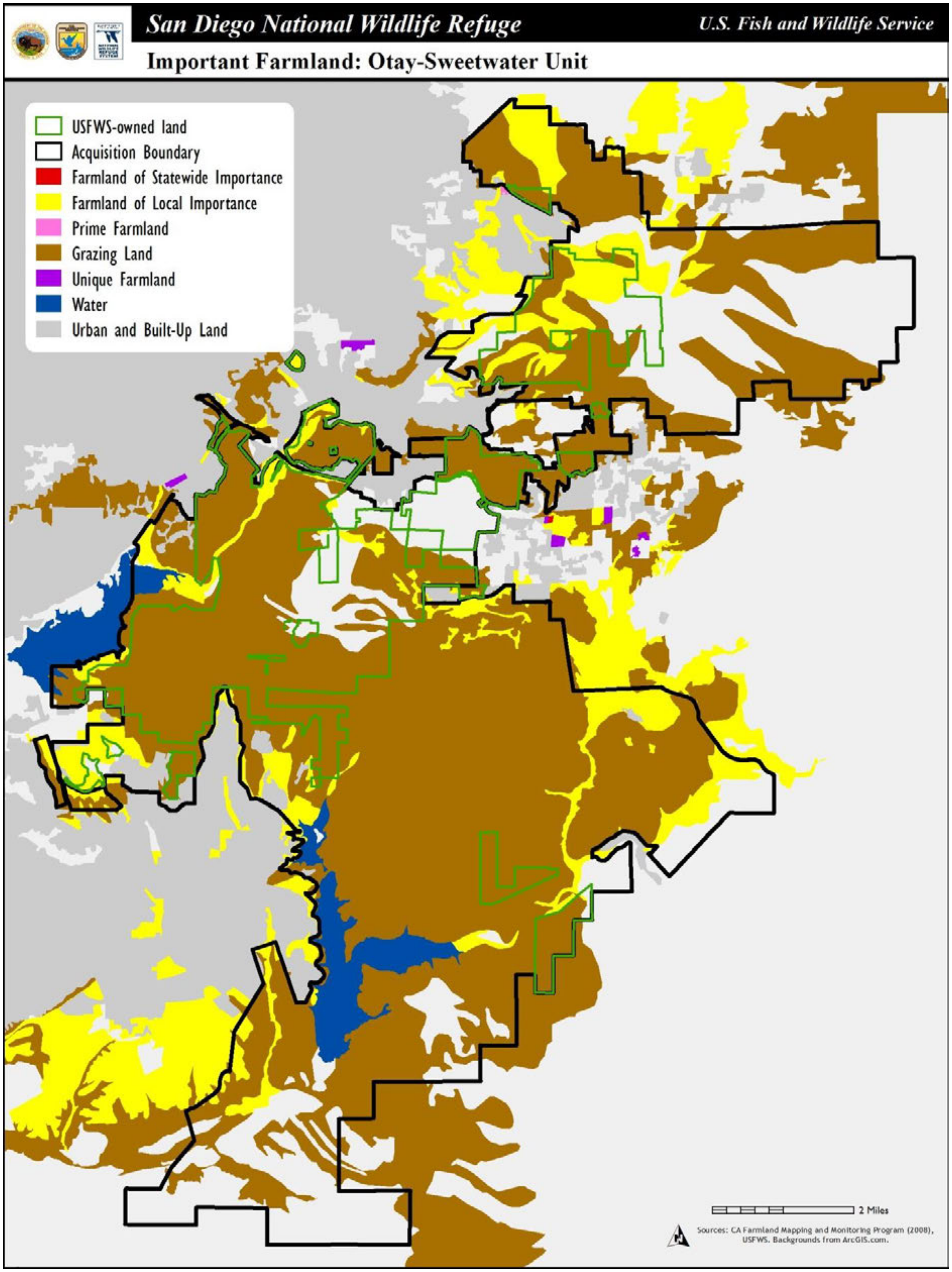

Figure 4-10. San Diego County Important Farmland, as mapped by the California Department of Conservation

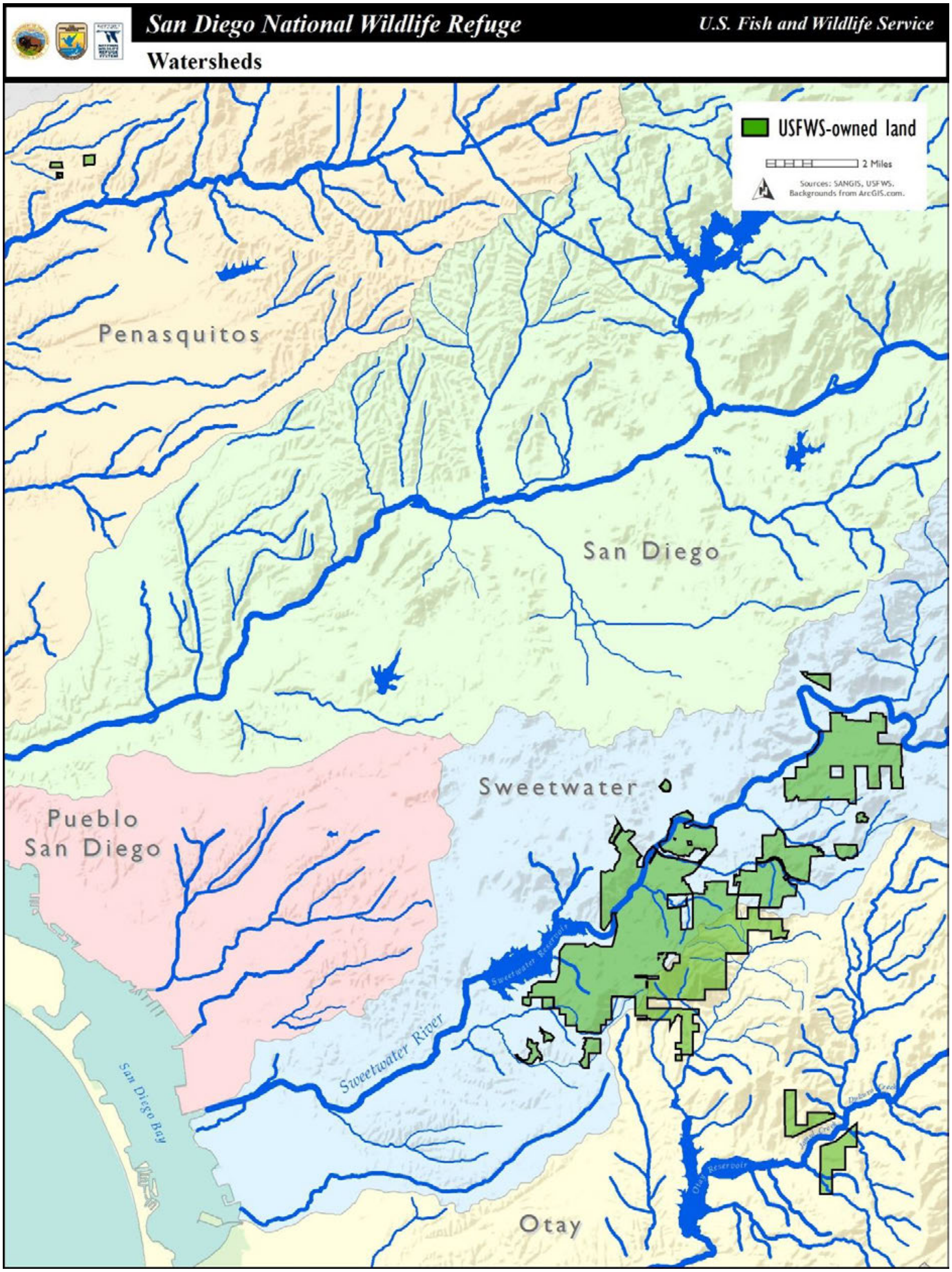

Figure 4-11. Watersheds included within the San Diego NWR

The Loveland Reservoir controls about 98 square miles of the drainage basin, while the Sweetwater Reservoir, located approximately 17 miles downstream, controls approximately 84 square miles the basin. Both reservoirs are owned and operated by the Sweetwater Authority, which provides water service to a population of approximately 186,000 within the western and central portions of the City of Chula Vista, all of the City of National City, and unincorporated areas of the County of San Diego (Bonita) (Sweetwater Authority and RMC Water and Environment 2011).

The water present in the Sweetwater Reservoir comes from two sources: surface runoff from the Sweetwater River watershed, which is fully appropriated to the Sweetwater Authority, and untreated water from the San Diego County Water Authority (Sweetwater Authority 2011). It is estimated that in a normal water year, approximately 7,400 acre-feet of the Sweetwater Authority's water comes from local surface water, representing about 33 percent of the annual water supply (Sweetwater Authority and RMC Water and Environment 2011).

Water movement from the Loveland Reservoir to the Sweetwater Reservoir relies on the Sweetwater River channel for conveyance. Downstream conveyance of water can occur by scheduled release or can occur when water levels in the Loveland Reservoir are sufficient to generate flows over the spillway and into the river channel. Prior to planned releases, which are scheduled during the winter months, the Sweetwater Authority implements protocols (USFWS 1999a) for avoiding impacts to arroyo toad (*Anaxyrus californicus*) and notifies all downstream property owners of the upcoming release. Because the Sweetwater River is an unlined natural floodway, normal transmission losses are about 20 percent of the water released from Loveland Reservoir. Another source of water for the Sweetwater Reservoir, in addition to the water supplied by local surface water, is imported raw water purchased from the San Diego County Water Authority.

As indicated in Figure 4-11, the eastern third of San Miguel Mountain area and the Refuge parcels along Jamul Creek are located within the Otay River watershed. The Otay River drains a watershed of approximately 143 square miles, extending for a distance of 25 miles east from San Diego Bay to the Cleveland National Forest. The Otay River watershed has been artificially increased due to the use of a flume that transfers water from Barrett Lake (on the Tijuana River watershed) to Dulzura Creek (on Otay watershed). The Refuge lands within the Otay watershed feed lower Dulzura Creek and Jamul Creek before water flows reach the lower Otay Lake. The hydrologic conditions in the lower reach of the watershed are influenced by the presence of the Upper and Lower Otay Reservoirs. These reservoirs, which control approximately 69 percent of the watershed, reduce the frequency of flows in the river and capture sediments that historically were carried by the river into San Diego Bay.

The Del Mar Mesa Vernal Pool Unit is part of the Los Peñasquitos Creek watershed (refer to Figure 4-11), which is located in the northern portion of the Los Peñasquitos Hydrologic Unit. This watershed includes an area of approximately 100 square miles and discharges into the 0.6-square-mile Los Peñasquitos Lagoon. The major drainage course within the Del Mar Mesa Preserve is Deer Canyon, which merges with McGonigle Canyon to the northwest of the Refuge lands, forming the Carmel Valley. Surface water in the Carmel Valley drainage passes under Interstate 5, where it empties into Peñasquitos Lagoon. Other smaller drainages within the Refuge parcels also carry water from the site into Carmel Valley. Runoff occurring on this unit is seasonal and attributed almost exclusively to rainfall, while the major downstream drainages tend to carry water throughout the year as result of urban runoff.

There are also several holding ponds within the Otay-Sweetwater Unit, likely remnants of old grazing operations. Some of these ponds hold local surface runoff year round, while others may go dry for extended periods. There are holding ponds present in the low-lying areas near the western base of McGinty Mountain, three ponds located along the western foothills of San Miguel Mountain, and one pond on the northeast side of San Miguel Mountain.

The species supported within the vernal pool habitat present on the Otay-Sweetwater Unit and the Del Mar Mesa Vernal Pool Unit also rely on surface runoff for survival but at a much smaller scale. The microtopography present in these areas results in water ponding following winter storms, and the hard pan present beneath the surface significantly restricts drainage from these ponded areas. The slightest modification of the topography in these areas, particularly modifications that redirect surface runoff, can have significant effects on the overall quality of this habitat.

Groundwater

The majority of the lands within the Otay-Sweetwater Unit overlay fractured rock aquifers. These aquifers, which generally occur in the foothills and mountainous areas of the county, tend to have low storage capacity, which causes the water table to rise and fall at relatively fast rates. Because less water is typically stored in fractured rock, seasonal variations in precipitation and drought conditions result in greater variations in water levels than in similar conditions in alluvial or sedimentary aquifers (County of San Diego 2011).

Alluvial and sedimentary aquifers are present below those portions of the Otay-Sweetwater Unit that are located along the Sweetwater River or adjacent to the Jamacha Valley. In addition, a large aquifer occurs below the southwestern portion of the San Miguel Mountain area at the south end of the Sweetwater Reservoir. Alluvial and sedimentary aquifers, which are typically found in river and stream valleys, are generally composed of consolidated (i.e., sedimentary rock) or unconsolidated (i.e., alluvium, colluvium) gravel, sand, silt, and clay (County of San Diego 2011). The storage capacity in these aquifers varies depending upon the thickness of the sedimentary or alluvium layer, the proximity of the area to a water body, and other geologic or hydrological factors.

A natural spring has been identified at 1,225 feet above MSL on McGinty Mountain. This spring occurs on the western slope of the mountain along a rock chute area, where some surface moisture is present throughout much of the year. Another spring is known to be present on the southern slopes of San Miguel Mountain, just off the Refuge at about 1,100 feet above MSL. Only one well currently operates on the Refuge. This well is located on the north slope of San Miguel Mountain, near the current site of a Refuge storage building. The well fills a holding tank that can be accessed by Refuge and fire management staff.

Flooding and Other Hydrologic Hazards

Hydrologic hazards include flooding, landslides and mudslides, river scour and deposition, and drought. Flooding, which is considered the most significant of the hydrologic hazards, is defined as a temporary condition of partial or complete inundation of normally dry land areas. Flooding is typically associated with the overflow of the floodways of rivers and streams; however, flooding can also occur in streets, stormwater drainage systems, water storage areas (e.g., reservoirs, ponds, lakes), and low-lying upland areas (County of San Diego 2011). The potential for flooding in San Diego County is considered high due to significant variability in the frequency, magnitude, and location of the region's seasonal precipitation (County of San Diego 2011). Most rainfall occurs during the winter months (typically between November and April); however, tropical storms from the south can also bring heavy rainfall during the summer months. Areas prone to flooding within the Refuge are generally limited to the floodway and floodplain of the Sweetwater River and Steele Canyon Creek in the Otay-Sweetwater Unit.

Steep drainages that occur on the slopes of McGinty, San Miguel, and Mother Miguel Mountains in the Otay-Sweetwater Unit, as well as the deeply cut drainages on the Del Mar Mesa Vernal Pool Unit, are susceptible to large water flows during heavy down pours. This situation can result in debris flows that travel rapidly down slopes, carrying rocks, brush, and other debris. Areas containing sandy soils and weathered gabbroic soils are prone to instability and sliding, as are recent burn areas.

Another flooding hazard that could affect portions of the Refuge is related to dam failure, primarily the failure of the Loveland Reservoir. If this dam were to fail, portions of the Refuge along the Sweetwater River floodway would be subject to inundation, and the area between the Loveland and Sweetwater Reservoirs would likely experience the effects of significant scour and deposition as floodwaters flow down the river channel (County of San Diego 2011).

Although a hazard that evolves much more slowly than hazards associated with too much water, drought can result in significant adverse effects to both surface waters and groundwater. This is particularly true for prolonged periods of drought, such as the drought California experienced between 1987 and 1992. Potential effects of drought on Refuge resources include lower groundwater levels in areas supporting riparian and oak woodland habitat, significant reductions in rainfall affecting overall plant growth on the Refuge, and reduced water levels in Loveland Reservoir, which could reduce or temporarily eliminate water releases that provide water flows between this reservoir and the Sweetwater Reservoir. The other effect of drought that could affect significant portions of the Refuge is the increased potential for wildland fires.

4.2.7.2 State and Federal Water Quality Regulations

Issues related to water quality in San Diego 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 laws 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 Clean Water Act addresses only surface waters.

The CWA establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The 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 is located within Region 9, which is administered by the staff of the San Diego 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 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 Basin Plans also include water quality standards for ground and surface waters within the basin. Per the requirements of the CWA, water quality standards are reviewed and, if necessary, updated every three years (California Regional Water Quality Control Board 1994).

The Water Quality Control Plan for the San Diego Basin (Basin Plan), most recently amended in June 2011, 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 components of the San Diego Basin Plan include: 1) the designation of beneficial uses for surface and ground waters; 2) the preparation of narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses; 3) a description of mitigation measures that can be implemented to protect the beneficial uses of all waters within the region; and 4) a description of surveillance and monitoring activities that enable the Regional Water Board to evaluate the effectiveness of the Basin Plan (California Regional Water Quality Control Board 1994). The Basin Plan designates the beneficial uses for all surface water and groundwater areas in the San Diego Region. Beneficial uses are defined as the uses of water necessary for the survival or wellbeing of man, plants, and wildlife. Statewide, 23 beneficial uses have been defined. Some of the beneficial uses identified in the Basin Plan for the areas in and around the San Diego NWR include municipal and domestic supply; agricultural supply; wildlife habitat; rare, threatened, or endangered species; and preservation of biological habitats of special significance, which includes uses of water that support designated areas or habitats located on established refuges, parks, sanctuaries, or ecological reserves. The specific beneficial use designations for water sources within the Refuge are indicated in Table 4-1.

The CWA has also 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 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 an NPDES municipal stormwater permit and to develop and implement an urban runoff management program to reduce pollutants in urban runoff and stormwater discharges.

Section 305(b) of the CWA 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 Clean Water Act 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. Impaired water bodies or segments on the Section 303(d) List must be addressed through the development of Total Maximum Daily Loads (TMDLs), through alternative regulatory programs, or through revisions in standards.

Table 4-1
Beneficial Uses of Surface and Ground Water in the Vicinity of the San Diego NWR

Surface or Ground Water	Beneficial Use[1]										
	MUN	AGR	IND	PROC	REC1	REC2	BIOL	WARM	COLD	WILD	RARE
Los Peñasquitos Creek Watershed											
Deer Canyon		■	■		℗	■		■		■	
Sweetwater River Watershed											
Mexican Canyon	■	■	■	■	■	■		■		■	
Steele Canyon	■	■	■	■	■	■		■		■	
Coon Canyon	■	■	■	■	■	■		■		■	
Otay River Watershed											
Jamul Creek (lower)	■	■	■	■	■	■		■		■	■
Little Cedar Canyon	■	■	■	■	■	■	■	■	■	■	
Loveland Reservoir	■	■	■	■	■	■		■	■	■	
Sweetwater Reservoir	■	■	■	■	■	■		■		■	
Sweetwater Hydrologic Unit											
Groundwater in Middle Sweetwater	■	■	■								

[1] Codes for Beneficial Uses defined in Table 4-2. ■ Existing Beneficial Use ℗ Potential Beneficial Use

Source: California Regional Water Quality Control Board 1994

Table 4-2
Codes for Beneficial Use Abbreviations from the Basin Plan

MUN - Municipal and Domestic Supply
Uses of water for community, military, or individual water supply systems, including but not limited to drinking water supply.

AGR - Agricultural Supply
Uses of water for farming, horticulture, or ranching, including but not limited to irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.

IND - Industrial Service Supply
Uses of water for industrial activities that do not depend primarily on water quality, including but not limited to mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.

PROC - Industrial Process Supply
Uses of water for industrial activities that depend primarily on water quality.

REC-1 - Water Contact Recreation
Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include but are not limited to swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

REC-2 - Non-contact Water Recreation
Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water nor any likelihood of ingestion of water. These uses include but are not limited to picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, and sightseeing activities.

Preservation of Biological Habitats of Special Significance (BIOL)
Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance, where the preservation or enhancement of natural resources requires special protection.

WARM - Warm Freshwater Habitat
Uses of water that support warm water ecosystems, including but not limited to preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

COLD - Cold Freshwater Habitat
Uses of water that support cold water ecosystems, including but not limited to preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

WILD - Wildlife Habitat
Uses of water that support terrestrial or wetland ecosystems, including but not limited to preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

RARE - Rare, Threatened, or Endangered Species
Uses of water that support aquatic habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered.

Source: California Regional Water Quality Control Board 1994

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 must 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 on August 4, 2010. On November 12, 2010, USEPA approved the 2008-2010 CWA Section 303(d) List that includes listings for the San Diego Region.

The California State Water Board recently approved an 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 US 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.

4.2.7.3 Ground and Surface Water Quality

Surface water quality within a watershed is directly affected by the types of land uses present within the watershed. As development in the watershed increases, the level of pollutants in surface runoff also increases. This situation is made worse because a high proportion of developed areas consist of impervious surfaces, greatly reducing the potential for native plants and soil to filter pollutants out of runoff water before it enters nearby rivers and streams. Pollutants such as petroleum products, antifreeze, heavy metals, and sulfates accumulate on impervious surfaces and are easily carried downstream by natural and human-generated runoff. In addition, irrigation and natural runoff transport fertilizers, pesticides, bacteria, viruses, and erosion-generated sediments into storm drains or natural drainages. These types of discharges are the primary sources of surface water and groundwater contamination in San Diego County (County of San Diego 2011).

All of the drainages located within the Otay-Sweetwater Unit, which ultimately empty into San Diego Bay, are part of the San Diego Bay Watershed Management Area (WMA). The pollutants of concern for this WMA include trace metals, other toxic substances, coliform bacteria, pesticides, and nutrients. Urban development within this WMA contributes to the current water quality issues in San Diego Bay.

There are no water bodies located within the Refuge boundary that have been included on the currently approved Section 303(d) List; however, Loveland Reservoir, located upstream of the Refuge, and Sweetwater Reservoir, located immediately to the west of the Refuge, are identified as impaired (California Regional Water Quality Control Board San Diego 2009). The Loveland Reservoir is included on the Section 303(d) List because sampling indicates that the water quality objectives for aluminum, manganese, dissolved oxygen, and pH are not being met. In the case of the Sweetwater Reservoir, the water quality objectives for dissolved oxygen are not being met.

The Final Program Environmental Impact Report for the County of San Diego's General Plan Update (County of San Diego 2011) identifies various areas in the unincorporated county with known groundwater quality issues. Of the areas identified, four occur within or in close proximity to properties located within the Otay-Sweetwater Unit. Three of these sites are identified as leaking underground fuel tank sites. These sites are generally located as follows: near the Sweetwater River where it crosses under Highway 94 within the Sweetwater River area; along Highway 94 near the western boundary of the Las Montañas area; and near the extreme southeastern portion of the McGinty Mountain area. The latter area also occurs in the general vicinity of a site identified as having nitrate-related groundwater quality problems. These problem areas have been identified based on a subset of wells in which nitrate levels have exceeded the maximum contaminant levels (MCLs) in groundwater samples analyzed (County of San Diego 2011). In this area, nitrate contamination can largely be attributed to septic system failures and/or agricultural uses.

Runoff from within the Refuge flows primarily into the Sweetwater River watershed, primarily upstream of the Sweetwater Reservoir. The remainder of the Refuge property flows into the Otay River watershed. An Urban Runoff Diversion System (URDS) maintained by the Sweetwater Authority is intended to decrease surface water quality impacts from upstream development. The URDS facilities, which were constructed in two phases in 1991 and 1999, consist of four lined temporary holding ponds, a pump station, and pipelines located on Authority property. An intercept barrier and additional pipelines are located approximately one mile upstream of the Sweetwater Reservoir in an easement on the Refuge. Preservation of this easement is very important to Authority operations. While operation of the Sweetwater Reservoir URDS has decreased surface water quality impacts from development adjacent to most of the north side of Sweetwater Reservoir and a portion of the urbanized watershed upstream, the URDS does not protect the reservoir from all land use changes and all resulting impacts to surface and subsurface water quality.

4.2.8 Climate and Climate Change

Current Climatic Conditions

The Mediterranean climate in southwestern San Diego County is generally mild with warm, dry summers and mild, wet winters. The high and low average temperatures on the coast in the winter are 66°F and 52°F, respectively. In the summer, the average high and low is 76°F and 66°F, respectively. The temperature range is slightly greater along the foothills. In Jamul, the high and low average temperatures in the winter are 60 °F and 44°F, respectively. In the summer, the average high and low is 87°F and 65°F, respectively.

Most of the precipitation falls during October through April, occurring principally as rain. On average, the wettest month at the coast is January; farther inland, the wettest month is March. Precipitation across San Diego County is highly variable in terms of yearly averages, location, and intensity. The coastal and western foothills regions of the county receive an average of 6 to 18 inches of rainfall per year.

During winter and spring, polar storm systems pass through the region as the eastern Pacific high weakens and shifts south. Most regional precipitation occurs during this period. Excessive rainfall can occur when the jet stream maintains a position over southern California and carries multiple storms across the region. Moderate to major flooding events have typically occurred from December through March, with the worst recorded flooding event occurring in January 1916, when catastrophic flooding caused the failure of the Otay Reservoir Dam, destroying structures, property, and lives in the Otay and Tijuana River valleys.

Winds are characterized by a moderately strong land and sea breeze cycle. Sea breeze conditions generally occur between late morning and late afternoon with an average direction from the west-southwest. Between late afternoon and early morning, a land breeze dominates the local wind pattern. Land breezes generally flow in from the east-northeast. The wind patterns, which are influenced by the topography, flow through the canyons and Sweetwater River Valley. Strong east to northeastern winds, referred to as Santa Anas, generally begin throughout southern California in fall, but can occur at any time throughout the year. These Santa Ana winds, which can include steady strong winds ranging from 20 to 40 miles per hour (mph) with occasional gusts of 60 to 70 mph or greater, carry warm to hot, very dry air from the deserts to the coast, dramatically increasing temperatures and decreasing relative humidity levels.

Climate Change

Climate change is defined as any change in climate over time, whether due to natural variability or the result of human activity (CCSP 2008). Changes in climate can interact with other environmental changes to affect biodiversity and the future condition of ecosystems. Scientific evidence acknowledges that world climate is 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 and International Resources Group 2009). This is significant because "climate is a dominant factor influencing the distributions, structures, functions and services of ecosystems" (CCSP 2008).

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. The conservative climate change forecast for western North America (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) is a linear change in mean temperatures ranging from +3.8 °F to +10.4 °F (+2.1 °C to +5.7 °C) and a linear change in mean precipitation ranging -3 percent to +14 percent through the end of the century (Friggens et al. 2012).

In California, maximum, average, and minimum air temperatures have shown an increase over the past century, with the greatest increase seen in minimum temperatures (Anderson et al. 2008). Between 1950 and 2000, the mean annual temperatures in California have increased by 1.8°F (LaDochy et al. 2007). According to recent climate modeling, California is projected to warm by approximately 2.7°F above 2000 averages by 2050, a threefold increase in the rate of warming over the last century. In addition, summer temperatures are expected to rise more than winter temperatures, with increases greater in inland California than on the coast. Heat waves, with higher temperatures and longer durations, are also expected to occur more frequently throughout California (Moser et al. 2012).

California's Mediterranean climate zone is typically described as having hot, dry summers and cool, wet winters. The habitats and species present in this climate zone have adapted to these variations in conditions. Past climate model projections have indicated that this wet/dry pattern would continue with seasonal, year-to-year, and decade-to-decade variability (Moser et al. 2012). However, more recent model projections of precipitation shifts have provided varying results, indicating less certainty in predicting changes in precipitation, particularly in the southwestern United States (Mastrandrea and Luers 2012, Barrows and Murphy-Mariscal 2012). Nevertheless, there is broad model support for the prediction that rainfall will become more variable and periods of heavy rain and drought will become more extreme (Barrows and Murphy-Mariscal 2012, IPCC 2007).

The issue of how and why climate model simulations disagree on whether future precipitation will increase or decrease in California was explored by Pierce et al. (2013). After examining a variety of global models and downscaling techniques, they determined that the differences related to the way each model combines changes in precipitation frequency and daily precipitation intensity, with changes in the occurrence of the heaviest precipitation days accounting for the majority of the disagreement in the projected change in annual precipitation. They also note that in the southern part of the state, although many simulations exhibit moderate increases in winter precipitation intensity, the simulations also indicate that these increases are offset and in several cases overwhelmed by decreases in the number of precipitating days (Pierce et al. 2013).

Some climate models for the San Diego region indicated that by mid-century the 30-year average precipitation in the San Diego region will decrease by more than 8 percent compared to historical totals, even under a lower greenhouse gas emissions scenario (Moser et al. 2012). With respect to temperature, several of the recent climate simulations for southern California suggest that increases in average temperature are more likely to occur during the summer than in the winter, with the effects felt most significantly in the interior areas of southern California (Cayan 2009). Pratt and Mooney (2013) hypothesize that Mediterranean plant communities (like those supported on the San Diego NWR) may be particularly sensitive to changes in precipitation, requiring the integration of biological processes, including local adaptation and adaptive plasticity, into forecasts of ecosystem response to changing climatic conditions.

Climate change research and monitoring is ongoing, and information about local and global climate conditions and trends continues to be expanded and updated. Also being explored are other possible climate-related changes and impacts, termed emerging issues by the State of California, Office of Environmental Health Hazard Assessment (OEHHA) (2013). A few of these emerging issues—that are believed to be, but have not yet been proven to be—influenced by climate change include: the increased survival and spread of forest disease-causing pathogens and insects; the increased susceptibility of trees to these pathogens, insects, and fire; and changes in the frequency and intensity of extreme events such as droughts and floods (California, OEHHA 2013).

Researchers are also continuing to refine their approach to modeling the changes in distribution of vegetation types and species in response to climate change. Recent research has provided empirical evidence of shifting species ranges (Hannah et al. 2012), but predicting how species distributions and vegetation communities will change is difficult. Until recently, modeling of shifting species distribution was conducted at larger landscape scales. Although modeling species response at this level is still important, to address the uncertainties of how populations of species, potentially adapted to local conditions, will respond to a changing climate, it is necessary to implement fine-scale (local-scale) modeling techniques that take into consideration the topographic and ecological complexities of a specific management area or species range (Barrows and Murphy-Mariscal 2012, Hannah et al. 2012). The results of these types of modeling efforts will assist in identifying those areas that should be conserved to accommodate predicted shifts in species ranges.

4.2.9 Air Quality

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

The Federal Clean Air Act (42 U.S.C. §§ 7401-7671q) requires the EPA to set outdoor air quality standards for the nation, referred to as National Ambient Air Quality Standards (NAAQS). To date, standards have been established for sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone 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 if needed. Within California, the California Ambient Air Quality Standards (CAAQS) set parameters for 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 ozone, sulfates (SO_4), hydrogen sulfide (H_2S), and visibility reducing particles.

In March 2008, the USEPA revised the NAAQS for ground-level ozone, lowering the primary eight-hour ozone standard from 0.08 ppm to 0.075 ppm and revised the secondary eight-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. On May 21, 2012, the USEPA issued a Final Rule in the *Federal Register* (77 FR 30160) in which air quality thresholds were established that define the classifications assigned to all nonattainment areas for the 2008 ozone NAAQS.

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 eight-hour ozone standard is needed to protect against welfare effects, including impacts on sensitive vegetation and forested ecosystems (USEPA 2011a). Although San Diego County is currently designated by the USEPA as a 2008 8-hour ozone standard nonattainment area, in May 2013, the USEPA approved California's request to redesignate the county as an attainment area for the 1997 8-hour ozone NAAQS.

Specific geographic areas are classified as either "attainment" or "nonattainment" areas for each pollutant based upon the comparison of measured data with NAAQS and CAAQS. When an air basin is in compliance with these standards, it is designated as an attainment area. Conversely, when an air basin is not in compliance with a national and/or California air quality standard, it is designated as a nonattainment area for that pollutant. As of April 1, 2013, the San Diego Air Basin was designated by the State of California as a "serious" nonattainment area for ozone and a nonattainment area for PM_{10} and $PM_{2.5}$. No changes to these State designations are currently included in the proposed 2013 State area designations.

The most significant regional sources of ozone, NO_2, and CO are automobiles and other on-road vehicles. Ozone is formed by the reaction of volatile organic compounds (VOC) and oxides of nitrogen (NOx), which are combustion products from gas and diesel engines. Other important sources of VOC are paints, coatings and process solvents. The major sources of PM_{10} are construction, demolition, and dust from paved and unpaved roads.

The San Diego Air Basin is managed by the San Diego Air Pollution Control District (APCD). In accordance with its monitoring responsibilities, the APCD maintains an ambient air monitoring network and records air quality readings to determine compliance with national and California standards. Compliance with air quality standards is measured based on these records. In addition to monitoring regional ambient air quality, the San Diego APCD also evaluates and issues air quality permits to ensure that proposed new and changed operations and industrial equipment meet emission standards. Construction and operation permits are required for any operation or equipment capable of emitting air contaminants. Persons building, altering, or replacing equipment that may emit air pollutants are required to obtain an Authority to Construct Permit. In addition, persons operating equipment that may emit air pollutants are required to obtain a Permit to Operate.

The Rules and Regulations established for the APCD do not specifically address grading projects, and no permit is required for construction. However, the APCD does have the authority to regulate construction activities that meet the definition of a "nuisance" as provided in Rule 51 of the APCD Rules and Regulations. Rule 51 states: "A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property." In the case of large-scale grading operations, the APCD may require specific measures to minimize the generation of dust during excavation.

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

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

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

4.2.10 Greenhouse Gas Emissions

There is general scientific consensus that increases in greenhouse gases (GHG) in the atmosphere are a contributing factor to increases in average global temperatures. GHG trap heat in the atmosphere, which in turn heats the surface of the Earth. Some GHG occur naturally and are emitted to the atmosphere through natural processes, while others are created and emitted solely through human activities. The emission of GHG 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 (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). 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 by 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.

In California, emissions from transportation, electrical power generation and the industrial sector account for over 80 percent of GHG emissions. The transportation sector alone is responsible for more than one third of all such emissions in the state (California OEHHA 2013). California is a substantial contributor of GHG, emitting over 400 million tons of carbon dioxide a year in 2006 (California Energy Commission 2006). However, since 2008, GHG emissions in California have decreased by more than seven percent (California OEHHA 2013).

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 2007). The IPCC constructed several emission trajectories of GHG needed to stabilize global temperatures and climate change impacts and concluded that a stabilization of GHG at 400 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, *Leadership in Environmental, Energy, and Economic Performance,* which addresses the need to set 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 response to Executive Order 13524, the Service made a commitment to become carbon neutral as an agency by the year 2020, and to reduce our carbon footprint by using less energy, reducing consumption, and appropriately altering land management practices. By incorporating sustainability into refuge day-to-day operations, we are making progress towards meeting our goal of achieving carbon neutrality.

In California, to avert the consequences of climate change the California legislature passed 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 the California Air Resources Board (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. In addition to the passage of AB 32, the Governor of California also set a long-range reduction goal of reducing GHGs to 80 percent below 1990 levels by 2050.

4.2.11 Contaminants

Contaminants can enter the Refuge via a variety of transport pathways involving surface water, groundwater, wind, and living organisms. Surface water enters the Refuge from adjacent lands via the Sweetwater River and several small drainage channels. Urban runoff and storm water from upstream urban areas flows into the Sweetwater River, Steele Canyon Creek, and other tributaries that flow into the Sweetwater River. Some common pollutants that can be carried in these waters include fertilizers, pesticides, oil and grease, detergents, coolant, and paint. Groundwater transport can transport contaminants from adjacent developed or cultivated areas into natural drainages and wetlands. In addition, wind can transport airborne contaminants such as fine particulate matter into wetland areas.

Prior to the acquisition of land for incorporation in the Refuge, a Level 1 Pre-acquisition Environmental Site Assessment is conducted in accordance with U.S. Fish and Wildlife Service Policy 341 FW 3. This assessment process involves the completion of an Environmental Site Assessment Level I Survey Checklist, which is used to determine whether there is any potential hazardous substance or other environmental problem on the site. Based on this initial assessment, it may be necessary to conduct a Level II or Level III Survey. A Level II Survey may be necessary when a potential issue is identified during the Level I Survey (i.e., the answer to a question on the Level I checklist is "Yes") or when no response is given and there is insufficient information documented to conclude that no additional investigation is necessary. The other reason for conducting a Level II Survey is when a bioassessment or sampling is needed to determine the presence or absence of a hazardous substance. Estimates of remediation or other cleanup costs, if any, must be included in the Level II Survey, unless a Level III Survey is recommended.

A Level III survey is required when the Service determines that a hazardous substance is probably present on the site and significant sampling and original research is necessary to determine the extent of any hazardous substance and the actual or potential costs for remediation. The Level III Survey may also be used to determine the extent of other environmental problems.

The Level I Surveys conducted for the various acquisitions on the Refuge have not identified the presence of any hazardous compounds on the acquisition lands. However, the Level I Survey conducted in 1995 for the Rancho San Diego acquisition area, the portion of the Otay-Sweetwater Unit identified as the Sweetwater River area in this document, did identify hazardous material contamination at two sites near the western side of the Sweetwater River, outside the boundaries of the Refuge (USFWS 1995b). These included a record of leaking underground storage tanks at the Otay Water District Water Plant located near Singer Lane, to the south of Highway 94; however, the record also indicated that the tanks had been removed and the site cleaned up in 1993. The other contamination site was the Jamacha Sanitary Landfill, located to the southwest of the intersection of Highway 54 and Highway 94. This landfill, which is unlined, was active from 1960 through 1978 and is currently managed and monitored by the County of San Diego.

In 2007, a debris site containing metal pipes, concrete, plastic, and other materials of unknown sources was exposed when the Harris Fire destroyed the existing vegetation that had been concealing the site. This debris site is located in a tributary canyon that flows into the Sweetwater River near the existing Sweetwater River trail bridge. Because of concerns that contaminants may be associated with the improper disposal of the waste at this site and that the exposed debris could be a health and safety hazard for the public, an environmental assessment of the site was conducted by the Environmental Contaminants Division in the Carlsbad Fish and Wildlife Office. It was determined that some of the debris piles were observed during the initial Level 1 Pre-acquisition Contaminants Survey in 1995 but were not considered to contain hazardous materials at that time. In the subsequent 2007 assessment, it was also concluded that the solid waste piles represented nonhazardous material, and remediation under the guidance of the applicable regulatory agencies, the County of San Diego, Solid Waste Management, Local Enforcement Agency, and the State of California Waste Management Board was recommended (USFWS 2008a).

As part of the 2007 assessment, information was also gathered regarding current and historic activities in the general area to evaluate whether known or suspected environmental concerns were present in this portion of the Refuge and/or on the adjoining properties. As a result, information regarding the Jamacha Landfill was updated. Monitoring wells are now located around the perimeter and downgradient of the landfill (outside of the Refuge boundary) to delineate and monitor contaminant levels in the groundwater. Although semi-annual groundwater monitoring reports obtained from the San Diego County's Geotracker database for the Jamacha Landfill show that some results exceed the maximum contaminant levels (MCLs) for drinking water, the sample results from the monitoring well located downgradient of the landfill and closest to the Refuge boundary show that the level of analytes are at less than detection limits (USFWS 2008a). Therefore, the groundwater down slope of the landfill in the vicinity of the Refuge does not pose an apparent risk to Refuge resources.

Another potential contaminants site is known to occur in the Sweetwater River floodplain to the north of Highway 94. This site contains an abandoned tanker trailer enclosed by a chain link fence. There is no evidence that the tank is leaking, and it appears to be hooked up to a well. Aerial photos from the early 1990s show a dirt road leading from the north at Jamacha Road to the site. That road has since grown over, and access from Jamacha Road is now constrained by road infrastructure. This may be the tanker that was identified in the 1996 Level I Survey as a portable water tanker. In March 2013, the tanker and surrounding area was once again inspected by the Environmental Contaminants Division and no evidence of contamination was identified.

Another potential contaminant issue that warrants further investigation is the presence of dark oily areas along portions of Millar Ranch Road and the access road to the top of San Miguel Mountain. These oily spots imply that prior to topping the roadway with asphalt, road oil may have been used along the present day alignment to improve access to the top of the mountain (pers. comm. Jill Terp, San Diego NWR).

Pet and livestock feces constitute another potential source of contamination. An undetermined number of dogs are brought onto the Refuge daily by their owners or enter the Refuge unescorted. In areas where dog walking is prevalent, such as the trail at Par Four Drive, the density of dog feces is excessive. The Refuge has installed dog waste stations in an effort to have owners pick up dog waste and reduce this pollutant source. An undetermined number of horses are ridden daily on Refuge trails, and their droppings are regularly encountered. Runoff from the droppings and from Bright Valley Farms may contribute pollutants (including nitrogen) into Steele Canyon Creek and Sweetwater River.

4.3 Biological Resources

This section addresses the biological resources present on the Refuge both from a regional context and at the site-specific level. Descriptions are provided of the Refuge's vegetation communities, plants, wildlife (e.g., birds, mammals, reptiles, amphibians, invertebrates), wildlife corridors, sensitive species, and invasive species. In addition to information obtained during site visits, a number of documents have been used in the preparation of this section, including the San Diego County General Plan Update Draft Final Environmental Impact Report (County of San Diego 2011), Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015), and Final Program Environmental Impact Report for the Draft General Plan (City of San Diego 2008).

4.3.1 Regional Species and Habitat Conservation Planning

Southwestern San Diego County includes a unique combination of physical features, climate, and hydrology that have resulted in a diversity of plants and wildlife unlike any other region in North America. These characteristics also drive the desire to work and live in this region, resulting in the loss of native habitats to support development. As such, the San Diego region has been identified as a major "hot spot" for biodiversity and species endangerments (City of San Diego 2008). Habitats within Southern California's Mediterranean climate support the highest concentration of locally endemic species, along with the highest number of species listed as threatened or endangered, in the continental United States (USFWS 1997a).

The development of the management actions addressed in this CCP to conserve the Refuge's listed and sensitive species, as well as the habitats that support them, was guided by a range of landscape-level, regional, and species and habitat specific planning efforts. The relevant national, state, and landscape-level programs are described in Chapter 1, while the regional and habitat specific planning efforts are described here.

4.3.1.1 San Diego Multiple Species Conservation Program

The San Diego MSCP preserve system (City of San Diego 1998a) has been designed to conserve large contiguous blocks of native habitat in an effort to sustain southwestern San Diego County's native biological diversity, as well as the extensive number of listed and sensitive species that occur within these protected native habitats. The lands within the San Diego NWR are identified as core biological resource areas in the San Diego MSCP Plan, and the acquisition of the lands within the Refuge represents the Federal government's contribution to the implementation of the MSCP. As per the agreements made in association with the approval of the MSCP, the Service will manage the lands within the San Diego NWR in accordance with the MSCP guidelines (City of San Diego 1998a). These management activities include:

- Identification of area-specific management actions (e.g., species monitoring, invasive species control, habitat restoration, use of herbicides, biological surveys, fire management, and appropriate public access), which are addressed through the preparation of the San Diego NWR CCP;
- Participation in a coordinated biological monitoring program to ensure uniformity in data gathering and analysis; and
- Participation in focused research studies addressing topics such as basic inventories of biodiversity, habitat value, and covered species populations; taxonomic studies; wildlife corridor and dispersal investigations; habitat restoration; population enhancement and reintroduction; and experimental fire management techniques (City of San Diego 1998a).

Refuge staff, along with representatives from the Carlsbad Fish and Wildlife Office, continue to participate in interagency coordination activities associated with the implementation of the San Diego MSCP, while also actively participating with other agencies and academia in the development and implementation of species and habitat monitoring protocols, habitat restoration and enhancement actions, and research.

4.3.1.2 Applicable Species Recovery Plans

Recovery plans are prepared to delineate the actions required to recover and protect federally listed plant and animal species. Management of the Refuge includes addressing the recovery actions outlined in recovery plans for the listed species known to occur on the Refuge or that have the potential to be reestablished on the Refuge in the future. Relevant recovery plans include:

- Vernal Pools of Southern California Recovery Plan (USFWS 1998a);
- Draft Recovery Plan for Least Bell's Vireo (USFWS 1998b);
- Arroyo Toad Recovery Plan (USFWS 1999b);
- Southwestern Willow Flycatcher Recovery Plan (USFWS 2002a);
- Recovery Plan for the California Red-Legged Frog (USFWS 2002c);
- Quino Checkerspot Butterfly Recovery Plan (USFWS 2003b); and
- Recovery Plan for Otay Tarplant (USFWS 2004b).

Each recovery plan includes specific recommendations for actions considered necessary to satisfy the biological needs and assure the recovery of the listed species. Recommended actions generally include habitat protection, enhancement, and restoration to support listed species, minimizing the effects of known stressors (e.g., invasive species, disturbance, frequent fire) when possible, monitoring, research, and public outreach. Recovery plan recommendations have been considered during the development of the San Diego NWR CCP and are reflected in the CCP goals, objectives, and strategies. Additional information is provided in the section "Federally and State Listed Endangered and Threatened Species."

4.3.1.3 Bird Conservation Plans

Sonoran Joint Venture Bird Conservation Plan

The SJV Bird Conservation Plan (SJV Technical Committee 2006) summarizes the status of avian species, prioritizes these species, provides habitat discussions and conservation recommendations, and lists focus areas for conservation action (i.e., specific locations or sites where conservation work can have a significant positive effect). As noted in Chapter 1, the USFWS-owned lands that comprise the San Diego NWR are located within the SJV's Californian Coast and Mountains Region. Of the priority bird species identified for the Californian Coasts and Mountains Region, the San Diego NWR supports 17 species of continental concern, 19 species of regional concern, and all 12 of the stewardship species (Table 4-3). The species of continental concern are recognized as vulnerable in either the breeding or the nonbreeding season by at least one of the national or international bird conservation initiatives, while the species of regional concern are species that have a combination of moderately high vulnerability, high regional threats, and declining regional population trends. The concern level for the species identified as stewardship species is not high at present; however, the SJV is responsible for ensuring that these species do not slip into a category of concern (SJV Technical Committee 2006).

Table 4-3 Priority Bird Species within the Californian Coasts and Mountains Region of the Sonoran Joint Venture		
Species of Continental Concern	**Species of Regional Concern**	**Stewardship Species**
California gnatcatcher[1]	Least "Bell's" vireo[1]	California quail
Wrentit[1]	San Diego cactus wren[1]	Green heron
California thrasher[1]	Southwestern willow flycatcher[2]	Black-crowned night heron
White-throated swift[2]	Loggerhead shrike[2]	White-tailed kite
Costa's hummingbird[2]	Sage sparrow[2]	Acorn woodpecker
Nuttall's woodpecker[2]	Western meadowlark[2]	Black phoebe
Oak titmouse[2]	Bufflehead[3]	Cassin's vireo
Black-chinned sparrow[2]	Snowy egret[3]	Western scrub jay
Tricolored blackbird[2]	Northern harrier[3]	Rock wren
Lawrence's goldfinch[3]	Sora[3]	Bewick's wren
Mallard[4]	Common-ground dove[3]	Ruby-crowned kinglet
Northern pintail[4]	Burrowing owl[3]	California towhee
Black swift[4]	American wigeon[4]	
Rufous hummingbird[4]	Golden eagle[4]	
Allen's hummingbird[4]	Long-eared owl[4]	
Olive-sided flycatcher[4]	Bushtit[4]	
Willow flycatcher[4]	Marsh wren[4]	
	Rufous-crowned sparrow[4]	
	Grasshopper sparrow[4]	

"1"-"4" Signifies vulnerability groupings, with those species indicated as "1" the most vulnerable (Note that all of the species listed under the first two columns meet the criteria for vulnerability either continentally or regional and are worthy of conservation (SJV Technical Committee 2006).

Conservation actions recommended in the SJV Bird Conservation Plan generally involve preserving large blocks of undisturbed native habitat that will meet the specific needs of bird species of concern. Such habitats include:

- Open terrain and adjacent foothill chaparral and mountain areas for golden eagles (*Aquila chrysaetos*);
- Native grasslands to support northern harrier (*Circus cyaneus*), grasshopper sparrow (*Ammodramus savannarum*), and western meadowlark (*Sturnella neglecta*);
- Secluded cliffs and steep canyons for black swifts (*Cypseloides niger borealis*), white-throated swifts (*Aeronautes saxatalis*), and rufous-crowned sparrows (*Aimophila ruficeps*);
- Oak woodland to support acorn woodpecker (*Melanerpes formicivorus*), oak titmouse (*Baeolophus inornatus*), and Lawrence's goldfinch (*Spinus lawrencei*);
- Riparian areas and adjacent open terrain to support long-eared owl (*Asio otus*), Nuttall's woodpecker (*Picoides nuttallii*), and least Bell's vireo;
- Dense chaparral for California thrasher (*Toxostoma redivivum*) and wrentit (*Chamaea fasciata*); and
- Large expanses of coastal sage scrub, some with extensive cactus patches, to support California gnatcatcher and cactus wren (*Campylorhynchus brunneicapillus*).

Partners in Flight – Conservation of the Land Birds of the United States

Partners in Flight, which began in 1990, addresses the challenges of bird conservation in North America through a cooperative partnership involving a variety of agencies, conservation groups, foundations, academia, and commercial enterprises. The mission of Partners in Flight is to stop the decline of, maintain, or increase healthy populations of landbirds in North America. To that end, Partners in Flight has completed a number of bird conservation plans that provide a comprehensive treatment of bird conservation issues in the continental United States (Pashley et al. 2000), including the conservation of landbirds. For planning purposes, Partners in Flight has divided its study area into physiographic areas that are largely based upon physiographic areas set by the North American Breeding Bird Survey. The San Diego NWR Refuge is located within the Central and Southern California Coast and Valleys physiographic area (and is identified as part of Bird Conservation Region 32 [Coastal California], a Partners in Flight North American Conservation Plan Planning Region).

Four of the habitats identified by Partners in Flight as habitats for which careful management is important for the conservation of land birds (i.e., coastal scrub/chaparral, oak woodland, riparian, grasslands) are supported within the San Diego NWR. The protection, restoration, and/or enhancement of these habitats are recommended to reverse declining bird populations within the Central and Southern California Coast and Valleys physiographic area. Presented here are goals and recommendations of the four applicable bird conservation plans. The relevant recommendations of each plan are included, as applicable, in the goals, objectives, and strategies prepared for inclusion in the San Diego NWR CCP.

Oak Woodland Bird Conservation Plan. The Oak Woodland Bird Conservation Plan was developed to promote conservation and restoration of oak woodland habitat to support long-term viability and recovery of both native bird populations and other native species in California (CalPIF 2002). Plan goals include:

- Defining the conservation implications of key problems facing California's oak woodlands (e.g., the long-term lack of recruitment, disease and vectors that result in the loss of significant numbers of oaks, destruction of oak woodland habitats for development and other purposes);
- Informing land managers and others about the complex and interrelated issues affecting California's oak woodlands and their management;
- Providing technical support necessary to select, design, and implement the highest priority conservation and land management actions identified in the plan; and
- Supporting and informing efforts to increase the quantity (acreage) and quality (ecosystem function) of California's oak woodland habitat by providing funding information and promoting on-the-ground conservation projects.

Plan recommendations relevant to the San Diego NWR include:

- Prioritizing oak woodland sites for restoration according to their proximity to existing high-quality sites and according to the likely success of regeneration and transplanted oak viability;
- Restoring protected oak woodland systems to benefit healthy bird populations and promote oak regeneration;
- Restoring understory components of oak woodland systems, as the presence of shrubs and brush piles in the understory of oak woodlands may also help promote the survival of oak seedlings;
- Replacing non-native annual grasses with native perennial grasses in oak woodland systems;
- Restoring upland oak woodland habitats in conjunction with adjacent riparian restoration;
- Restoring natural fire regimes in oak woodlands, whenever possible;

- Restoring a mosaic configuration of a diversity of oak woodland types; and
- Controlling and, where possible, eradicating non-native animal species such as European starlings (*Sturnus vulgaris*), feral cats, and pigs that may be harmful to native birds (CalPIF 2002).

Coastal Scrub/Chaparral Bird Conservation Plan. The Coastal Scrub/Chaparral Bird Conservation Plan was developed to guide conservation policy and action on behalf of coastal scrub/chaparral habitats and wildlife. The primary goals of this plan include:

- Emphasizing the conservation of populations of species and species assemblages;
- Synthesizing and summarizing current scientific knowledge of the requirements of birds in shrubland habitats;
- Providing recommendations for habitat protection, restoration, management, and monitoring to ensure the long-term persistence of birds and other wildlife dependent on shrubland ecosystems; and
- Supporting efforts to increase the overall acreage and effectiveness of shrubland habitat conservation efforts in California (CalPIF 2004)

Plan recommendations relevant to the San Diego NWR include:

- Prioritizing coastal scrub sites for protection and restoration according to their proximity to existing high-quality sites;
- Promoting coastal scrub and chaparral ecosystem health by ensuring that the patch size, configuration, and connectivity of restored scrub habitats adequately support the desired populations of scrub-dependent species;
- Designing and implementing restoration projects that mimic the diversity and structure of natural shrubland plant communities;
- Restoring both shrub canopy and herbaceous understory in coastal scrub habitats;
- Locating restoration sites close to existing shrub habitat patches to allow rare, native, understory herb species to invade restored sites and to increase the structural and floristic diversity of the habitat;
- Planting coastal scrub species in a mosaic pattern modeled after the spatial design of an existing healthy site with similar abiotic characteristics; and
- Controlling and, if possible, eradicating non-native plant species in existing coastal scrub and chaparral sites (CalPIF 2004).

Riparian Bird Conservation Plan. The Riparian Bird Conservation Plan summarizes the current state of scientific knowledge concerning the requirements of birds in riparian habitats and provides recommendations for habitat protection, restoration, management, research, monitoring, and policy (Riparian Habitat Joint Venture 2004).

Those recommendations relevant to the San Diego NWR include:

- Prioritizing the restoration of riparian sites by the ability to restore the natural hydrology of the area, proximity to existing high-quality riparian sites and "source" populations of species that can disperse into the restored habitat, and the ability to provide adequate undisturbed buffer areas;
- Ensuring that the patch size, configuration, and connectivity of restored riparian habitats adequately supports the desired populations of riparian dependent species;

- Increasing the value of ongoing restoration projects for bird species by restoring and managing the structural diversity and volume of the understory, planting native forbs and sedge species, restoring the width of the riparian corridor, and planting vegetation in a mosaic design with dense shrub patches interspersed with trees to achieve a semi-open canopy;
- Providing undisturbed native upland habitat adjacent to riparian areas to provide migratory stopover grounds, foraging habitat, and dispersal corridors for non-breeding adults and juveniles;
- Coordinating with management and restoration projects that are focusing on non-avian taxa to ensure that the benefits of conserving riparian habitats are maximized; and
- Controlling and, where possible, eradicating non-native plant species on a watershed scale (Riparian Habitat Joint Venture 2004).

Draft Grassland Bird Conservation Plan. The draft Grassland Bird Conservation Plan (CalPIF 2000) was developed to guide conservation policy and action on behalf of grassland habitats and birds; to synthesize and summarize current knowledge concerning the requirements of birds in grassland habitats; and to provide recommendations for habitat protection, restoration, management, and monitoring in an effort to ensure long-term persistence of birds and other wildlife dependent on grassland ecosystems.

Those conservation action recommendations presented in the plan that are relevant to the San Diego NWR include:

- Contributing to a statewide monitoring and research effort that will improve our understanding of the distribution of grassland birds in California, identify those habitat qualities that best support grassland bird species, and provide insight into how grassland habitats should be managed to benefit these birds;
- Considering the habitat requirements of grassland bird species when developing and implementing native grassland habitat management and restoration plans; and
- Protecting native grassland areas from disturbance (CalPIF 2000).

4.3.2 Vegetation Communities

4.3.2.1 Overview

San Diego County supports a wide range of native vegetation communities, many of which occur within the boundaries of the San Diego NWR. The type of vegetation present in a particular area is influenced by many factors, including geographic location, soil type and sometimes the associated underlying geologic formation, moisture availability and precipitation rates, slope aspect (i.e., the direction a slope is facing), degree of site inclination or steepness, site elevation, and level of disturbance. These factors also affect the distribution and abundance of specific plant species within the various vegetation communities.

Vegetation mapping for the Del Mar Mesa Vernal Pool Unit was prepared by SANDAG (1995), with classifications based on Holland (1986). Vegetation mapping for the Otay-Sweetwater Unit was conducted in 2007 by Recon Environmental, Inc. (RECON). This vegetation mapping effort involved evaluating existing vegetation mapping prepared for the San Diego MSCP Plan (SANDAG 1995) and updating that data as necessary based on current aerial photography and some field investigations to "ground truth" the results of the aerial photography analysis. The delineation of vegetation communities was based on *Preliminary Descriptions of the Terrestrial Natural Communities of California* (Holland 1986), as revised by Thomas Oberbauer in 1996.

Following completion of the Refuge's updated vegetation mapping project, the Holland classification system was further modified for San Diego County in *Draft Vegetation Communities of San Diego County* (Oberbauer et al. 2008) and again in February 2011 in the *Vegetation Classification Manual for Western San Diego County* (Sproul et al. 2011). The most recent classification, which delineates the vegetation communities more narrowly than either Holland or Oberbauer, describes the native and naturalized vegetation types known to occur within western San Diego County and provides users with a means to determine each vegetation type through direct observations of species composition (Sproul et al. 2011). This latest classification manual was prepared consistent with the recommendations for standardized data collection and analysis provided in CDFW VegCAMP (http://www.dfg.ca.gov/biogeodata/vegcamp/), as well as the methods used to prepare *A Manual of California Vegetation*, 2nd ed. (Sawyer et al. 2008).

These methods are modeled after the National Vegetation Classification Standards (NVCS), "a central organizing framework for how all vegetation in the United States is inventoried and studied, from broad scale formations (biomes) to fine-scale plant communities" (http://usnvc.org/). The latest classification standard was published in 2008 by the Federal Geographic Data Committee and provides the basis for ongoing refinement of the National Vegetation Classification. The hierarchy of the NVCS is represented by eight primary levels, with the highest levels emphasizing physiognomic (structural and ecological) similarities with floristic composition. The lowest levels, referred to as alliances and associations, focus on floristic variations within an area (Sproul et al. 2011). Alliances are typically defined by the presence of diagnostic species within a range of cover values within a single plant stratum, whereas associations represent a subset of types within an alliance, which are further defined by additional diagnostic species that may be present in any stratum.

A listing of the vegetation types present on the Refuge, using the Holland classifications as modified by Oberbauer et al. (2008), is presented in Table 4-4, as is the estimated acreage of each vegetation type within the Otay-Sweetwater Unit and Del Mar Mesa Vernal Pool Unit.

Table 4-4
Summary of Vegetation Types Present on the San Diego NWR[1]

Vegetation Type	Approximate Acreage on the Otay-Sweetwater Unit	Approximate Acreage on the Del Mar Mesa Vernal Pool Unit
Coastal Sage Scrub	7,700 acres	0
Chaparral	3,100 acres	60 acres
Native Grassland	154 acres	0
Non-native Grassland	78 acres	0
Oak Woodland	114 acres	0
Coast Live Oak Riparian Forest	86 acres	0
Cottonwood-willow Riparian Forest	170 acres	0
Riparian Willow Scrub	4 acres	0
Other Wetlands	15 acres	0
Southern Interior Cypress Forest	3 acres	0
Non-Native Woodland	36 acres	0
Unvegetated	10 acres	0

[1] This table does not include vernal pool vegetation, a specialized vegetation type that occurs in depressions (vernal pools) surrounded by grassland vegetation on the Otay-Sweetwater Unit and chaparral vegetation on the Del Mar Mesa Vernal Pool Unit.

(For a crosswalk to correlate the modified Holland nomenclature with the vegetation classifications used in the *Vegetation Classifications Manual for Western San Diego County*, refer to Appendix C of *Vegetation Classification Manual for Western San Diego County* [Sproul et al. 2011]). More detailed mapping of the vegetation on the Otay-Sweetwater Unit is available for review upon request at the Refuge Complex headquarters.

A general description of the mapped vegetation types, consistent with the Holland classifications (1986), is presented in the following text. Additional information about these vegetation types is taken from Oberbauer et al. (2008) and Sproul et al. (2011). This general discussion of vegetation types is followed by a more detailed description of the vegetation present within each of the six management areas within the Refuge boundary.

4.3.2.2 Forest and Woodland Vegetation

Upland Forests and Woodlands

Southern Interior Cypress Forest. Southern interior cypress forest is a relatively dense, low, fire-maintained coniferous forest dominated by Tecate cypress (*Hesperocyparis forbesii*). Stands are often even-aged due to high mortality rates during fires and the requirement of high temperature to stimulate seed germination. Tree density varies in relation to site factors and fire history. Tecate cypress is locally common on portions of Otay Mountain, occurring within chaparral on slopes and ridges and in steep drainages.

Coast Live Oak Woodland. This woodland is dominated by evergreen coast live oaks (*Quercus agrifolia)* reaching 32 to 82 feet (10 to 25 meters) in height. This vegetation typically occurs on north-facing slopes or in shaded ravines and intergrades with coastal sage scrub or mixed chaparral on drier sites (Holland 1986). The shrub layer is typically poorly developed but may include tree (*Heteromeles arbutifolia*), currant *(Ribes* spp.), laurel sumac (*Malosma laurina*), and desert elderberry (*Sambucus mexicana*). The herbaceous component is continuous and often dominated by weedy species.

Eucalyptus Woodland. Eucalyptus woodland is typically characterized by dense stands of gum trees *(Eucalyptus* spp.). Plants in this genus, imported primarily from Australia, were originally planted in groves throughout many regions of coastal California as a potential source of lumber and building materials, for their use as windbreaks, and for their horticultural novelty. They have increased their cover through natural regeneration, particularly in moist areas sheltered from strong coastal winds. Gum trees naturalize readily in the region and, where they form dense stands, they tend to completely supplant native vegetation, greatly altering community structure and dynamics. Very few native plants are compatible with eucalyptus (City of San Diego 1995)

Riparian Forests and Woodlands

Southern Riparian Woodland. This vegetation is characterized by moderate-density riparian woodlands dominated by small winter-deciduous trees or shrubs (e.g., willows [*Salix* sp.], mulefat [*Baccharis salicifolia*]) with scattered taller riparian trees. This vegetation, which contains more western sycamores (*Platanus racemosa*) than cottonwoods (*Populus fremontii*), typically occurs in those areas of major river systems and smaller major tributaries that are routinely or periodically affected by flood scour (Oberbauer et al. 2008).

<u>Southern Cottonwood-Willow Riparian Forest</u>. This vegetation community occurs along streams and rivers, occupying relatively broad drainages and floodplains. It can consist of an open or closed canopy forest, with trees that are generally greater than 20 feet (six meters) high. Dominated by mature winter deciduous trees, including Fremont's cottonwood and several species of tree willows (i.e., *Salix gooddingii, S. lasiandra, S. lasiolepis*), this community often has a dense understory of shrubby willows, mulefat, and mugwort (*Artemisia douglasiana*). The dominant species require moist, bare mineral soil for germination and establishment (Holland 1986), an environment that is provided after flood waters recede. Riparian forest differs from riparian woodland in that western sycamore is generally lacking, or at least is not dominant. Coast live oaks are also mostly absent from this community.

<u>Southern Coast Live Oak Riparian Forest</u>. Holland (1986), as modified by Oberbauer et al. (*2008*), identifies open to locally dense riparian forests of coast live oak located in bottomlands and outer floodplains along larger streams as southern coast live oak riparian forest. This vegetation tends to be richer in herbs and poorer in understory shrubs than those of other riparian communities. In addition to coast live oak, these areas are characterized by mugwort, spotted eucrypta (*Eucrypta chrysanthemifolia*), toyon, wild cucumber (*Marah macrocarpus*), California wild rose (*Rosa californica*), desert elderberry, and poison oak (*Toxicodendron diversilobum*) (Oberbauer et al. 2008).

<u>Southern Arroyo Willow Riparian Forest</u>. This vegetation type consists of winter-deciduous riparian forests with closed or nearly closed canopies that are dominated by moderately tall broad-leaved trees, primarily arroyo willow (*Salix lasiolepis*) (Oberbauer et al. 2008). Typically occurring on frequently flooded areas along rivers and streams, southern arroyo willow riparian forest and the understory usually consists of mulefat and shrubby willows, including sandbar willow (*Salix exigua*) and occasional Goodding's (black) willow (*Salix gooddingii*) and/or red willow (*Salix laevigata*). Understory plants can include western ragweed (*Ambrosia psilostachya*), mugwort, and spiny rush (*Juncus acutus* ssp. *leopoldii*) (Sproul et al. 2011).

4.3.2.3 Shrubland Vegetation

<u>Chaparral</u>

This shrubland vegetation is widely distributed throughout California on dry slopes and ridges at low and medium elevations where it occupies thin, rocky, or heavy soils. It is typically composed of hard-stemmed, leathery leaved shrubs, with a species composition that varies considerably with location. The plants of this community have adapted to wildfire by either resprouting from underground roots following a burn and/or producing seeds that require a fire-related cue to stimulate germination. If fires occur too frequently, the chaparral vegetation may be replaced with weedy, non-native vegetation (City of San Diego 1995).

Four distinct chaparral associations were recognized by Holland (1986), and numerous associations and alliances are described by Sproul et al. (2011). The four associations recognized by Holland are present within the San Diego NWR: southern maritime chaparral, southern mixed chaparral, chamise chaparral, and scrub oak chaparral.

Southern maritime chaparral, which is further divided into species-specific associations by Sproul et al. (2011), is generally comprised of low, relatively open vegetation characterized by such species as wart-stemmed ceanothus (*Ceanothus verrucosus*), Del Mar manzanita (*Arctostaphylos glandulosa* ssp. *crassifolia*), summer-holly (*Comarostaphylis diversifolia* ssp.

diversifolia), Del Mar sand aster (*Corethrogyne filaginifoila var. linifolia*), and sea dahlia (*Coreopsis maritima*). Other species that commonly occur in this habitat are chamise (*Adenostoma fasciculatum*), mission manzanita (*Xylococcus bicolor*), and toyon. The southern maritime chaparral present on the Refuge's Del Mar Mesa parcels supports Nuttall's scrub oak (*Quercus dumosa*), which is included in the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants on list 1B.1 (rare in CA and elsewhere). Geographically, southern maritime chaparral is restricted primarily to the coastal fog belt (Oberbauer et al. 2008). As with other chaparral associations, fire appears to be necessary for continued reproduction of many of the characteristic species within southern maritime chaparral (Holland 1986).

Distinguishing southern maritime chaparral from southern mixed chaparral, as described by Oberbauer et al. (2008), can be difficult. The larger differences between these two associations include the number and dominance of characteristic southern maritime chaparral species, the structural characteristics of the vegetation, and the range of soil types and geographical areas over which these habitats occur. Species such as Del Mar manzanita, wart-stemmed ceanothus, summer-holly, and others tend to be more frequent and have increased dominance in southern maritime chaparral, while species such as chamise, toyon, and mission manzanita typically dominate southern mixed chaparral. Species richness (i.e., the number of species per unit area) also seems to be higher in southern maritime chaparral than in southern mixed chaparral, and southern maritime chaparral is often more open and lower growing than southern mixed chaparral (Oberbauer et al. 2008).

Chamise chaparral is characterized by nearly monotypic stands of chamise, with these shrubs measuring from three to 10 feet (one to three meters) in height. Additional shrub species, such as mission manzanita and our Lord's candle (*Yucca whipplei*), may be present, but contribute little to the overall cover. The herbaceous component of this association is largely lacking. Chamise chaparral occurs on xeric slopes and ridges and is found on shallower, drier soils or at somewhat lower elevations than southern mixed chaparral (City of San Diego 1995).

Southern mixed chaparral is typically dominated by broad-leaved sclerophyllous (i.e., hard-leaved) shrubs or small trees that characteristically occupy protected north-facing slopes, as well as canyon slopes or ravines, where more mesic conditions are present. Dominant shrubs in this community are generally about five feet (1.5 meters) in height on ridges and 6.5 to 8.0 feet (2.0 to 2.5 meters) high in ravines. This association is typically a mixture of chamise, mission manzanita, Ramona lilac (*Ceanothus tomentosus* spp. *olivaceus*), and laurel sumac. Subdominant shrub species include holly-leafed redberry (*Rhamnus ilicifolia*), yellow-bush penstemon (*Keckiella antirrhinoides*), flat-top buckwheat (*Eriogonum fasciculatum*), our Lord's candle, Mohave yucca (*Yucca schidigera*), scrub oak (*Quercus berberidifolia*), and toyon. The understory of dense stands of mixed chaparral is fairly sparse. Many species in this community are adapted to fire. Although the vegetation is usually dense, it can include patches of bare soil where the vegetation is more open. A variety of species may be present in these open areas including, mariposa lily (*Calochortus* spp.), soap plant (*Chlorogalum* spp.), and bedstraw (*Galium* spp.) (Oberbauer et al. 2008).

Scrub oak chaparral is a dense, evergreen chaparral association that approaches 20 feet (six meters) in height and is dominated by scrub oak. This habitat occurs on more mesic sites than other chaparral associations and often at slightly higher elevations. These more favorable sites often allow scrub oak chaparral to recover from fire more quickly than other chaparral types (City of San Diego 1995). Other shrub species that occur in scrub oak chaparral include toyon, mountain mahogany (*Cercocarpus montanus* var. *glaber*), and holly-leaf redberry. Understory species that may be present include poison oak and bedstraw.

Rock outcrops are common within areas supporting chaparral vegetation. Where present, these rocky outcrops often provide distinct microhabitats that support plant species generally absent or uncommon throughout most of the surrounding mixed chaparral community. Such species include melic grass (*Melica frutescens*), California bee-plant (*Scrophularia californica* var. *floribunda*), cotton fern (*Cheilanthes newberryi*), California brickelbush (*Brickellia californica*), and caterpillar phacelia (*Phacelia cicutaria*).

The vegetation mapping as of August 2013 indicated that approximately 27 percent of the lands included within the Otay-Sweetwater Unit support chaparral vegetation. Within the Del Mar Mesa Vernal Pool Unit, virtually all of the lands support chaparral vegetation (SANDAG 1995).

Coastal Sage Scrub
Coastal sage scrub is comprised of low, soft-woody subshrubs, generally no higher than three feet (one meter). This vegetation community is typically located on dry sites, such as steep, south-facing slopes or clay-rich soils that are slow to release stored water. The dominant shrub species vary depending on local site factors and levels of disturbance. Sproul et al. (2011) separates these into distinct associations and alliances. Dominants may include California sagebrush (*Artemisia californica*), flat-top buckwheat, laurel sumac, white sage, broom baccharis (*Baccharis sarothroides*), and San Diego sunflower (*Bahiopsis laciniata* [*Viguiera laciniata*]). Other, less frequent, constituents include spiny redberry (*Rhamnus crocea*), deerweed (*Lotus scoparius*), and yellow bush-penstemon (City of San Diego 1995).

The shrub layer in this community ranges from a continuous canopy and little understory to a more open canopy with widely spaced shrubs and a well-developed understory. Native understory species include foothill stipa (*Stipa lepida*), ashy spike-moss (*Selaginella cinerascens*), chalk live-forever (*Dudleya pulverulenta*), wishbone bush, and coast barrel cactus (*Ferocactus viridescens*).

Vegetation mapping of the Refuge indicates that as of August 2013, coastal sage scrub vegetation covered approximately 67 percent (about 7,700 acres) of the lands included within the Otay-Sweetwater Unit. No coastal sage scrub vegetation is present on the four parcels included within the Del Mar Mesa Vernal Pool Unit (SANDAG 1995).

Riparian Scrublands
This scrubby vegetation, which occurs in riparian zones, is described by Holland (1986) as modified by Oberbauer et al. (2008) as southern riparian scrub, consisting of mulefat scrub and southern willow scrub, while Sproul et al. (2011) divides riparian scrublands into various associations (e.g., *Salix lasiolepis* Association, *Salix laevigata* Association) based on the dominant species present in a particular location.

The mix of species in riparian scrub vegetation can vary from a dense, broad-leaved, winter-deciduous association dominated by several species of willow (southern willow scrub) to an herbaceous scrub association dominated by mulefat (mulefat scrub). The former association is found on loose, sandy, or fine gravelly alluvium deposited near stream channels during floods, and most stands are too dense to allow much understory to develop (Holland 1986). Typical willow species include arroyo willow, sandbar willow, red willow, and Goodding's willow. Other species typically present in these areas include mulefat and western sycamore. Frequent flooding maintains this early seral community, preventing succession to a riparian woodland or forest (Holland 1986). Most stands are too dense to allow any substantive understory development (Oberbauer et al. 2008).

Areas dominated by mulefat scrub occur along intermittent streams with a fairly coarse substrate and moderately deep water table. The vegetation is depauperate, tall, herbaceous riparian scrub strongly dominated by mulefat (Oberbauer et al. 2008). Other characteristic species include sandbar willow, arroyo willow, poison oak, and stinging nettle (*Urtica holosericea*). This early seral community is maintained by frequent flooding; without flooding, most stands would be expected to succeed to cottonwood- or sycamore-dominated riparian forests or woodlands (City of San Diego 1995, Sproul et al. 2011).

Less than five acres of riparian scrub vegetation has been mapped within the Otay-Sweetwater Unit. This vegetation type is not present on the parcels included within the Del Mar Mesa Vernal Pool Unit.

4.3.2.4 Herbaceous Vegetation

Upland Herbaceous Vegetation

Native Perennial Grassland. Perennial grassland is grassland dominated by native bunchgrass (City of San Diego 1995). Within the Refuge, it is typically dominated by dense, irregular tussocks of native purple needlegrass (*Stipa pulchra*) interspersed with several other herbs and grasses, including shooting-star (*Dodecatheon clevelandii*), blue-eyed grass (*Sisyrinchium bellum*), common golden star (*Bloomeria crocea*), morning glory (*Calystegia macrostegia*), splendid mariposa lily (*Calochortus splendens*), and several non-native grasses such as fescue (*Vulpia* sp.) and soft chess (*Bromus hordeaceus*). This plant association, which typically alternates with coastal sage scrub on some clay soils, often occurs on more mesic exposures and at the base of slopes.

Approximately 15 acres within the McGinty Mountain area have been mapped as native grassland vegetation. Native grassland vegetation also occurs in various other locations throughout the Otay-Sweetwater Unit.

Non-native Grasslands. Non-native grassland is a dense to sparse cover of annual grasses, often associated with numerous species of showy-flowered native annual forbs (City of San Diego 1995). Characteristic species include wild oats (*Avena* spp.), foxtail chess (*Bromus madritensis* ssp. *rubens*), ripgut grass (*Bromus diandrus*), ryegrass (*Lolium* sp.), and mustard (*Brassica* spp.). Most of the annual introduced species in this vegetation community originated from the Mediterranean region, an area with a climate similar to California. Plant germination in these grasslands occurs with the onset of the late fall rains, well before many native forbs have sprouted; growth, flowering, and seed-set occur from winter through spring. With a few exceptions, the plants are dead through the summer-fall dry season, persisting as seeds. Approximately 78 acres on the Otay-Sweetwater Unit were mapped as non-native grasslands as of August 2013. A number of the areas mapped as non-native grasslands within the San Miguel Mountain and Sweetwater River areas burned in the 2007 Harris Fire. Although dominated by non-native grasses and annuals at the time of mapping, these areas may ultimately recover from the effects of the fire and eventually support coastal sage scrub or native grassland habitat.

Hydrophytic Herbaceous Vegetation

Freshwater Marsh. Freshwater marsh is dominated by perennial, emergent monocots ranging from four to seven feet (1.3 to 2 meters) in height. Uniform stands of bulrushes *(Schoenoplectus* spp.) or cattails *(Typha* spp.) often characterize this habitat. Freshwater marsh occurs in wetlands that are permanently flooded by standing fresh water (Holland 1986).

Emergent Wetland. These wetlands, which are dominated by low growing perennial wetland species such as sedges (*Carex* spp.), spike rushes (*Eleocharis* spp.), rushes (*Juncus* spp.), docks (*Rumex* spp.), and bur reed (*Sparganium eurycarpum*) occur in channels, seeps and springs, floodplains, margins of lakes and rivers, and various basins such as pools and ponds (Oberbauer et al. 2008).

Vernal Pools. Vernal pools are a unique, specialized form of seasonal wetlands that occur in a geographical area extending from southern Oregon through California into northern Baja California, Mexico (USFWS 1998a). Vernal pool habitats are not homogeneous throughout this large area because of regional differences in climate, topography, and soils (USFWS 1998a). Although the vernal pools of southern California share some wide-ranging temporary wetlands species with pools in other parts of the State, the pools in southern California support species unique to the area, which helps to set them apart (Stone 1990). In fact, the vernal pools in southern California support at least 12 endemic plants (USFWS 1998a), including seven plant species protected under the ESA.

Vernal pools require a unique combination of climatic, topographic, geologic, and evolutionary factors for their formation and persistence. In southern California, these pools form in areas where downward percolation of water is prevented by an impervious subsurface layer consisting of claypan, hardpan, or volcanic stratum (Holland 1976, Holland 1986). Under these conditions, the pools appear as shallow depressions filled with rainwater during fall and winter months and as dry depressions in the summer after the water in the pools has evaporated (Holland 1976, Thorne 1984). Seasonal inundation makes vernal pools too wet for adjacent upland plant species adapted to drier soil conditions, while rapid drying during late spring makes pool basins unsuitable for typical marsh or aquatic species that require a more persistent source of water. As a result, vernal pools support a distinctive living community adapted to extreme variability in hydrologic conditions (Oberbauer et al. 2008).

According to Bauder and McMillan (1998), the vernal pool landscapes in San Diego County are fragmented by "mountains and the discontinuity of suitable soils and/or microtopography." This fragmentation, along with differences in the underlying geological formations, surface soil properties, hydrology, micro- and landscape-level topography and sub-regional climate, results in a species distribution that varies greatly within the pools located between north coastal San Diego County and the Mexican border. The plant species confined to these pools constitute what Thorne (1976) calls the vernal pool ephemeral plant community and Holland (1986) refers to as San Diego mesa vernal pools (City of San Diego 1995).

For convenience of reference, groups of vernal pools are sometimes referred to as vernal pool complexes that may include two to several hundred individual vernal pools (Keeler-Wolf et al. 1998). Vernal pool complexes are defined as a series of vernal pool groups that are hydrologically connected with similar soil types and species compositions. Within San Diego County, they were first described and surveyed by Beauchamp and Cass (1979) and subsequently updated in 1986 (Bauder) and by the City of San Diego in 2004. Local upland vegetation communities associated with vernal pools include needlegrass grassland, annual grassland, coastal sage scrub, maritime succulent scrub, and chaparral (USFWS 1998a).

Holland recognizes two types of vernal pools in San Diego County: San Diego mesa hardpan vernal pools, like those found on Del Mar Mesa, and San Diego mesa claypan vernal pools, such as those found on Otay Mesa, in Proctor Valley, around Lower Otay Reservoir, and to the southeast of the Sweetwater Reservoir. Vernal pools are often surrounded by low hummocks called mimamounds, but this feature is not always present.

San Diego mesa hardpan vernal pools, which are present in the Del Mar Mesa Vernal Pool Unit of the Refuge, are a low, mesic, herbaceous community dominated by annual herbs and grasses. Sensitive plant species expected to occur in these types of pools include San Diego button-celery (*Eryngium aristulatum var. parishii*), federally listed as endangered; little mousetail (*Myosurus minimus* ssp. *apus*); spreading navarretia (*Navarretia fossalis)*, federally listed as threatened; Orcutt's brodiaea (*Brodiaea orcuttii*); California adder's tongue-fern (*Ophioglossum lusitanicum* ssp. *californicum*); and San Diego mesa mint (*Pogogyne abramsii*), federally listed as endangered. The mimamounds associated with these pools are generally well developed, and the surrounding vegetation is often chamise chaparral (City of San Diego 1995). Iron-silica cemented soils, often of the Redding soils series, form the hardpan layer (Holland 1986).

San Diego mesa claypan vernal pools, which are present in the Otay-Sweetwater Unit of the Refuge, are generally characterized by lower, overall vegetative cover than hardpan pools. Typical sensitive plant species in these pools include San Diego button-celery; little mousetail; spreading navarretia; California Orcutt's grass (*Orcuttia californica*), federally listed as endangered; and Otay mesa mint (*Pogogyne nudiuscula*), federally listed as endangered (City of San Diego 1995). The microrelief of these pools is often lower than hardpan pools, and they are generally surrounded by grassland or sparse coastal sage scrub rather than chaparral. Claypan pools are restricted to marine terraces in the southwestern portion of the county.

Historically, vernal pool habitat, which was scattered throughout San Diego County in locations with appropriate soil and hydrological conditions, covered approximately 200 square miles (520 square kilometers), or about six percent of the county (USFWS 1998a). Only a fraction of this habitat remains intact today. Current estimates indicate that 95 to 97 percent of the vernal pool habitat in the San Diego County has been lost to urbanization and agriculture (Bauder and McMillan 1998). In recent years, efforts have been made to restore and/or recreate vernal pool habitat on preserved lands, including within the Otay-Sweetwater Unit of the San Diego NWR, where vernal pools were historically present.

4.3.2.5 Overview of the Vegetation Types Present within Each Refuge Area

This discussion provides an overview of the vegetation types present within the five distinct areas of the Otay-Sweetwater Unit, as well as the Del Mar Mesa Vernal Pool Unit.

Otay-Sweetwater Unit - McGinty Mountain Area

Much of this portion of the Refuge has been largely unchanged by development and human activity. The primary exception is a network of trails that cross the area. As illustrated in Figure 4-12, six general vegetation communities occur within this portion of the Refuge: coastal sage scrub, which is the most wide spread plant community on McGinty Mountain; southern mixed chaparral, which in some areas forms dense, impenetrable stands, is the dominant plant community at the higher elevations; perennial native grassland; oak woodland; a small area of riparian scrub; and eucalyptus woodland. The mesa to the north of McGinty

Mountain peak supports a small area of riparian scrub, as well as a mosaic of coastal sage scrub and intervening patches (less than 0.1 acre) of native grassland (Dudek & Associates 1995).

Coast live oak occurs in low densities on some of the area's north-facing slopes and is the dominant species in the southern coast live oak woodland present within the area's major drainages and more mesic mountain slopes. Engelmann oak (*Quercus engelmannii*) and scrub oak also occur within areas identified as southern coast live oak, including portions of the parcel located along Jamul Drive, the southernmost parcel within this area.

The composition and structure of the vegetation in this management area is also influenced to some extent by the chemical and structural properties of the soil types present on McGinty Mountain, primarily the gabbro soils of the Las Posas soil series. A number of sensitive plant species are either wholly restricted to or generally associated with these soil types, which are present on portions of McGinty Mountain's west and south-facing slopes.

The upper elevations of the mountain are characterized by outcrops of gabbro-derived soils. Gabbro outcrops weather into soils that content a greater iron and magnesium contact than other more common soils in the area. The unique mineral content of these gabbro-derived soils restricts the growth of many common plant species, while allowing species that are gabbro-tolerant to thrive (Dudek & Associates 1995). The threatened San Diego thornmint (*Acanthomintha ilicifolia*) is a gabbro-tolerant plant species present within the McGinty Mountain area.

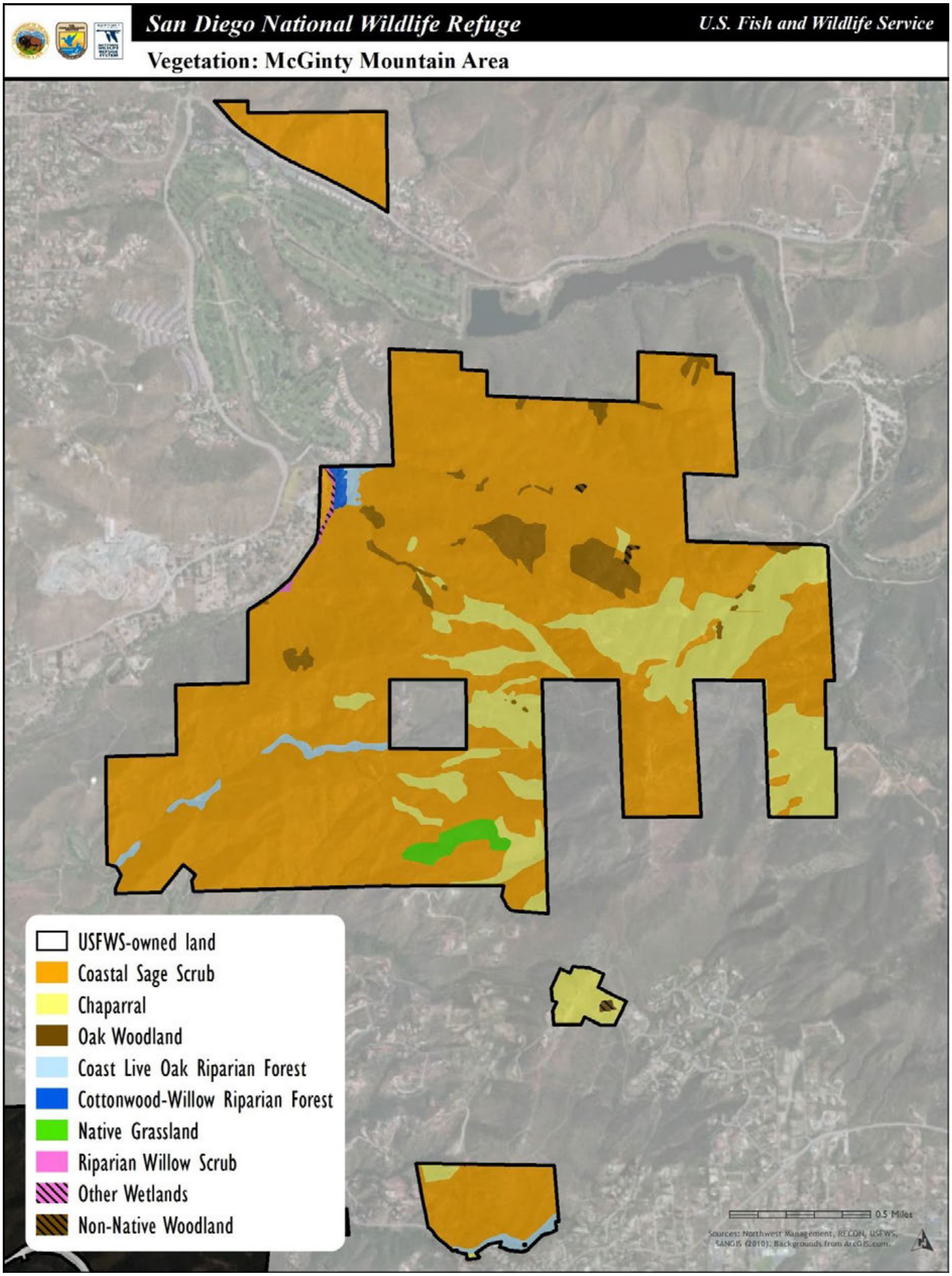

Figure 4-12. Vegetation Types Present on the McGinty Mountain Area

Otay-Sweetwater Unit - Las Montañas Area

Unlike the McGinty Mountain area, portions of the Las Montañas area have been subject to significant human disturbance. In the early 1990s, approximately 190 acres of this area were graded and/or cleared in conformance with approved development plans (Dudek & Associates 1994). Over the years, natural recruitment of pioneer coastal sage scrub species has occurred within these disturbed sites, particularly within previously graded areas on the south side of Highway 94, and much of this area now supports successional coastal sage scrub vegetation. The rest of this management area is mostly undisturbed, supporting a rich diversity of plant and wildlife species.

As illustrated in Figure 4-13, five native plant communities (southern mixed chaparral, coastal sage scrub, southern coast live oak riparian forest, coast live oak woodland, and mulefat scrub) are present in this area. North of Highway 94, the dominant vegetation type is coastal sage scrub; to the south, the majority of the site supports dense southern mixed chaparral, with oak woodland present in the major drainages and coastal sage scrub present on the drier slopes.

Located within the drainage that parallels the south side of Highway 94 is a well-developed southern coast live oak riparian forest dominated by coast live oak; it also includes individual western sycamores and Mexican elderberry, as well as patches of willow and mulefat. Also occurring in this vegetation are non-native trees including eucalyptus and Brazilian pepper-tree (*Schinus terebinthifolius*). Coast live oaks can also be found in shaded canyon bottoms and on mesic north-facing slopes within this area.

Otay-Sweetwater Unit - Sweetwater River Area

This portion of the Otay-Sweetwater Unit includes a 3.0-mile (4.8-kilometer) section of the Sweetwater River located between the Sweetwater Reservoir in the south and an existing golf course located near the intersection of Willow Glen Drive and Jamacha Road in the north. Within the Sweetwater River floodplain, the riparian vegetation ranges from riparian scrub, characterized by willows and mulefat, to well-developed riparian woodland. This riparian woodland is dominated by arroyo willow and black willow, with scattered individuals of western sycamore, coast live oak, velvet ash (*Fraxinus velutina*), and California black walnut (*Juglans californica*). This vegetation, as well as areas of coast live oak woodland, is present along Steele Canyon Creek. There are also areas of freshwater marsh located within this portion of the Sweetwater River floodway.

Coastal sage scrub is the predominant vegetation type within the upland portions of this area, occupying most of the south- and east-facing slopes that extend down into the Sweetwater River floodplain. Other native plant communities include southern mixed chaparral, coast live oak woodland, and native grassland (Figure 4-14). Coast live oak woodland tends to occur in deeper drainages and on steep north-facing slopes (Ogden 1994).

Small patches of native grassland (too small to depict in Figure 4-14) can be found scattered throughout the area south of Steele Canyon Creek upstream of its confluence with the Sweetwater River. Additional exotic and native grassland is present on the parcel north of Jamacha Road. An isolated 25-acre refuge parcel referred to as Lot 707 (northwest of the Sweetwater River) consists of an abandoned olive grove with an understory of native and non-native plants, including patches of native coastal sage scrub vegetation.

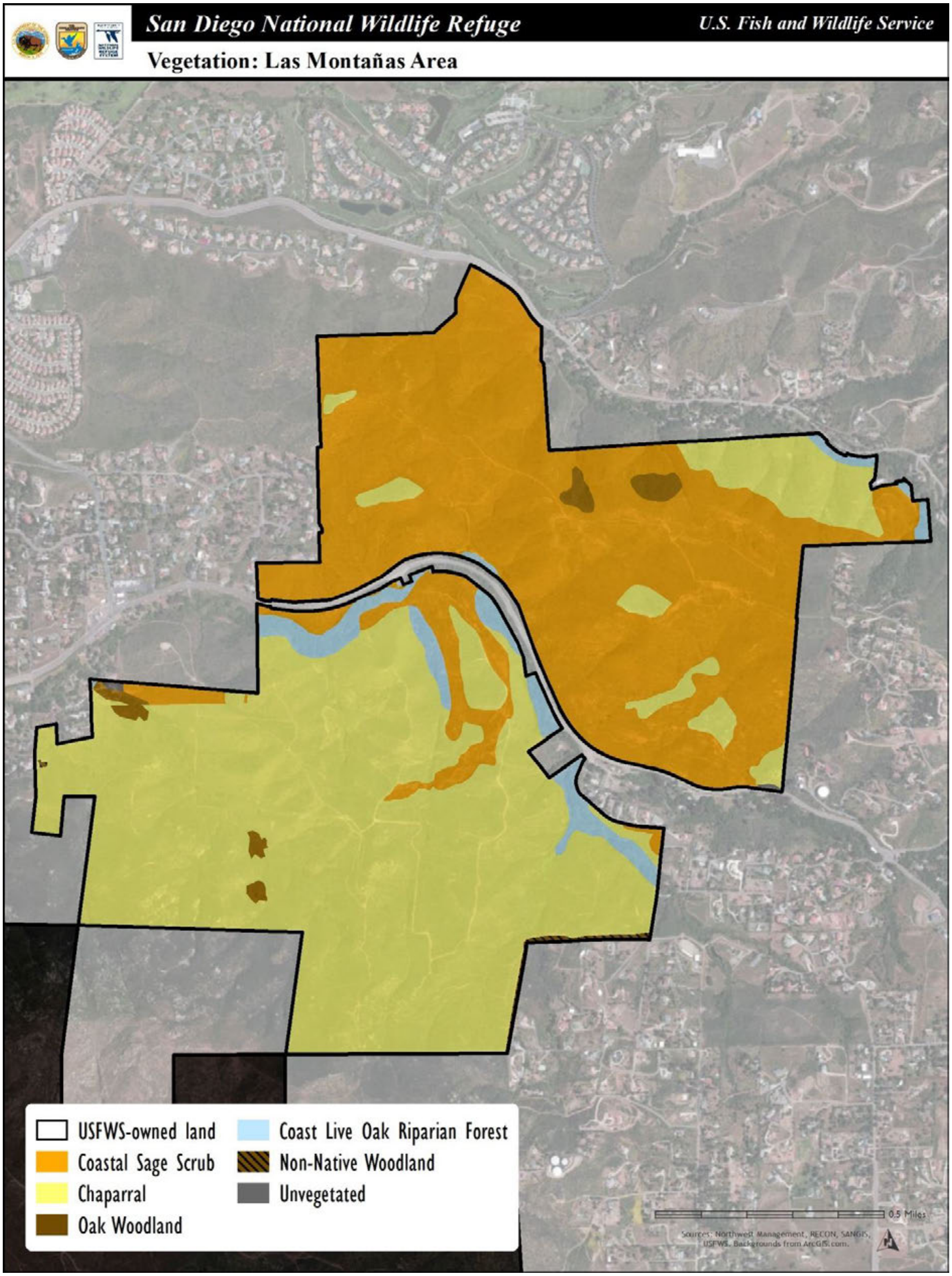

Figure 4-13. Vegetation Types Present on the Las Montañas Area

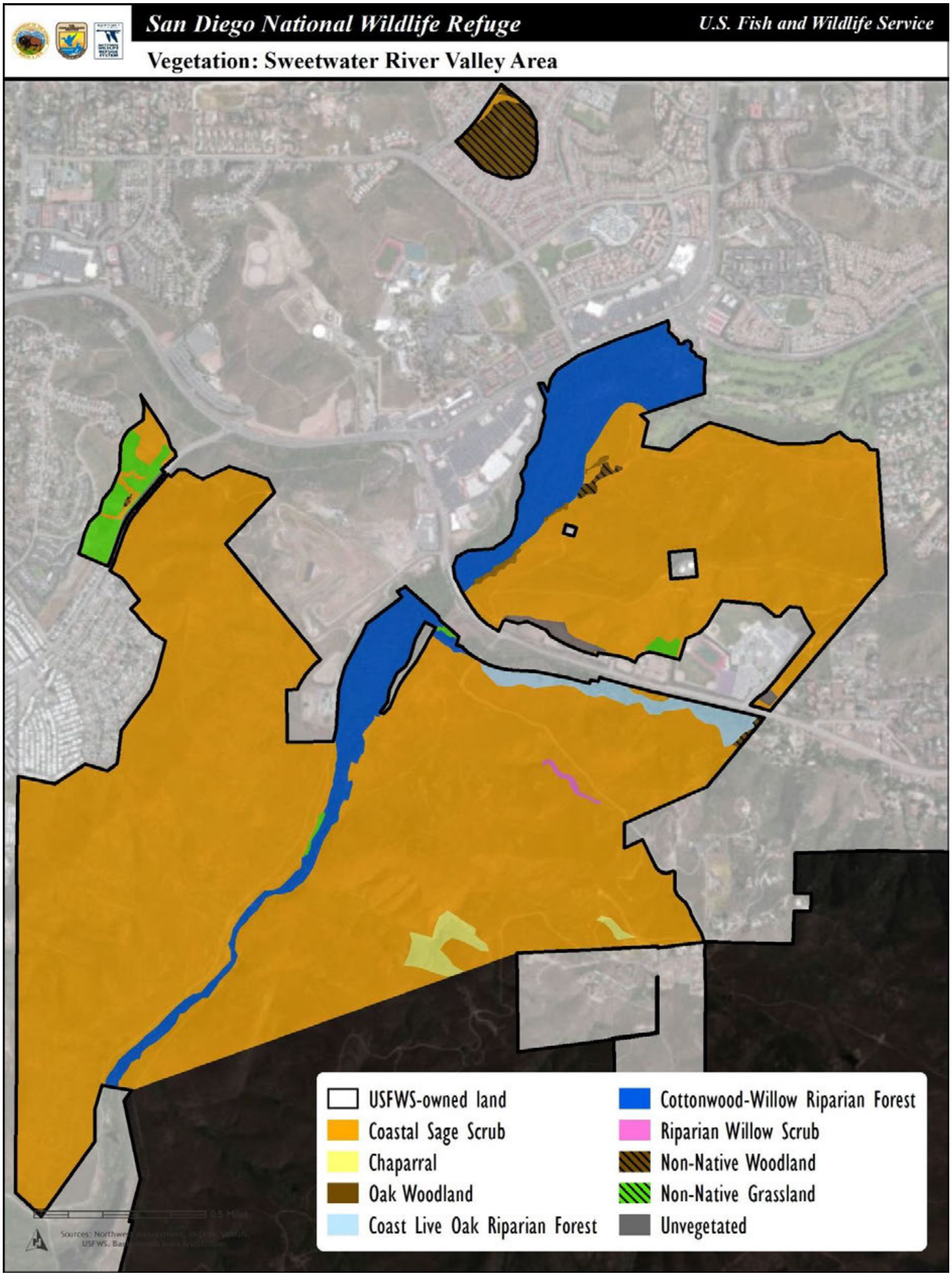

Figure 4-14. Vegetation Types Present on the Sweetwater River Area

Otay-Sweetwater Unit - San Miguel Mountain Area

The vegetation types present within the San Miguel Mountain area, as illustrated in Figure 4-15, include coastal sage scrub, southern mixed chaparral, riparian scrub, and non-native grasslands. Small areas of disturbed native grassland also occur in this area. The majority of the vegetation within the San Miguel Mountain Area has been adversely affected by wildland fires. The fire history of this area is illustrated in Figure 4-16. This history includes a number of small fires and several notable large fires including the 1970 Laguna Fire (Pacific Southwest Biological Services, Inc. 1991), the 1985 Miller Fire, and the Harris Fire, which burned almost the entire San Miguel Mountain area in 2007.

Historically, Mother Miguel Mountain and the western slopes of San Miguel Mountain were dominated by very high quality coastal sage scrub vegetation, interspersed with pockets of native grassland, chamise chaparral, and southern mixed chaparral vegetation (Pacific Southwest Biological Services, Inc. 1991). This area also includes several old stock ponds and ephemeral drainages that support freshwater marsh and riparian scrub vegetation. Vernal pool habitat has been restored in the extreme southwestern portion of this area.

The eastern portion of this area, particularly the upper southern, eastern, and northern slopes of San Miguel Mountain, is dominated by southern mixed chaparral, while the southeast-facing slopes located along the western edge of Proctor Valley support coastal sage scrub. A small canyon in the northeastern portion of this area supports coast live oak woodland. In the northeast portion of the San Miguel Mountain area is Hidden Valley, which is dominated by areas of coastal sage scrub and chaparral. Also present are two patches (totally about 22 acres) of dense coast live oak woodland. Areas of southern mixed chaparral are present on the north-facing slopes along this area's northern boundary.

The metavolcanic rock and associated soils, which occur at the upper elevations of San Miguel Mountain and on portions of the Jamul Mountains, support an assemblage of unique plant species, including Gander's pitcher sage (*Lepechinia ganderi*) and San Miguel savory (*Satureja chandleri*). In addition, clay lenses, known to support a variety of narrow endemic plants, are present in the lower elevations of this area. Clay lenses are typically devoid of woody perennial shrubs and instead support forbs, native grasses, and geophytes (perennial plants propagated by buds on underground bulbs, tubers, or corms such as lilies, iris, and onions) (Oberbauer and Vanderwier 1991). Native plants that may be found in these areas include Palmer's grapplinghook (*Harpagonella palmeri*), variegated dudleya (*Dudleya variegata*), wild hyacinth (*Dichelostemma pulchellum*), golden stars, San Diego golden star (*Muilla clevelandii*), chocolate lily (*Fritillaria biflora*), and small-flowered morning glory (*Convolvulus simulans*).

Otay-Sweetwater Unit - Otay Lakes and Mesa Area

As illustrated in Figure 4-17, the area's northern parcel supports coastal sage scrub with scattered barren, rocky outcrops and small pockets of chamise and ceanothus chaparral. Some of the species included within this site's coastal sage scrub habitat include Munz's sage (*Salvia munzii*) and San Diego sunflower. The area's southern parcel burned in 2003 and again in 2007, and currently non-native grasses dominate nearly all habitats. Historically, it supported native grassland and coastal sage scrub. Coast live oak woodland is present within Little Cedar Canyon and southern mixed chaparral was present in the other major drainage on this parcel. Although damaged by fire, some Tecate cypress saplings are likely present on the Refuge in Woodwardia Canyon and in Little Cedar Canyon upstream of the Refuge.

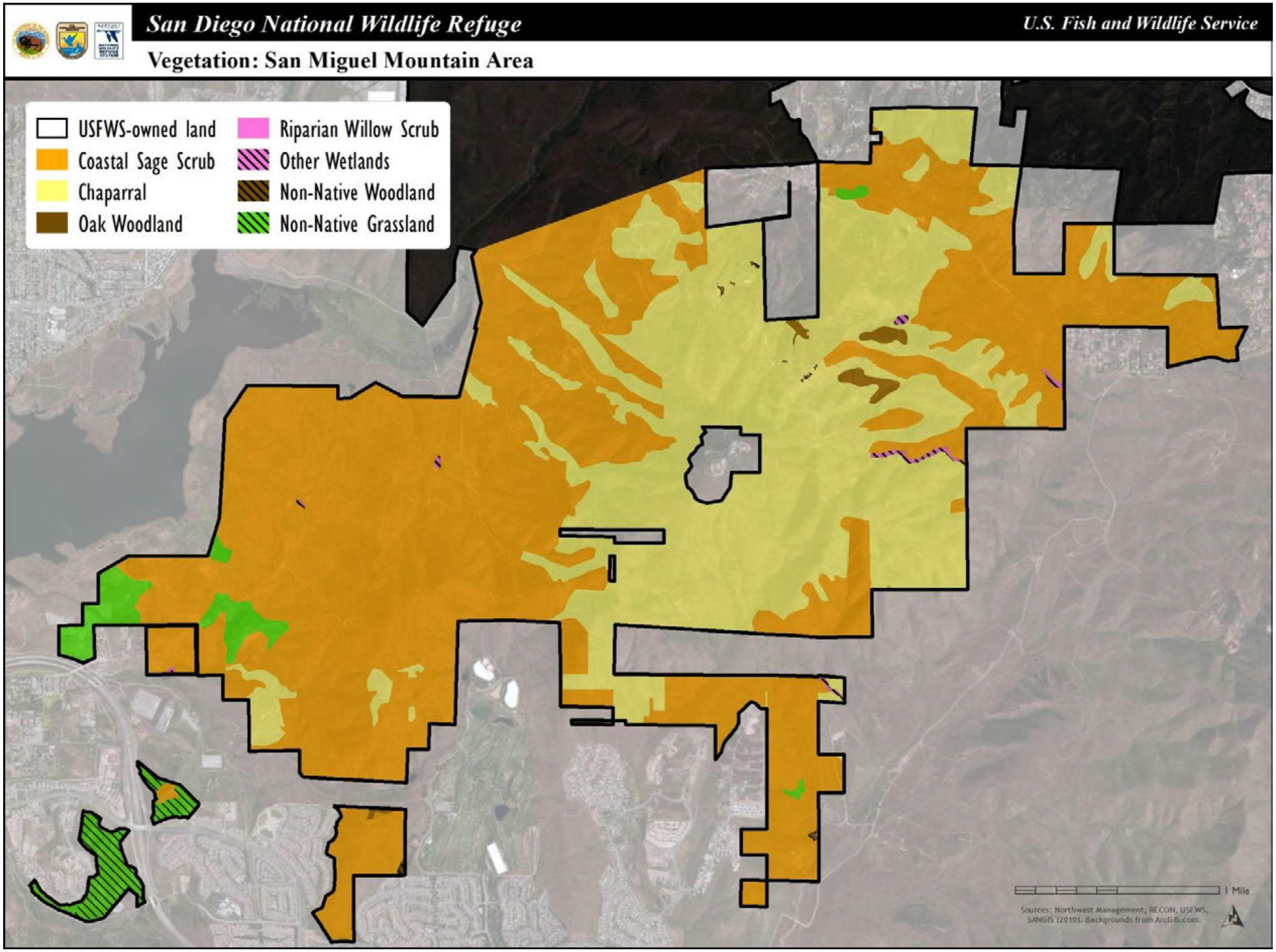

Figure 4-15. Vegetation Types Present on the San Miguel Mountain Area

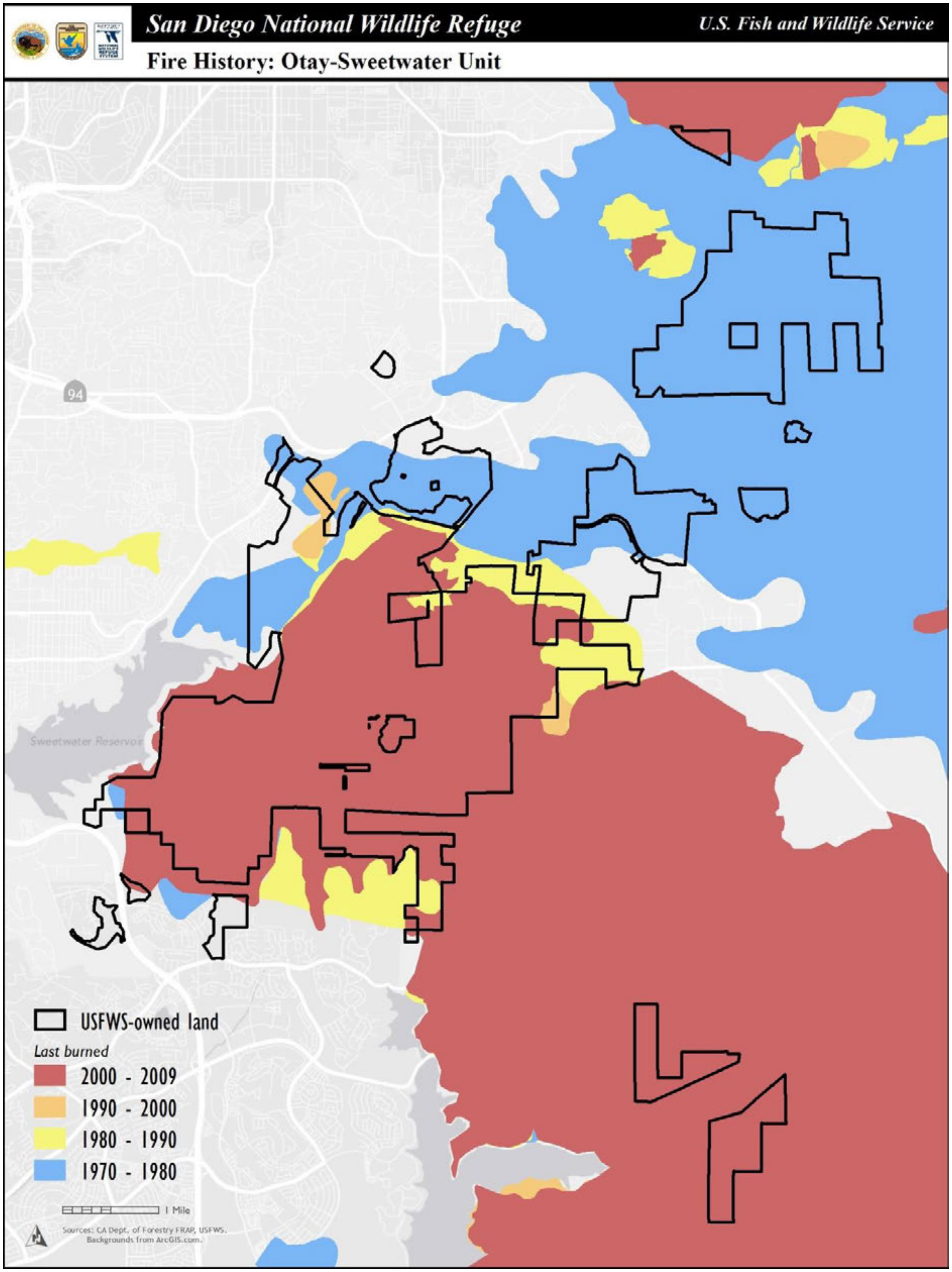

Figure 4-16. Fire History for the Otay-Sweetwater Unit

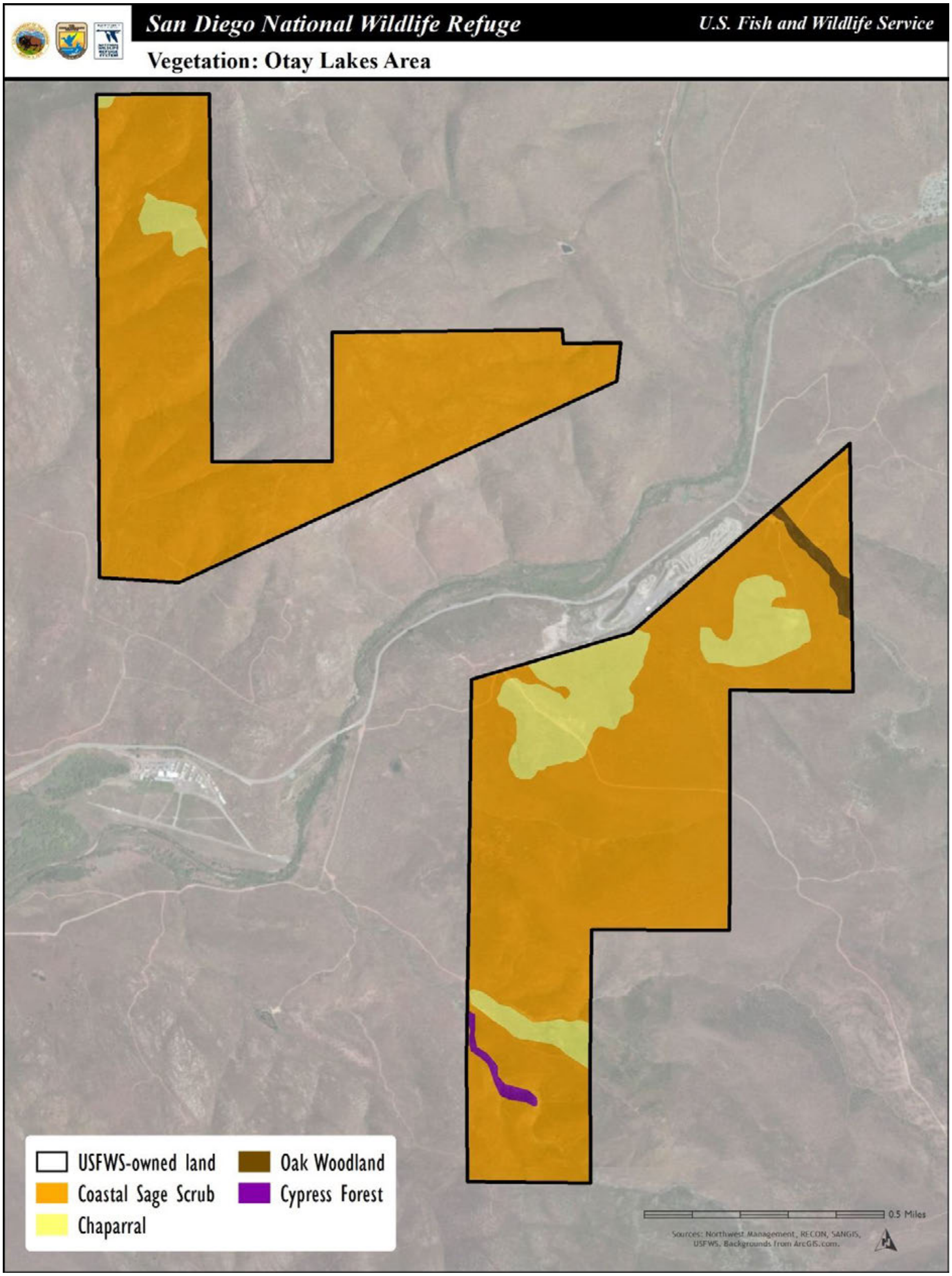

Figure 4-17. Vegetation Types Present on the Otay Mesa and Lakes Area

Del Mar Mesa Vernal Pool Unit

The vegetation communities present on the Refuge parcels in the Del Mar Mesa Vernal Pool Unit, as illustrated in Figure 4-18, include chamise chaparral on the flatter mesa areas and southern mixed chaparral on protected north-facing and canyon slopes or ravines. For the most part, chamise chaparral, as the name implies, is dominated by chamise with associated species contributing little cover; however, in some locations on the mesa, Nuttall's scrub oak and other species can make up to 25 percent of the scrub cover. The most common species present in the areas of southern mixed chaparral found on these Refuge parcels include chamise, Nuttall's scrub oak, laurel sumac, and black sage (City of San Diego 2015).

A deep canyon that extends into the northwestern most corner of one of the western Refuge parcels (refer to Figure 4-18) supports scrub oak chaparral that is characterized by a dense, nearly monotypic stand of Nuttall's scrub oak (City of San Diego 2015). Open patches of chamise chaparral and southern mixed chaparral located on the flatter portions of this unit, where appropriate soil conditions and microtopography are present, support areas of vernal pool habitat. Species dominating the pools in this portion of the mesa can include San Diego button-celery, California water starwort (*Callitriche marginata*), woolly marbles (*Psilocarphus brevissimus*), and grass poly (*Lythrum hyssopifolia*). San Diego mesa mint, toothed downingia (*Downingia cuspidate*), and little mousetails, along with small populations of California adder's tongue, may be present in some pools (City of San Diego 2015).

4.3.3 Plants

A comprehensive plant inventory has not been completed for the San Diego NWR; however, various biological surveys have been conducted over the years for different portions of the Refuge. The results of these surveys provide general information about the range of plant species observed on the Refuge at various times. In addition to general plant surveys, a number of directed searches for rare plants are periodically conducted throughout the Refuge. The results of these directed searches are documented and plant locations are mapped for use during future searches. More information regarding those plants species identified as endangered, threatened, rare, or species of concern that have been documented on the Refuge is provided in subsequent sections.

4.3.4 Wildlife

A comprehensive wildlife inventory has not been completed for the San Diego NWR; however, various surveys have been conducted over the years for different portions of the Refuge. More information about the types and extent of wildlife present on the Refuge is provided in the following sections, and partial species lists are provided in Appendix H.

4.3.4.1 Birds

The Refuge includes woodland, shrubland, riparian, and grassland habitats that support a wide range of bird species. More than 180 species of birds have been observed on the Refuge, including a number of listed and sensitive species. A list of species observed on the Refuge is provided in Appendix H.

The birds present within the Refuge's oak woodlands are connected to this habitat in part through acorns, which dozens of species, such as acorn woodpecker, western scrub-jay, and oak titmouse, eat and store (CalPIF 2002). In addition to providing an important food source, oaks can provide nesting habitat for cavity-dependent nesting birds and other wildlife, as well as nesting sites for cup-nesting species. They also can serve as cache sites for acorn woodpeckers and other species.

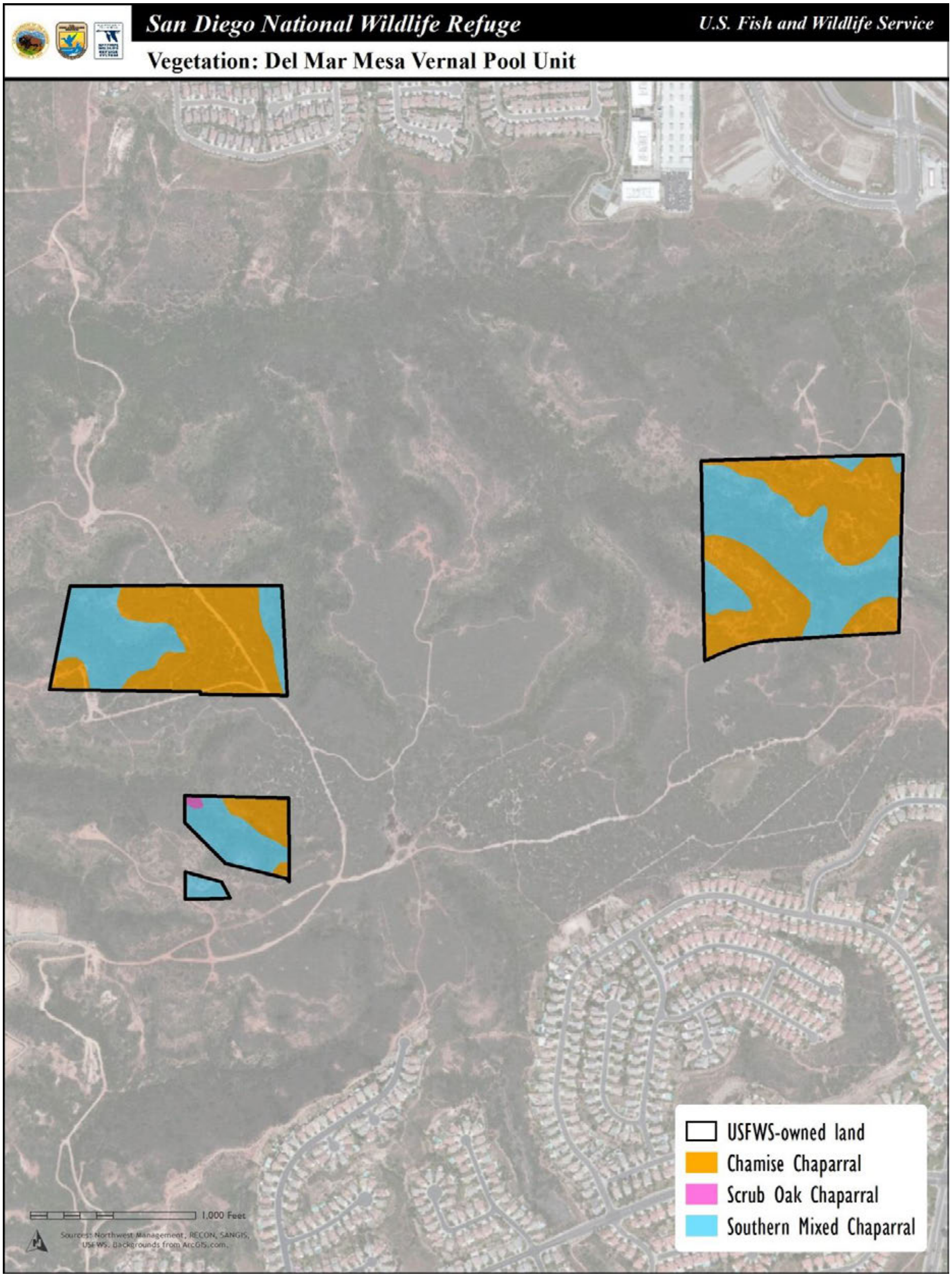

Figure 4-18. Vegetation Types Present on the Del Mar Mesa Vernal Pool Unit

The mistletoe that is often found growing in coast live oaks is an important food source for species such as western bluebird (*Sialia mexicana*) and phainopepla (*Phainopepla nitens*) (CalPIF 2002), and the insects found in these areas provide forage for species such as Nuttall's woodpecker. Bewick's wren and California quail can be found foraging within the understory of oak woodland habitat.

Shrublands are generally characterized by woody perennials with multiple stems growing from the base; however, despite similarities in general growth form within shrublands, there are notable structural and physiological differences among shrubland types (CalPIF 2004). These differences in structure and cover are important to a variety of bird species. The two predominant shrubland types on the Refuge include coastal sage scrub and chaparral, each providing slightly different nesting and foraging opportunities for birds. California gnatcatchers and rufous-crowned sparrows are associated almost exclusively with coastal sage scrub, while other species such as Costa's hummingbird, greater roadrunner (*Geococcyx californianus*), western scrub-jay, wrentit, California thrasher (*Toxostoma redivium*), and California towhee (*Pipilo crissalis*) can be found in both vegetation types.

Within the Refuge's shrubland habitats, there are local, small-scale non-shrub features such as cryptobiotic crusts, which create open gaps of low, sparse herbaceous vegetation, or rock outcrops that support low, sparse herbaceous vegetation that add to the structural diversity of the vegetation as bird habitat (CalPIF 2004). The chaparral habitat on the Refuge also includes areas of restricted floristic mixes that may provide additional elements or diversity for bird assemblages.

Important features within some areas of the Refuge's coastal sage scrub habitat are large cactus patches composed primarily of coastal cholla (*Cylindropuntia prolifera*), but they may also include coastal prickly pear (*Opuntia littoralis*) and foothill prickly pear (*O. oricola*). These areas provide nesting habitat for the coastal cactus wren, which is an obligate inhabitant of coastal sage scrub. Fire has destroyed or seriously damaged a number of the cactus patches found within the Sweetwater River and San Miguel Mountain areas. Efforts to reestablish healthy cactus patches in these areas are ongoing.

Riparian areas, which have been identified as habitat essential to the conservation of Neotropical migrant birds in California (RHJV 2004), harbor the highest number of bird species found in the arid and semiarid portions of the western United States. Not only do riparian areas provide important breeding grounds for birds, but they also represent vital overwintering and migration stopover areas and corridors for dispersal (RHJV 2004) for a variety of birds. The diversity and abundance of birds present within a particular riparian and other wetland area varies with the extent of tree cover, understory cover and composition, and proximity of the habitat to adjacent high-quality upland habitats. Portions of the riparian habitat along the Sweetwater River provide critical habitat for the endangered least Bell's vireo, while these and other riparian areas also support a range of migrant and resident birds including yellow-breasted chat, yellow warbler, blue grosbeak, belted kingfisher (*Ceryle alcyon*), and warbling vireo.

Although grasslands are limited on the Refuge, they do provide foraging habitat for a variety of avian species, from raptors to seed eating birds. Greater roadrunners, which occur at low densities, are year-round residents that nest in relatively open chaparral and coastal scrub habitats and forage in open areas of low grasses. Other species that utilize the grassland areas of the Refuge include grasshopper sparrow, northern harrier, white-tailed kite, and burrowing owl (*Athene cunicularia*).

Occasionally golden eagles are sighted foraging around San Miguel Mountain, and as recently as 2005, a golden eagle nest was documented near the peak of San Miguel Mountain. A variety of other raptor species have also been observed foraging throughout the Refuge, including northern harrier, sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*), and red-tailed hawk (*Buteo jamaicensis*). The oak woodland and riparian habitats on the Refuge provide potential nesting habitat for several of these species, and over the past few years, an occupied northern harrier nest has been documented within the grassland area north of Mother Miguel Mountain.

The CCP includes opening a portion of the Otay Mesa and Lakes area of the Refuge to hunting, including the hunting of quail and dove. For that reason, additional information about these species is provided in the following sections.

California Quail

The California quail (*Callipepla californica*) is a medium-sized quail, with the male measuring about 10.2 to 10.6 inches (260 to 270 millimeters) in length and the female measuring 9.5 to 10.5 inches (241 to 266 millimeters) in length. The males and females have similar markings; however, males are brighter and more boldly patterned. The male has a black-and-white patterned face with a buffy forehead. There is a brown patch on the rear crown and nape, and a set of six forward-facing, comma-shaped black plumes arise from the top of the bird's head. The breast is gray and the sides and flanks are streaked with white. The remaining underparts are buffy with black "scaling" and a chestnut patch at center of the belly. The adult female is similar but duller and browner, with the head entirely brownish gray and the belly lacking a chestnut patch (Calkins et al. 1999).

California quail occur in scrub habitat primarily in California, Oregon, and Washington. This bird prefers habitats such as chaparral and coastal sage scrub characterized by a dense cover of shrubby perennials that are interspersed with patches of open areas supporting annuals and other low forms of vegetation. The quail's primary diet consists of seeds, leaves, and flowers from grasses, shrubs, and trees but can also include berries, catkins, plant galls, and insects (Calkins et al. 1999).

Typically monogamous, the California quail spends most of the year in large groups called coveys (Mastrup 2002). Coveys, which can typically range from 30 to 70 individuals, are usually formed in August and September and consist of several family groups, including parents and their offspring. The quail in these coveys perform all of their daily activities as a group, including roosting together at night and feeding together during the day.

The California quail can now be found within and well beyond the boundaries of its historical range. Breeding surveys conducted in California from 1968 to 2003 indicate a generally stable population trend (Zornes and Bishop 2009). Unfortunately, there is currently no reliable population estimate for California quail within Bird Conservation Region (BCR) 32, in which the Refuge is included; therefore, the Western Quail Management Plan (Zornes and Bishop 2009) uses harvest by hunters as an index to quail abundance. A rough estimate of average annual harvest in BCR 32 for 2002–2004 was 200,000 birds.

The California quail is recognized as an upland game bird and, where permitted, is hunted over much of its range. It is not a species covered by the Migratory Bird Treaty Act (MBTA) of 1918, as amended. According to the information available, the present levels of hunting do not appear to have negative effects on this species' population levels. The largest harvest of this species occurs in California. In 1992, approximately 0.8 million birds were taken by California hunters (Calkins et al. 1999). Based on the results of California's 2000 Game Take Hunter Survey, quail hunting is the third most popular form of hunting in terms of time spent in pursuit (Mastrup 2002). In 2000, the average seasonal bag of California quail per hunter was 10.6, the average number of California quail bagged per day hunted was 1.9, and the average number of days in the field hunting California quail was 5.7 per hunter (Mastrup 2002). These numbers are subject to fluctuation, just as the size of the quail population fluctuates in any given year due to climatic conditions.

For the 2010/2011 archery and firearm hunting season, where permitted in San Diego County, California quail were hunted from the third Saturday in October extending through the last Sunday in January. The bag limit was 10 quail in any combination of species per day, and the possession limit was double the daily bag limit. Hunting quail using falcons was permitted from the third Saturday in August extending through the last day in February. The bag limit and possession limit were the same as for archery and firearm, with hawking hours designated as sunrise to sunset.

In 2007, surveys were conducted to assess habitat usage and relative abundance of various game species, including California quail, on portions of the McGinty Mountain, Las Montañas, and San Miguel Mountain areas of the Otay-Sweetwater Unit (Dudek & Associates 2008). To determine relative abundance of California quail, bird call count surveys were conducted at 50 point sample locations in April 2007 and again in June 2007 (Dudek & Associates 2008). Relative abundance estimates were made by averaging the number of calls recorded for all of the sample locations within a sampled vegetation type. Quail calls were heard in all three survey areas. On McGinty Mountain, quail were present in both chaparral and coastal sage scrub habitat but were more abundant in chaparral than coastal sage scrub. In the Las Montañas and San Miguel Mountain areas, quail were also found to be more abundant in chaparral areas than in coastal sage scrub. Surveys were not conducted on the area south of Otay Lakes Road, but the chaparral vegetation found in this area is expected to support California quail at abundance levels similar to those encountered in chaparral vegetation within the Las Montañas and San Miguel Mountain areas.

Based on the survey results, the expected highest use areas for quail on McGinty Mountain would occur at the upper elevations of the mountain (ranging from an elevation of about 1,200 feet [366 meters] to 2,100 feet [640 meters] at the top of the mountain). In the Las Montañas area, the expected highest use area would be on the south side of Highway 94, covering much of the area from 1,000 feet (305 meters) south of Highway 94 to the southern boundary of the Refuge in this area. The expected highest use areas in the San Miguel Mountain area include the upper west-facing slopes of San Miguel Mountain and an area of north-facing slopes just below Mother Miguel Mountain.

Mountain Quail

The mountain quail (*Oreortyx pictus*) is the largest of the native quail in California. Measuring about 10 to 12 inches (25 to 30.5 centimeters) in length, this quail has a long, slender black plume atop its head, a chestnut throat broader with white, and bluish gray breast, upper back, and head. The sides are chestnut with broad black and white stripes (Mastrup 2002). Although this species of quail occurs in various locations throughout California, it is only found in certain habitat types, typically shrub-dominated communities such as chaparral. The populations in the Sierra Nevada and in California's coastal ranges appear to be stable (Winter 2002). Mountain quail forage in shrub and forest communities under the canopy and at the edge of shrub or tree cover. Primary foods are plant materials, with less than five percent of the diet composed of invertebrates (Gutierrez and Delehanty 1999).

Although not recently documented on the Refuge, isolated populations of mountain quail were located on the eastern slope of McGinty Mountain, as well as over most of Otay Mountain, which abuts the Otay Mesa and Lakes area of the Refuge, in 2000 during surveys conducted for the San Diego County Bird Atlas project (Unitt 2004).

Dove

Four species of dove have been documented on the Refuge: mourning dove (*Zenaida macroura*), white-winged dove (*Zenaida asiatica mearnsi*), Eurasian collared-dove (*Streptopelia decaocto*), and common ground-dove (*Columbina passerina*). Of these, mourning dove, white-winged dove, and Eurasian collared-dove can be hunted in California in accordance with CDFW hunting regulations. The hunting season for dove is generally September 1 through 15 and from the second Saturday in November extending for 45 days, although the season may vary from year to year. There is currently no open hunting season on common ground-doves in California.

Mourning Dove. The mourning dove is a mid-sized bird with a small head and long graduated tail. The total length of this species ranges from 10.4 to 13.4 inches (26.5 to 34 centimeters) for a male and 8.9 to 12 inches (22.5 to 31 centimeters) for a female. It is grayish blue or grayish brown above and buffy below, with black spots on the wing coverts and behind the eye. The wing and tail feathers are gray with black-bordered white tips on the tail. This dove has a delicate, black bill and dull red legs and feet. The eyes are dark brown bordered by bluish skin (Otis et al. 2008a).

Mourning doves are habitat generalists that can be found in both urban- and rurally-developed landscapes, as well as native habitats such as grasslands, coastal sage scrub, and chaparral. They are almost always seen feeding on the ground, with approximately 99 percent of their diet consisting of seeds from cultivated and wild plants (Otis et al. 2008a).

The mourning dove is classified as a migratory bird under the MBTA. The MBTA permits hunting of migratory birds and gives individual states the ability to impose more restrictive regulations for such things as hunting seasons and daily bag limits, but it does not permit states to enact regulations more liberal than the Federal frameworks. The mourning dove is the most harvested migratory game bird in North America, with some 20 million mourning doves, representing 5 to 10 percent of the mourning dove population, harvested annually by approximately one million hunters (Otis et al. 2008b; Seamans et al. 2011).

In 2001, a National Mourning Dove Planning Committee was formed to develop guidelines that could be used to prepare harvest management plans for mourning doves. As a result, the Mourning Dove National Strategic Harvest Management Plan was completed in July 2003 and approved by all four flyway councils by August 2003. The purposes of this plan were to promote the concept of coordinated management of mourning doves to: 1) insure uniformity of regulatory action and equitable conservation across the species range; 2) acknowledge the need to recognize demographic differences among management units within the United States; and 3) acknowledge that the knowledge base supporting the harvest management system in place at the time of the plan's approval needed improvement. The plan also acknowledged the need for future recommendations regarding management unit-specific harvest strategies and the initiation of new, long-term monitoring efforts (USFWS 2003a). The compilation of data needed to provide useful assistance in the harvest regulation process was expected to take several years to complete; therefore, the USFWS Regulations Committee requested that interim mourning dove harvest management strategies be developed for each management unit based on currently available information.

An initial mourning dove harvest strategy was approved in 2004 for the western management unit, and a revised strategy was issued in 2008. In 2008, the Service accepted and endorsed the interim harvest strategies for the western management unit, determining that the interim mourning dove harvest strategy was an important step towards implementing the previously approved Mourning Dove National Strategic Harvest Plan. In 2009, the interim harvest strategy was successfully implemented (76 FR 44730, July 26, 2011).

The 2008 Mourning Dove Harvest Management Strategy for the Western Management Unit uses hierarchical modeling techniques to produce composite estimates of dove trends at the management unit scale. Composite estimates of trends are derived from four data sources, including call count surveys of doves heard (1966–2006), call count surveys of doves seen (1966-2006), North American Breeding Bird Surveys (1996–2006), and indirect population growth rate estimates (2003–2006) calculated from harvest and banding data (Otis et al. 2008b). The management goal for this strategy is to optimize harvest of mourning dove in a sustainable fashion, which is to be accomplished by learning how changes in hunting regulations affect changes in harvest rates, vital population rates, and abundance.

The Final Rule for Migratory Bird Hunting; Final Frameworks for Early-Season Migratory Bird Hunting Regulations for the 2011/2012 migratory bird hunting season (76 FR 54052, August 30, 2011) identified the mourning dove hunting season as not more than 60 days, which was split between two periods, September 1to 15 and November 1through January 15. In addition to mourning doves, take of white-winged doves and Eurasian collared-doves was also permitted. The daily bag limit in California during the 2011/2012 season was 10 mourning and white-winged doves in the aggregate. There was no limit for Eurasian collared-doves.

The mourning dove is one of the most widely distributed and abundant bird species in North America (Seamans et al. 2011). A recent estimate of the fall population of mourning doves in the United States was 350 million (Otis el al. 2008b). The Service annually collects information on the abundance and harvest of mourning doves in the United States. The most recent report was provided in 2011 (Seamans et al. 2011). Abundance is reported primarily as trends in the numbers of doves heard per route during the annual Mourning Dove Call-count Survey.

Additional input is provided by the number of doves seen during the call count survey, as well as birds seen during the annual Breeding Bird Survey. The 2011 report states that based on the call count heard data, as well as the Breeding Bird Survey, it appears that the abundance of mourning doves decreased in Western Management Unit, which includes California, during both the long term (1966–2011) and during the past 10 years. There was no evidence of a change in abundance in the Western Management Unit over the past two years. About 15 percent of the total mourning dove in the United States occurs within the Western Management Unit (Seamans et al. 2011).

As described for California quail, surveys were conducted in 2007 on the Refuge to assess the habitat usage and relative abundance of several game species, including the mourning dove. As with the quail, these surveys took place within the McGinty Mountain, Las Montañas, and San Miguel Mountain areas of the Otay-Sweetwater Unit (Dudek & Associates 2008). For mourning doves, bird call count surveys were used to determine relative abundance in various habitat types. Estimates were made by averaging the number of calls recorded for all of the sample locations within a sampled vegetation type. Mourning dove calls were heard in all three survey areas. On McGinty Mountain, mourning doves were present in both chaparral and coastal sage scrub habitat, with mourning dove more abundant in coastal sage scrub than chaparral. In addition, there were more doves than quail in coastal sage scrub areas and more quail than doves in chaparral areas. In the Las Montañas area, mourning doves were equally abundant in coastal sage scrub and chaparral. As on McGinty Mountain, there were more doves than quail in coastal sage scrub areas and more quail than doves in chaparral areas. In the San Miguel Mountain area, both mourning dove and California quail were most abundant in chaparral; however, doves were more abundant than quail in these areas, as well as in coastal sage scrub areas. Mourning doves were least abundant in grassland areas.

White-winged Dove. One of 12 subspecies of white-winged dove, the western white-winged dove has been observed on the Refuge. The western white-winged dove is similar in overall appearance to a mourning dove, but is somewhat larger and grayer, with a white band across the middle of the wing that forms a white border along the front of the folded wing. The white-winged dove head and beak are relatively larger than that of the mourning dove, and its beak is slightly downcurved near the tip. Compared to the mourning dove, the white-winged dove tail is shorter and more rounded. The iris of the eye is bright red surrounded by a patch of bare blue skin (Pacific Flyway Council 2003). White-winged doves nest at relatively low densities throughout the Sonoran, Mohave, and Chihuahua deserts of southern and western Arizona, southern California, and southern New Mexico.

The breeding range of the western white-winged dove extends from southeastern Nevada and southeastern California through most of southern Arizona into southwestern New Mexico, and Baja California and Sonora in Mexico. Virtually the entire western breeding population migrates south to spend the fall and winter in western Mexico.

White-winged doves are managed cooperatively by the Service and State wildlife agencies, with management direction provided in the Pacific Flyway Management Plan for Western White-winged Doves (Pacific Flyway Council 2003). The purpose of the management plan is to provide guidelines for cooperative management of the western race of white-winged doves in the U.S. and Mexico, where practical. The plan goal is to maintain the western white-winged dove populations in a healthy, productive state. Management activities include population and harvest assessment, harvest regulation, and habitat management. Each year to monitor the population status of this subspecies, breeding population and harvest surveys are conducted by biologists and others in Arizona, and harvest data is collected in California and New Mexico; California began collecting harvest data for western white-winged doves in 1992. The information provided by this survey and harvest data is used by wildlife administrators to set annual hunting regulations (Rabe and Sanders 2010).

The Management Plan indicates that in recent times, white-winged dove densities have been greatest in areas near agriculture where food is abundant. The response of white-winged doves to agricultural activities is likely partially responsible for recent large changes in abundance in the southwestern U.S. Hunting seasons for white-winged doves have been permitted in Arizona and California since the turn of the century. In California, Nevada, and New Mexico, seasons and bag limits have remained relatively constant; bag limits in these states are taken together with mourning doves.

In 1992, the Harvest Information Program (HIP) was implemented to coordinate migratory bird harvest information among states and the Service. As part of this program, all dove hunters must register for HIP and surveys are sent to a random sample of registrants before the start of the season in each state. Consistent, timely harvest estimates among states are critical for effective dove management (Pacific Flyway Council 2003).

Research indicates that white-winged doves may be more vulnerable to over harvest than mourning doves (George 1993). A combination of high dove harvest in Arizona during the 1960s, destruction of river-bottom nesting habitat, and a shift in agricultural crops were considered major factors in declining harvests in Arizona in the 1960s. As a result, in 1970 bag limits were reduced. Continued harvest declines prompted further reduction in bag limits (six per day) in 1980. In 1988, season length was reduced from 3 weeks to 2 weeks and half day shooting was implemented in 1989 (Pacific Flyway Council 2003). This downward trend has not been documented in California. From 1992 to 2003, the mean California harvest was 64,644. There were peak harvests of over 100,000 in 1994 and 1997. Based on these figures, there appears to be no clear upward or downward trend in the California data (Pacific Flyway Council 2003). The number of western white-winged doves present on the Refuge is not known and no breeding surveys have been conducted on the Refuge for this species.

<u>Eurasian Collared-dove</u>. This nonnative dove is larger than a mourning dove, gray-brown in color with vinous pink flush, especially on chest. It has a distinctive black collar marking on nape, has dark eyes, and red legs. The tail is not as sharply pointed as the mourning dove.

A native of the Middle East, the Eurasian collared-dove was inadvertently released in the Bahamas in the 1970s. By the late 1970s or early 1980s, Eurasian dove populations were established in southern Florida. Today, this dove is a year-round resident in most of the mid-west, and all of the southwest and northwest states, including California. The number of Eurasian collared-doves present on the Refuge is not known. In California, there is no limit to the number of Eurasian collared-doves that a licensed hunter can take or possess during the hunting season.

<u>Common Ground-dove</u>. The common ground-dove, one of the smallest doves in North America, is about the size of a song sparrow (approximately 6.5 inches long). It is common across the southernmost parts of the U.S. from California to Florida and can be found in southern California within open habitats and along the edges of more dense habitats. There is no open hunting season on common ground-doves.

4.3.4.2 Mammals

A comprehensive survey of the mammals present within the Refuge has not been conducted, but a number of species have been observed directly or detected by tracks, scat, burrows, pellets, or other indirect signs. Mammals present on the Refuge range from small rodents to large species such as southern mule deer (*Odocoileus hemionus fuliginatus)* and mountain lion.

A fairly diverse range of rodent species is expected to be present on the Refuge; however, trapping to thoroughly sample for the presence of these species has not been conducted. Information from various surveys conducted on specific portions of the Refuge over the years does, however, provide some information about the types of species observed or expected to occur on the Refuge. During these surveys, evidence of burrows and dusting areas for Pacific kangaroo rats (*Dipodomys agilis*) was observed in open areas of coastal sage scrub habitat; Botta's pocket gopher (*Thomomys bottae*) diggings were observed throughout the Refuge; desert woodrat (*Neotoma lepida*) nests were identified in rock outcrop areas and cactus patches; and dusky-footed woodrat (*Neotoma fuscipes*) nests were observed in more mesic locations such as drainages and dense scrub and chaparral vegetation (ERCE 1991). Other species such as San Diego pocket mouse (*Perognathus fallax*), California pocket mouse (*Perognathus californicus*), deermouse (*Peromyscus maniculatus*), and California mouse (*Peromyscus californicus*) have also been observed on the site.

California ground squirrel (*Spermophilus beecheyi*), brush rabbit (*Sylvilagus bachmani*), and desert cottontail (*Sylvilagus audubonii*) are the most commonly observed mammals on the Refuge. These species are important prey items for the Refuge's carnivores, raptors, and large snakes (ERCE 1991). Southern mule deer is an MSCP-covered species that inhabits a variety of vegetative communities within the Refuge, including coastal sage scrub, chaparral, oak woodland, grasslands, and riparian habitats. The San Diego black-tailed jackrabbit (*Lepus californicus bennettii*), a CDFW species of special concern, is also known to be present in various locations throughout the Refuge, including the Del Mar Mesa Vernal Pool Unit. This strict herbivore, which ranges throughout southern California with the exception of high-altitude mountain areas, prefers shrubland habitat with intermediate density canopy for cover and open shrub/herbaceous and tree/herbaceous edges for foraging (Zeiner et al. 1988-1990).

In 2002 and 2003, the U.S. Geological Survey conducted bat surveys within the preserved lands of the San Diego County MSCP, including some bat roosting and bat foraging sites located within or immediately adjacent to the Refuge (Stokes et al. 2005). A bat foraging area located along the Sweetwater River was identified as the third richest site within the survey area in terms of species observed, with 11 bat species documented. An additional species, Townsend's big-eared bat (*Corynorhinus townsendii*), was one of six bat species observed at a granite boulder-covered hill on the Refuge near McGinty Mountain (Stokes et al. 2005). Of the 12 species identified on the Refuge, three of these species (Townsend's big-eared bat, western mastiff bat [*Eumops perotis*], and western red bat [*Lasiurus blossevillii*]) have been identified as California Species of Special Concern. A list of the bats observed on the Refuge during the USGS surveys is provided in Appendix H.

A number of carnivores are known to be present on the Refuge, and several others may be present or historically occurred in the area. Some of the species known to be present include striped skunk (*Mephitis mephitis*), gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), coyote (*Canis latrans*), bobcat (*Lynx rufus*), and mountain lion (*Felis concolor*). In 1990, the voters of California approved Proposition 117, making mountain lions a specially protected species in California. It is also an MSCP-covered species. Carnivores potentially and/or historically present on the Refuge include American badger (*Taxidea taxus*), an MSCP-covered species, and ringtail (*Bassariscus astutus*). The presence of a badger den near Sweetwater Reservoir was reported in the 1970s (Pacific Southwest Biological Services 1991); however, subsequent surveys to locate this species on the Refuge have been negative. Although the presence of the secretive ringtail, a nocturnal carnivore, has not been documented on the Refuge, it may be present in some of the large rocky canyon areas within the San Miguel Mountain area and similar habitat elsewhere on the Refuge.

As part of the CCP process, the potential for opening one or more portions of the Refuge for hunting is being evaluated. The location and type of species to be taken varies with the alternatives. Species that have the potential to be hunted on the Refuge depending upon the alternative selected (either Alternative C or D) include big game mammals (i.e., southern mule deer, wild pig [an introduced, nonnative species]) and small game mammals (i.e., brush rabbit, desert cottontail rabbit, jackrabbit). To address the potential effects of hunting, additional information about the native species listed here are provided below.

Southern Mule Deer

Southern mule deer (mule deer) are present in various locations throughout the Otay-Sweetwater Unit, as well as on the Del Mar Mesa Vernal Pool Unit. The southern mule deer, which is an MSCP-covered species, is the principal food source of the mountain lion, another MSCP-covered species. In addressing the mule deer, the MSCP Plan states "Although not considered sensitive, this broadly distributed species has aesthetic and intrinsic values, and is the only large native herbivore in the plan area, thereby making it an important species to protect" (City of San Diego 1998a).

Mule deer is the only native species of deer in California. It gets its name from its mule-like ears. Mule deer have reddish coats in the summer and grayer coats in the winter (Nelson and Hooper 1975). The most abundant and popular big game animals in California, mule deer have a keen sense of hearing and can easily detect motion. Their vision of stationary objects is, however, poor.

Only male mule deer (bucks) develop antlers, which they shed every winter. It is the physical condition of the buck that dictates antler size and number of points—not age. Bucks will mate with multiple female mule deer (does); therefore, it is not necessary to maintain equal numbers of bucks and does to maintain adequate population levels in a given area (Nelson and Hooper 1975). The breeding season varies throughout the State, occurring from September through January depending upon elevation and latitude. First time breeders are usually 1.5 years old. Fawns are born about seven months after mating, with the peak of fawning occurring from April through July.

The home range of bucks appears to be highly variable, with mean home ranges estimated at 705 acres (285.3 hectares). Smaller home ranges averaging 247 to 741 acres (100 to 300 hectares) have been estimated for doe and fawn groups (Penrod et al. 2006). Actual home range sizes vary depending upon the availability of food, cover, and water. In coastal San Diego County, mule deer are considered resident species, as they are not known to migrate long distances.

Mule deer are herbivores, eating twigs and leaves of shrubs and trees, as well as grasses, weeds, and acorns when available (Nelson and Hooper 1975). Because of their need for visual and escape cover, mule deer are generally found in woodland and shrubland vegetation. These animals, which require a mosaic of habitat types of different age classes, reach their highest densities in oak woodlands, riparian areas, and along edges of meadows and grasslands (Penrod et al. 2006). In addition, mule deer occur in areas with varying slopes and topography where there is variability in shade and sun exposure.

Little historical information is available regarding the mule deer population on the Refuge. In 2007, surveys were conducted on portions of the Otay-Sweetwater Unit (i.e., McGinty Mountain, Las Montañas, San Miguel Mountain areas) to assess the habitat usage and relative abundance of mule deer in these areas (Dudek & Associates 2008). To determine relative abundance, pellet count surveys were conducted along eight transects measuring one mile (1,609 meters) in length located randomly within the three sampling areas and crossing multiple vegetation types. The surveys were conducted on six days in April 2007 (Dudek & Associates 2008). Surveyors walked the transect line as closely as possible, utilizing GPS, and visually surveyed a corridor about three feet (one meter) wide for mule deer scat.

Mule deer scat observations were very low during this survey. No scat was observed on the two transects in the Las Montañas area, and scat was observed on only two of the three transects in both the McGinty Mountain and San Miguel Mountain areas. A total of eight scat piles were found on four of the eight transects. Within the McGinty Mountain area, one scat pile was found within the oak riparian forest habitat; however, the total area sampled for this vegetation type was relatively small. The three remaining scat piles were observed in coastal sage scrub habitat. Observations in the field found several scat piles on the roads, game trails, and foot trails in the Las Montañas area, but none were observed adjacent to the transects within this area. Unfortunately, the number of observations made during this survey was too low to make a meaningful estimate of relative abundance of mule deer in any of the areas beyond the actual raw count of scat pile observed (Dudek & Associates 2008). No surveys were conducted in the Otay Mesa and Lakes area of the Refuge.

CDFW, which has trustee responsibility for the conservation and management of deer and other wildlife in California, has been tasked with providing information regarding mule deer population trends regionally and statewide. In implementing its responsibilities, CDFW is guided by State policies and laws relating to deer and other wildlife. The Fish and Game Code (Section 450) states: "It is hereby declared to be the policy of the Legislature to encourage the conservation, restoration, maintenance, and utilization of California's wild deer populations. Such conservation shall be in accordance with the principles of conservation of wildlife resources set forth in Section 1801 and in accordance with the objectives and elements stated in *A Plan for California Deer, 1976*."

CDFW gathers deer population data throughout the State and has monitored deer habitat conditions on public lands at varying levels of intensity over the years. This data indicates that deer populations in California peaked in the late 1950s to 1960s and are now at a lower level of statewide population (CDFG et al. 1998). This decline it attributed to long-term declines in habitat quality throughout the State brought about by various factors, including development, past fire management practices, increased frequency of wildland fires in some parts of the State, and drought. Today, the deer population in coastal southern California, described by CDFW as the South Coast Deer Assessment Unit, is considered fairly stable; however, it has decreased considerably since 1952, when the population was estimated at about 79,000 deer (CDFG et al. 1998). In 1998, the deer population for this area was estimated at 16,000 to 24,000.

CDFW is also responsible for establishing deer management units and plans and for setting annual deer hunting regulations and limits. California Deer Kill Reports are issued annually to summarize the information gathered from deer tag report cards returned by successful hunters. Data received is analyzed by season or hunt category; zone and hunt (Deer Management Subunit); zone of kill (Deer Management Unit); Deer Assessment Unit; county; Department region; Private Lands Management Area; archery method kill; method of kill; sex; antler class; and land ownership. Also included within these reports are analyses of duplicate kill (hunters killing two deer); county of residence information; deer hunting regulation summary for the year of the report, and deer tag draw summary. All of this data is available online at http://www.dfg.ca.gov/wildlife/hunting/deer/deerhunt.html.

Much of the information included in the Deer Kill Reports is derived directly from returned deer tags (reported kill), but the report also includes estimated kill information, which is the reported kill number times a correction factor which is specific for each zone. This zone correction factor is an estimator of the non-reporting rates specific to each zone and takes into account those successful hunters that failed to submit the report card section of the deer tag. The estimated deer kill is considered a more realistic approximation of the actual deer harvest and is used primarily for population modeling and analysis.

In general, where hunting is permitted in the San Diego region (with some exceptions), the 2011 deer hunting season was split between an archery season (September 3, 2011, through September 25, 2011) and a general method season (October 22, 2011, through November 29, 2011). The portion of the county that includes the Refuge is identified by CDFW in the hunting regulations as Zone D-16. In Zone D-16, some areas were only open to hunting on certain days during these periods. Within Zone D-16, 3,000 tags were available, and the take of one buck with a forked horn or better was permitted per tag. For the 2010 season, hunter success was approximately 12 percent, with an estimated total take for the area of 225 bucks. For the 2011 season within Zone D-16, hunter success was approximately 14 percent with an estimated take for the zone of 421 bucks; and in 2012, estimated hunter success was about 15 percent with an estimated take for the zone of 451 bucks. There were also several special hunts in 2011, including the San Diego antlerless deer hunt, a general method hunt, in which 300 tags are available; a San Diego muzzle loading rifle hunt, allowing the take of a buck or doe, in which 80 tags are available; and a San Diego archery either sex hunt with a split season, in which 1,000 tags are available. In 2010, hunters involved in the San Diego antlerless deer hunt had a success rate of 20 percent. The success rate for the San Diego muzzle loading rifle hunt and San Diego archery either sex hunt was eight percent and six percent, respectively. CDFW also issues archery only tags and there is no quota. Hunters with archery only tags may not possess a firearm or crossbow while hunting with this tag. In 2009, only five deer were taken in Zone D-16 by hunters with archery only tags: statewide, an estimated 286 were taken with these tags. Additional harvest data is available at http://www.dfg.ca.gov/wildlife/hunting/deer/deerhunt.html.

In an effort to address the many issues affecting mule deer populations, the Western Association of Fish and Wildlife Agencies through the Mule Deer Working Group developed the North American Mule Deer Conservation Plan (Mule Deer Working Group 2004). The overall goal of this plan is to achieve ecologically sustainable levels of mule and black-tailed deer throughout their range through habitat protection and management, improved communication, increased knowledge, and ecoregional-based decision making. The plan addresses the need for standardized survey methodologies, population models, and harvest data collection processes that are based on scientifically sound standards and assumptions.

From 2006 through 2009, the Mule Deer Working Group published habitat management guidelines for all seven North American ecoregions, including the California woodland chaparral ecoregion in which the lands within the San Diego NWR are located. These guidelines provide comprehensive recommendations to private, tribal, State, provincial, and Federal land managers for maintaining and improving mule deer habitat. In 2011, the Mule Deer Working Group also issued Methods for Monitoring Mule Deer Populations (Keegan et al. 2011), which provides a comprehensive collection of population monitoring methods for mule deer. The intent of this document is to facilitate "collecting and disseminating scientifically defensible and comparable mule deer population information to increase interagency coordination, collaboration, and management capabilities" (Keegan et al. 2011).

Brush Rabbit and Desert Cottontail

There are four types of rabbits and three species of hares in California, of which two species of rabbits (brush rabbit and desert cottontail) and one species of hare (San Diego black-tailed jackrabbit) are present on the San Diego NWR. Brush rabbits, desert cottontails, and jackrabbits are classified as resident small game by CDFW.

The brush rabbit is a small gray rabbit, measuring about 13 inches (33 centimeters) long and weighing one to two pounds (0.45 to 0.9 kilograms). The desert cottontail, which has brown fur, black-tipped ears, and a large white tail, is slightly larger, averaging about 15 inches (38.1 centimeters) long and weighing from 1.5 to 2.5 pounds (0.68 to 1.13 kilograms).

Brush rabbits and desert cottontail are both abundant, yearlong residents on the Refuge. Brush rabbits tend to occur in dense, brushy areas, particularly the chaparral vegetation on the Refuge (Polite in Zeiner et al. 1988–1990), while desert cottontails occur in more open habitat areas. Both rabbit species are herbivorous, grazing on a wide variety of grasses and forbs in the spring and summer and on tender leaves, twigs, buds, and bark of various species during the fall and winter months. Desert cottontail will also eat fallen fruit and acorns (Polite and Ahlborn in Zeiner et al. 1988-1990). These two rabbit species tend to be most active around dusk and dawn, although they may occasionally also be active at night or during the day.

Brush rabbits and desert cottontails usually nest beneath dense brushy cover on the ground or in cavities that range from three to six inches (7.6 to 15.2 centimeters) in depth. Nests may be lined with dry vegetation and/or fur, and nests are often plugged with dry vegetation if located in a cavity or burrow.

The breeding season for these rabbits is December through June, with peak activity occurring between March and May. Females produce two to four litters per year and have one to six young per litter. Young rabbits remain in the nest for approximately two weeks (Polite and Ahlborn in Zeiner et al. 1988-1990).

In those areas in which hunting is permitted in California (except as described in Section 308(d) of the Fish and Game Code), the general rabbit hunting season is July 1 extending through the last Sunday in January. Rabbits may be taken using falconry during the general rabbit season and from the first Monday following the close of the general season extending through the third Sunday in March. The daily bag limit is five rabbits total, and the possession limit is 10 rabbits.

As of 2013, detailed rabbit population data was not available for the Refuge; however, rabbit scat studies were conducted in April 2007 to establish the relative abundance of rabbits in various locations and habitats within the Otay-Sweetwater Unit of the Refuge (Dudek & Associates 2008). Survey methods involved conducting surveys along sixteen 328-foot (100-meter) long transects that crosses coastal sage scrub, chaparral, oak riparian forest, and riparian scrub habitat within the McGinty Mountain, Las Montañas, and San Miguel Mountain areas of the Refuge. In addition to these linear transects, circular 3.3-foot (one meter) plots were sampled at 65.6-foot (20-meter) intervals along each transect. For each plot, the number of individual rabbit scat piles was counted. In cases where the number of pellets was very high, an estimate was made of the total number of pellets and the number of clusters was recorded. Relative abundance was calculated as the average number of scat piles in each sample plot within the sampled vegetation type.

Survey data indicates that rabbit scat was nearly ubiquitous across the sampling areas. No rabbit scat was found in the plots located within riparian scrub vegetation, and oak riparian forest habitat had the highest observed abundance of scat piles, followed by chaparral and coastal sage scrub. In terms of relative abundance within the areas sampled, the average scat piles per plot ranged from a low of 0.58 piles per plot in the San Miguel Mountain area to 1.79 piles per plot in the Las Montañas area (Dudek & Associates 2008).

San Diego Black-tailed Jackrabbit

The San Diego black-tailed jackrabbit has long ears with black tips and very long front and rear legs. Generally found in open habitats, including grasslands, sage scrub, and oak woodlands, this jackrabbit is primarily nocturnal. It typically does not inhabit a burrow; rather it takes refuge during the day under shrubs in depressions referred to as forms.

The jackrabbit is considered a small game animal by CDFW. In those areas in which hunting is permitted in California (except as described in Section 308(d) of the Fish and Game Code), the hunting season for jackrabbits is year round, there are no daily bag or possession limits, and shooting hours are from one-half hour before sunrise to one-half hour after sunset.

Although this species exhibits natural fluctuations in population size and distribution, habitat loss associated with urban development has affected the total population size and distribution of this species throughout portions of its range. As a result, the San Diego black-tailed jackrabbit is included on CDFW's list of species of special concern (CDFG 2011). The extent of the jackrabbit population on the Refuge was not known in 2013.

4.3.4.3 Reptiles and Amphibians

The habitats in coastal southern California provide support for a substantial number reptile and amphibian species, one of the richest herpetofaunas in the United States. Among these species are several with federally listed and/or State protected status (Fisher and Case 2000). Because of the range of habitats present within the San Diego NWR, many of the species known to occur in coastal southern California are expected to occur at one or more locations within the Refuge.

A list of the species known to occur on the Refuge, including several species of conservation concern (e.g., San Diego horned lizard [*Phrynosoma coronatum blainvillei*], orange-throated whiptail [*Cnemidophorus hyperythrusbeldingi*], silvery legless lizard [*Anniella pulchra pulchra*], red diamond rattlesnake [*Crotalus ruber*], southwestern pond turtle [*Actinemys marmorata pallida*]) is provided in Appendix H.

Although not listed as Federal or State threatened or endangered species, the southwestern pond turtle is included on the list of Amphibian and Reptile Species of Special Concern in California (Jennings and Hayes 1994). It is also a covered species under the San Diego MSCP. Suitable habitat for the southwestern pond turtle occurs on the Otay-Sweetwater Unit within portions of the Sweetwater River corridor, as well as in portions of Steele Canyon Creek that extend east to west through the Las Montañas area. A single southwestern pond turtle was identified on the Refuge in Steele Canyon Creek in 2010. No turtles were detected within the Sweetwater River during surveys conducted in 2002 by USGS, nor were they detected in artificial ponds in Coon Canyon and Wild Man's Canyon in the San Miguel Mountain area of the Otay-Sweetwater Unit during surveys conducted in 2003 (Madden-Smith et al. 2005).

Based on survey results, the two areas surveyed by USGS were identified as possessing high habitat quality that could have the potential to support pond turtles. This ranking takes into consideration the presence of deep pools and slow moving water, basking sites, aquatic refugia, streamside refugia, and upland nesting habitat, but it does not take into consideration threats, such as the presence of non-native species that may prey on pond turtles or disturbance related to human activities (Madden-Smith et al. 2005). Both of these factors have the potential to render the sites on the Refuge as less suitable for pond turtles than the habitat quality may suggest.

Several reptiles and amphibians found on the Refuge, including bullfrog (*Lithobates* [*Rana*] *catesbeianus*), African clawed frog (*Xenopus laevis*), and red-eared slider (*Trachemys scripta elegans*), are non-native, invasive species that can severely limit the presence of native herpetofauna such as southwestern pond turtle, California red-legged frog, and arroyo toad. Although the latter two species are not currently present on the Refuge, reestablishment of viable populations of these species, which historically occurred in the area, would be difficult if these invasive species are present within suitable habitat areas.

4.3.4.4 Fish

No native fish occur on the Refuge, but at least four species of non-native fish are present within the Sweetwater River, including mosquito fish (*Gambusia* sp.), carp (*Cyprinus carpio*), green sunfish (*Lepomis cyanellus*), and largemouth bass (*Micropterus salmoides*). There is also the potential for black bullhead (*Ameiurus melas*) to be present in some portions of the floodway. All of these species are known to prey on frog eggs and larvae, representing a threat to red-legged frogs and arroyo toads. Largemouth bass are also a threat to southwestern pond turtle hatchlings.

4.3.4.5 Terrestrial and Aquatic Invertebrates

Although the Refuge is believed to support a diverse array of terrestrial invertebrates, little is known about the diversity, abundance, or distribution of the species present. The surveys that have been conducted within various areas of the Refuge in the past have identified numerous species of butterflies, various species in the order Diptera (true flies) and the order Coleoptera (beetles and weevils), as well as a variety of beetles in the genus Eleodes. During surveys conducted in the McGinty Mountain area in 1995, 33 species of butterflies were observed. In spring 2011, Keng-Lou 'James' Hung, a graduate student from UCSD, collected more than 125 species in the family Apidae (bees) on the Refuge during a study of bee species found in various coastal sage scrub locations in San Diego County. Of the species identified during the study, 35 species found on the Refuge were not collected elsewhere in the county.

A large number of aquatic and semi-aquatic insects are also present in the various riparian and other wetland areas on the Refuge, and ticks are very abundant in shrubland areas (Dudek & Associates 1994). The vernal pools on the Refuge also support a unique array of aquatic invertebrates, including two species of endangered fairy shrimp. The endangered, threatened, and rare terrestrial and aquatic invertebrates present on the Refuge are described under the section "Federally and State Listed Endangered and Threatened Species."

4.3.4.6 Wildlife Corridors

A wildlife corridor, as defined by San Diego County's Biological Mitigation Ordinance (Section 86.508), is "a specific route that is used for movement and migration of species," while a linkage is defined as "an area of land which supports or contributes to the long-term movement of wildlife and genetic material." These two terms are often used interchangeably to describe the need to connect core areas within the San Diego MSCP planning area for purposes of facilitating animal movement between areas of habitat or between habitat and geographically discrete resources (e.g., water) and maintaining demographic and genetic exchange between wildlife populations residing within geographically disjunct areas (Hierl et al. 2005). For large animals (e.g., mule deer, mountain lion), corridors provide a link between habitat patches, increasing the area available for dispersal, foraging, and breeding. For smaller animals, the corridor itself may provide habitat adequate to sustain viable populations.

The San Diego MSCP (City of San Diego 1998a) established 16 core biological resource areas within the MSCP study area boundary, as well as numerous associated habitat linkages, for a total of about 202,757 acres. Portions of three of these 16 core areas are preserved within the Otay-Sweetwater Unit. Specifically, the refuge lands within the McGinty Mountain area are located within Core Area 8 (McGinty Mountain/Sycuan Peak-Dehesa), refuge lands within the Sweetwater River and San Miguel Mountain areas are included within Core Area 7 (Sweetwater Reservoir/San Miguel Mountain/Sweetwater River); and the refuge lands within the Otay Lakes and Mesa area are included within Core Area 6 (Jamul Mountains). Habitat linkages are identified that connect these core areas to each other, as well as to other regional core areas. The Sweetwater River corridor located between San Miguel Mountain and McGinty Mountain (Biological Linkage L) is an important linkage that is located within and adjacent to the Refuge. The Otay Mountain/Jamul

Mountains to Sycuan Peak linkage (Biological Linkage N) is located outside the Refuge boundary but provides a link for wildlife movement between the McGinty Mountain area and the Sweetwater River, San Miguel Mountain, and Otay Lakes and Mesa areas of the Refuge. The Del Mar Mesa Vernal Pool Unit is included within Core Area 14 (Los Peñasquitos Lagoon/Del Mar Mesa/Peñasquitos Canyon).

4.3.5 Invasive and Exotic Species

4.3.5.1 Invasive Plant Species

Invasive species are organisms that have been introduced into a non-native ecosystem and are causing or are likely to cause harm to the environment, economy, or human health. Invasive species can be plants, animals, or 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 outcompete 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. Invasive species are one of the most significant threats to the NWRS (Haskett 2007). This threat is clearly visible on the San Diego NWR where over 100 species of non-native plants occur. Invasive plant species often displace the native species and/or change species composition, community structure, or ecosystem function (Bossard et. al. 2000). Invasive plants represent a serious threat to biological diversity, directly affecting both native plants and wildlife.

The distribution, abundance, and diversity of non-native plants currently on the Refuge are not thoroughly known; however, there are sufficient numbers and diversity of these non-native plants on the Refuge to warrant concern. A list of the known invasive plants on the Refuge, which includes a wide range of non-native invasive annual grasses and forbs, is provided in Appendix H.

As part of the implementation of a national strategy for management of invasive species developed by the National Invasive Species Strategy Team in 2003, the San Diego NWR was selected as one of four refuges to participate in a NWRS pilot project to evaluate the similarities and differences in invasive plant inventory objectives and methods across a variety of refuge environments. Results of the pilot project are being used to inform development of a standardized guide or process for conducting invasive plant inventories on refuge lands. As part of the pilot project, Utah State University (USU) was asked to conduct an inventory for targeted invasive non-native plants within selected portions of the refuge. A one-day webinar and a two-day workshop were conducted with refuge staff and partners in September 2011 to develop inventory objectives and identify priority species and areas for inventory.

A total of 1,961.6 acres, which represents 21 percent of the 9,235 acres included within the Refuge at that time, were inventoried by USU crewmembers in 2012. This work included the complete inventory of trails and roads within the McGinty Mountain (536.8 acres) and Las Montañas (284.6 acres) management areas, as well as additional trails and roads in the Sweetwater (506.6 acres), San Miguel (576.4 acres), and Otay Lakes and Mesa (57.2 acres) management areas. About 58 percent of the total inventoried area (1,139.98 acres) supported 4,805 individual infestations or patches of both targeted and non-targeted species. Of the initial 24 targeted invasive plant species, 20 species were located within the inventoried management areas (Table 4-5).

Table 4-5 Targeted Invasive Plant Species Identified on the Refuge in 2011	
False brome	*Brachypodium distachyon*
Sahara mustard	*Brassica tournefortii*
Ripgut brome	*Bromus diandrus*
Red brome	*Bromus madritensis spp. rubens*
Italian thistle	*Carduus pycnocephalus*
Starthistle (tocolote)	*Centaurea melitensis*
Crown daisy	*Chrysanthemum coronarium*
Andean pampasgrass	*Cortaderia jubata*
Pampasgrass	*Cortaderia selloana*
Cape ivy	*Delairea odorata*
Stinkwort	*Dittrichia graveolens*
Perennial veldtgrass	*Ehrharta calycina*
Fennel	*Foeniculum vulgare*
French broom	*Genista monspessulana*
Shortpod mustard	*Hirschfeldia incana*
Tree tobacco	*Nicotiana glauca*
Scotch thistle	*Onopordum acanthium*
Crimson fountaingrass	*Penniseum setaceum*
Big periwinkle	*Vinca major*
Rattail fescue	*Vulpia myuros*

Source: Evardchuk et al. 2012

The four targeted invasive species that were not identified during the surveys for the pilot project include Scotch broom (*Cytisus scoparius*), Spanish broom (*Spartium junceum*), Portuguese broom (*Cytisus striatus*), and crystalline iceplant (*Mesembryanthemum crystallinum*). To date, these species have not been identified elsewhere on the Refuge, although crystalline iceplant is likely to occur in some disturbed portion of the Refuge.

Data on diversity, abundance, and distribution of invasive exotic plant species generated by this pilot project will be used to:

- Inform future eradication efforts (early detection and rapid response, EDRR);
- Inform development of resource management plans;
- Increase the efficiency and effectiveness of invasive plant management;
- Protect and maintain existing restoration projects;
- Increase funding support for invasive plant eradication or control; and
- Facilitate partnerships for invasive plant management at the refuge and larger landscape scale.

Various upland areas within the Refuge—particularly recently burned areas and areas disturbed in the past by ranching and other agricultural activities, utility installations, and other human activities—typically experience some level of invasion by non-native plants. Invasive plant species in these areas consist primarily of non-native grasses and annual weeds (e.g., wild oats, bromes [*Bromus* spp.], ryegrasses, mustard species, filarees [*Erodium* spp.], fennel, thistles [*Cirsium* spp.], wild radish [*Raphanus raphanistrum*]). Periodic surveys are conducted of vulnerable areas on the Refuge to ensure early detection of invasive species known to be present elsewhere in coastal southern California. If new invasive species are detected, actions are taken to control new invaders and avoid further invasion into native habitat areas. Species of particular concern include but are not limited to perennial pepperweed (*Lepidium latifolium*), carnation spurge (*Euphorbia* *terracina*), Canary Island starthistle (*Volutaria canariensis*), globe chamomile (*Oncosiphon piluliferum*), barbed goatgrass (*Aegilops triuncialis*), and bladderflower (*Araujia sericifera*).

Invasive plants present in the Refuge's freshwater habitats that can adversely affected habitat quality include giant reed (*Arundo donax*), castor bean (*Ricinus communis*), tamarisk (Tamarix sp.), pampas grass, cape ivy, Peruvian pepper (*Schinus molle*), Brazilian pepper-tree, and common periwinkle (*Vinca minor*).

Non-native plants on the Refuge also include exotic plant species that represent remnants of past human disturbance. Examples include olive and other orchard tree specimens, various species of eucalyptus trees and shrubs, palms, and Brazilian pepper-tree. Some of these exotic trees and shrubs do not appear to be spreading, while others, such as some eucalyptus species, have naturalized and continue to reproduce.

On the Refuge, invasive plants are controlled using a combination of mechanical (i.e., physical removal either by hand, hand tool, or heavier equipment) and chemical (i.e., conventional herbicides applied in accordance with label requirements) methods. Other methods that are available but are not currently being used include biological control (i.e., introduction of a known natural predator or parasite) and controlled burns. A more detailed discussion of invasive plant control on the Refuge is provided in the Integrated Pest Management Plan that accompanies this CCP (Appendix D).

4.3.5.2 Invasive and Exotic Wildlife

Just as non-native plants can adversely affect native species composition and habitat quality, animal invaders also threaten native species by competing with and displacing or preying on indigenous wildlife, acting as vectors or reservoirs of disease, and physically altering habitats (Pimentel et al. 2005). Examples of how noninvasive wildlife can adversely affect native species are presented in the following text.

Invasive or Exotic and Parasitic Birds

Several non-native bird species present in San Diego County including European starlings and wild turkeys (*Meleagris gallopavo*), have the potential to impact Refuge resources. Starlings are already present on the Refuge, while the range of the introduced wild turkey has not yet expanded to include Refuge lands. There are also several other non-native bird species present on the Refuge that do not appear to be adversely affected the Refuge native bird species, possibility because they do not occur in large numbers on the Refuge. These include the rock dove (*Columba livia*), Eurasian collared-dove, and house sparrow (*Passer domesticus*).

European starlings have the potential to affect native birds through competition for nest sites with secondary cavity-nesting species such as acorn woodpecker, Nuttall's woodpecker, downy woodpecker (*Picoides pubescens*), western bluebird, ash-throated flycatcher (*Myiarchus cineraeus*), and oak titmouse.

Although a native species, the brown-headed cowbird (*Molothrus ater*) is a brood parasite that lays its eggs in the nests of open cup-nesting passerine birds. Nestling cowbirds are larger, grow faster, beg more effectively, and compete with the host nestlings to the extent that most nests parasitized by cowbirds fledge no host young. Impacts of cowbirds on threatened and endangered birds such as California gnatcatcher, least Bell's vireo, and southwestern willow flycatcher (*Empidonax traillii extimus*) are well documented. Data on brood parasitism by brown-headed cowbirds on the Refuge have not been collected within the last 15 years.

However, of 591 nests examined on Sweetwater Authority lands adjacent to the Refuge, only 0.85 percent were parasitized by a cowbird (Famolaro 2009). This low rate of parasitism may be a result of the Sweetwater Authority's active brown-headed cowbird trapping program, which involves active trapping from mid-March through mid-July at three locations: the Sweetwater Dam, the upper end of the Sweetwater Reservoir, and the Bright Valley Farms horse stables.

Wild turkeys, successfully introduced to San Diego County in 1993, are now widespread in higher-elevation areas from the Riverside County line to within 10 miles of the Mexican border (Unitt 2004). They have yet to be recorded on the San Diego NWR, but since the Refuge includes some good-quality turkey habitat (i.e., oak woodlands with a patchy shrub understory) that is connected by riparian corridors of similar habitat to areas inhabited by turkeys, it is reasonable to assume that they may occur on the Refuge within the time period for which the CCP is in effect. Turkeys have the potential to reduce recruitment of oaks and other native plants, alter soil ecological processes through litter disturbance, and eat sensitive native plants and animals, though it is not clear at this time that they have any of these impacts. Exclosure experiments have demonstrated that where turkeys have access to oak woodland habitat, litter cover, abundance of acorns and other hard mast (i.e., bay nuts), and arthropod abundance and diversity are reduced (D. Gluesenkamp, CalFlora, pers. comm. to John Martin, San Diego NWR).

Invasive and Exotic Mammals

Cats (*Felis catus*). Feral and domestic cats are known to prey on native birds, mammals, reptiles, and amphibians. Given that the Refuge shares a boundary with hundreds of homes, it is likely that domestic, abandoned, and feral cats make incursions into the Refuge and kill native animals. Crooks and Soulé (1999) studied domestic cat depredation on small vertebrates at the urban/wildland interface in San Diego. This study found that 32 percent of residents bordering native wildlife habitat in San Diego owned cats, and 77 percent of these cat owners let their cats outdoors. Of the cats that went outdoors, 84 percent brought prey back to the house, with each of these cats bringing back an average of 24 rodents, 15 birds, and 17 lizards each year. Using these data, Crooks and Soulé estimated that at an urban interface with about 100 homes, cats brought back about 840 rodents, 525 birds, and 595 lizards annually. These are likely underestimates of predation, as they only address animals that the cats bring back to the house.

Barratt (1997) found that radio-collared suburban cats routinely made incursions of several hundred meters into adjacent native wildlife habitat. Given the results of these studies and the high probability that abandoned and feral cats are also present in this urban interface, it is likely that wildlife in those areas of the Refuge located near urban interfaces experience some level of cat depredation. However, at present, there is little evidence that feral and domestic cats pose a significant problem to wildlife on the Refuge. This is likely because cat numbers, movements, and depredations on wildlife are currently reduced by the coyotes, which prey on cats and other small mammals present within the Refuge.

Crooks and Soulé (1999) found cat carcasses in most habitat fragments occupied by coyotes, found cat remains in 21 percent of coyote scat examined, and observed that 25 percent of their radio-collared cats were killed by coyotes. Coyotes are frequently seen on the Refuge, but feral or domestic cats are rarely, if ever, detected. In 2,400 hours of operation of nocturnal trail cameras on the Refuge, no cats were detected, and coyotes were detected over 80 times (Dana Morin, Virginia Tech University, pers. comm. to John Martin, San Diego NWR). Cat depredations on wildlife can be managed by supporting the continued presence of coyotes on the Refuge, through maintenance of extensive high-quality habitat, through prohibition of coyote hunting, through land acquisition to maintain habitat connectivity between currently disjunct Refuge parcels, and by taking steps to minimize impacts to the Refuge's coyote population due to road mortality.

Feral pigs (*Sus scrofa*). Feral pigs are a non-native species known to occur in California and throughout the United States. These wild populations can consist of escaped domestic stock, introduced European wild boar, or a hybrid of both types. They are considered an invasive species in California and the rest of the Americas (California Department of Parks and Recreation [CDPR] 2013).

The environmental and agricultural damage caused by feral pigs has been widely documented in scientific literature and media reports (USDA Forest Service 2013). Feral pigs cause substantial damage across the United States; conservative estimates of the financial cost of this damage nationwide are in the range of $1.5 billion annually (West et al. 2009). As a result, several feral pig eradication and control efforts have been accomplished or are underway across the country.

Until recently, feral pig populations in San Diego County have been very low (a few individuals) or non-existent. Over the past several years, however, feral pigs have been introduced by people, either intentionally or inadvertently, and populations have become established in several areas within the region. As of 2013, an estimated 300 to 500 feral pigs were present in San Diego County (CDPR 2013). As of January 2014, feral pigs were not known to be present on any lands within the San Diego NWR; however, models for geographic expansion of San Diego County pig distribution predict that pigs inhabiting oak woodland and chaparral in and around the Capitan Grande Indian Reservation have the potential to reach the Refuge within one to two dispersal events (CBI 2009). It is not clear how frequently pigs cross suboptimal habitat to colonize new areas of high-quality habitat; thus, it is difficult to accurately predict when pigs might be likely to colonize the Refuge.

Feral pig populations can grow rapidly and dispersal can result in pigs quickly colonizing and populating new areas (Waithman et al. 1999) resulting in damage to habitat, competition with native species, negative impacts to drinking water quality, damage to agriculture and rangelands, destruction of archeological sites, and transmission of diseases to livestock and humans (CDPR 2013). As habitat generalists, these opportunistic omnivores can be found in a variety of habitats, although they appear to prefer riparian and oak grassland habitats. They are known to eat almost anything from grass, worms, and insects to young fawns, small mammals, eggs and chicks of ground-nesting birds, and reptiles (CBI 2009, CDPR 2013), but their diet generally consists of plants (e.g., roots, tubers, fruit, acorns). Feral pigs cause extensive and severe soil disturbance due to rooting, wallowing, and trampling. Their foraging techniques can result in serious disturbance to soils and associated plants and animals (Sweitzer and Van Vuren 2002, 2008).

If feral pig populations become established on the Refuge, they will have high potential to adversely affect the federally listed species and MSCP-covered species present on the Refuge, as well as to reduce habitat quality for other wildlife. In addition, pigs may potentially affect human health and safety, cause economic losses both on and off the Refuge, and potentially damage cultural resources through severe soil disturbance. Because pigs have high reproductive potential and begin breeding at a young age, there is a potential for rapid population growth should a population become established on the Refuge.

The feral pig population in San Diego County is not isolated on any particular jurisdiction; they have spread onto Federal lands managed by the Forest Service and BLM, State lands (e.g., parks, wildlife areas, ecological reserves), lands managed by local jurisdictions, tribal lands, and private lands. Many of the lands that could be affected are lands set aside to preserve the region's biodiversity as part of the San Diego MSCP.

To help coordinate feral pig control efforts across the County, an Inter-Governmental Group on Feral Pig Impacts was formed. A Principles of Understanding (POU) was signed by tribal governments and jurisdictions ranging from city governments, State agencies, water districts, Forest Service, and BLM (USDA Forest Service 2013). All these entities agreed to work together, potentially pooling financial and human resources towards a countywide effort to eradicate or control feral pigs recognizing that any course of action necessitates cooperation and willingness of adjacent landowners to work together since pigs move freely across jurisdictional boundaries.

The purpose of the group is to coordinate feral pig management actions, foster collaboration and share information to address the negative impacts of feral pigs to natural and cultural resources, as well as the economic and physical health of the region (USDA Forest Service 2013). To that end, the Forest Service, as the lead agency, prepared an EA, in accordance with NEPA, for the Feral Pig Damage Control Project on Cleveland National Forest and Bureau of Land Management Lands in 2013. The BLM was a cooperating agency in this effort. Concurrent with the EA, CDPR issued a Mitigated Negative Declaration (MND), per the California Environmental Quality Act (CEQA), which also addressed the multiple jurisdictional Feral Pig Eradication and Control Project for San Diego County (CDPR 2013). CEQA responsible agencies included CDFW, City of San Diego, County of San Diego, Vista Irrigation District, and Helix Water District.

Invasive and Exotic Aquatic Wildlife

Exotic aquatic species known to occur on the San Diego NWR include red swamp crayfish (*Procambarus clarkii*), bullfrog, African clawed frog, red-eared slider, spiny soft-shelled turtle (*Trionyx spiniferus*), mosquito fish, carp, largemouth bass, and green sunfish. It is likely that all of these species were intentionally introduced by humans: as discarded pets, for mosquito control, for food, for sport fishing, or as bait.

Exotic crayfish are thought to threaten amphibian species. Diamond (1996) showed that crayfish, which are abundant on the Refuge, preyed on eggs, larvae, and adults of the California newt (*Taricha torosa*). Crayfish predation was seen as one factor leading to the disappearance of the species, which does not have mechanisms of defense against the new predator. Crayfish are resistant to tetrodotoxin poison in newt adults and eggs, are able to open the egg mass' protective gelatin, and are not recognized as predators by the larval newts, which fail to identify chemical cues from the crayfish (Diamond 1996). An example of the indirect impact on amphibian populations by alien crayfish was provided by Axelsson et al. (1997), who demonstrated that an increase of the predation rate upon the tadpoles of the European green tree frog (*Hyla arborea)* was a consequence of the reduction in the habitat complexity due to the consumption of macrophytes by the alien North American crayfish (*Pacifastacus leniusculus*).

Bullfrogs are a serious impediment to management of aquatic habitat on the Refuge for three species of concern: the California red-legged frog, arroyo toad, and the southwestern pond turtle. Several researchers in central California have noted the decline and eventual disappearance of California red-legged frogs once bullfrogs become established at the same site (Moyle 1976, Fisher and Schaffer 1996). Bullfrogs prey on California red-legged frogs (Twedt 1993) and may have a competitive advantage over them because of their larger size, generalized food habits (Bury and Whelan 1984), extended breeding season (Storer 1933) that allows for production of two clutches of up to 20,000 eggs during a breeding season (Emlen 1977), and the unpalatability of their larvae to predatory fish (Kruse and Francis 1977). Lawler et al. (1999) found that fewer than five percent of California red-legged frogs survived in ponds with bullfrog tadpoles, and the presence of bullfrogs delayed frog metamorphosis. Red-legged frogs have long been extirpated from the Sweetwater River in San Diego County, and bullfrogs likely contributed to their disappearance.

Bullfrogs are also known to eat larval and adult arroyo toads (Sweet 1993) and hatch-year southwestern pond turtles (Chris Brown, US Geological Survey, pers. comm. to John Martin, San Diego NWR). In addition to these sensitive species, they may attempt to eat any animal that they can fit into their mouth, and thus may impact a wide array of wildlife on the Refuge.

African clawed frogs introduced to San Diego County consume native invertebrates, and the eggs, tadpoles, and adults of native frogs (McCoid and Fritts 1980, Stebbins 2003). These non-indigenous frogs inhabit the Santa Clara River estuary in Ventura County, California, and include the endangered tidewater goby (*Eucyclogobius newberryi*) in their diet (Lafferty and Page 1997). Additional native Californian vertebrates consumed by the frog include western toads (*Bufo boreas*), arroyo chub (*Gila orcutti*), and the endangered threespine stickleback (*Gasterosteus aculeatus*) (Stebbins 2003). African clawed frogs are also known to carry a diverse parasite load (Prudhoe and Bray 1982, Tinsley 1996, Lafferty and Page 1997, Kuperman et al. 2004); however, there are no studies to verify if these parasites pose a direct threat to native wildlife. They are also asymptomatic carriers of the virulent amphibian fungus *Batrachochytrium dendrobatidis* (chytrid) (Kraus 2009). On the San Diego NWR, the Mother Miguel Pond supports a dense population of larval (and presumably adult) African clawed frogs.

Exotic turtles, such as red-eared sliders and spiny soft-shell turtles, present problems primarily for the management of the native southwestern pond turtle. Potential threats include serving as vectors for disease and parasites (Holland 1991, Holland 1994, Hays et al. 1999, Jacobson et al. 1999, Cadi and Joly 2004) and competition for resources, including food and basking sites (Spinks et al. 2003, Cadi and Joly 2003, Cadi and Joly 2004). Pond turtles in California have evolved without the presence of other turtles and may be more susceptible to diseases and competition, whereas most non-native species (native to other areas within the United States), such as the red-eared slider, have evolved in assemblages of multiple turtles and are more accustomed to inter-specific competition (Cadi and Joly 2003, Cadi and Joly 2004). Furthermore, pond turtles, which typically are smaller than most of the introduced species and other species of Emydid turtles, are known to display avoidance behavior with larger turtles (Bury and Wolfheim 1973, Lindeman 1999), so it is likely that the larger non-native turtles out-compete them for resources.

As described previously, the only fish on the Refuge are introduced, non-native fish, including mosquito fish. Although mosquito fish are known to prey on the eggs and larvae of desert fishes (Courtenay and Deacon 1983), no native fishes are known or suspected to occur on the Refuge. Therefore, it is not currently clear that mosquito fish affect important resources on the Refuge. They do however eat aquatic invertebrates (particularly mosquito larvae); therefore, they may compete with other native aquatic insectivores for prey. Laboratory and field studies (Blyth 1994, Webb and Joss 1997) of frogs in Australia showed direct predation on tadpoles, injuries to tadpoles in tanks or ponds with mosquito fish, and reduced survival and recruitment of frogs. Analysis of field data from Australia (Webb and Joss 1997) demonstrated a significant drop in frog abundance when mosquito fish were present.

Largemouth bass, together with the bullfrog, is probably the most serious obstacle to management for native aquatic vertebrates on the Refuge. Largemouth bass are native to the eastern half of the United States and Canada, from Quebec and Ontario to the Gulf Coast. Highly prized by anglers, largemouth bass have been introduced as game species throughout the United States and the world (Lee et al. 1980). They are long-lived, large in size, and predatory, eating a wide variety of invertebrates and vertebrates; young fish feed on zooplankton. Their habitat requirements include low turbidity, moderate amounts of cover, moderate to high oxygen content, and low alkalinities (Sigler and Sigler 1996). Largemouth bass are extremely territorial. They spawn at age two or three years, when they dig and defend a nest. From 2,000 to 90,000 eggs are laid in this nest, which the male defends for approximately two weeks. Their nests are negatively influenced by declining water levels. Bass are essentially "gape-limited" predators, meaning that they will eat any animal that they can fit in their mouth. A moderate-sized bass 11.8 inches (300 millimeters) in length has a gape of approximately 1.4 inches (36 millimeters). A hatchling southwestern pond turtle with a 0.9 to 1.2-inch (23 to 31-millimeter) long carapace (Holland 1994), an adult arroyo toad, an adult red-legged frog, or any native amphibian on the San Diego NWR could easily be eaten by a large-mouth bass. Bass are relatively common in the Sweetwater River as it passes through the Refuge. Individual bass exceeding 15.7 inches (40 centimeters) in length have been observed here. Bass occur in Loveland Reservoir upstream of the Refuge, as well as in Sweetwater Reservoir downstream of the Refuge; therefore, large populations of bass are within easy dispersal distance of Refuge waters and are likely to provide a ready source of colonists.

Green sunfish are also common in the Sweetwater River. They are predatory centrarchid fish, attaining a length of 3.15 to 7.1 inches (8 to 18 centimeters). Their diet includes a wide variety of aquatic invertebrates up to the size of crayfish, small fish, aquatic and terrestrial insects, and other arthropods. They are known to prey on amphibian larvae, including those of lowland leopard frog (*Rana yavapaiensis*) (Rosen and Schwalbe 2002). It is reasonable to assume that they would prey on other ranid larvae such as red-legged frog, as well as other amphibian larvae on the Refuge.

Another aquatic exotic species established in the Sweetwater River on San Diego NWR is the Asian clam (*Corbicula fluminea*). It is not currently known to have a deleterious effect on wildlife species of management concern but, in large concentrations, may reduce the amount of planktonic fauna in the water, reducing food resources for native species.

4.3.5.3 Vectors and Other Pests

A vector is any insect or other arthropod, rodent, or other animal of public health significance capable of causing human discomfort or injury, or capable of harboring or transmitting the causative agents of human disease. The vectors of most interest in open space areas are ticks and mosquitoes. Ticks are blood-eating parasites that live and feed on mammals, birds, and reptiles; they are known carriers of diseases such as Lyme disease and Tularemia, a rare but very infectious disease. Nine cases were reported in San Diego County in 2011. Adult ticks find hosts by "questing," a process in which ticks crawl up the stems of grasses and weeds or perch on the edges of leaves with their front legs extended. When a potential host passes by their extended legs, the ticks climb onto the host. Questing occurs in the fall and potential hosts range from deer, dogs, cats, and horses to humans and other mammals (County of San Diego Vector Control Website, accessed 2/1/12).

Mosquitoes, which are a natural component of wetland ecosystems, including those on the Refuge, are known carriers of disease. To date, 12 mosquito-borne viruses have been identified in California, including western equine encephalomyelitis virus, St. Louis encephalitis virus, and West Nile virus. Of these, West Nile virus is the most prevalent mosquito-borne disease in the United States. The County of San Diego, Department of Environmental Health, Vector Surveillance and Control Program is responsible for the monitoring and control of vectors. Mosquito monitoring is not currently occurring on the Refuge, but it does occur in various locations throughout the county. Vector Control staff is also responsible for monitoring West Nile virus in the county. They do this by trapping and testing mosquitoes and maintaining a database that is shared with other agencies in the State. According to the California West Nile virus website (westnile.ca.gov), only one mosquito sample in San Diego County tested positive for West Nile virus in 2011, and no human cases of the disease were reported in the county in 2011.

A pest of interest to the Refuge that does not affect the health of humans but that can have a devastating effect on mature oak trees is the goldspotted oak borer (*Agrilus auroguttatus*), a beetle native to oak forests in southeastern Arizona. This beetle, which was first detected in San Diego County in 2004, has contributed to the mortality of more than 80,000 trees in southern California (UCR, Center of Invasive Species Research 2011). Coast live oak, which occurs on the Refuge, is one of the oak species susceptible to this pest. Management of the borer is still being developed, but ensuring that infected wood is not transported to other locations is essential to the control of this pest.

4.3.6 Federal and State Listed Endangered and Threatened Species

The areas of the Refuge designated as Critical Habitat for listed species, per the ESA, are illustrated in Figures 4-19 and 4-20. Table 4-6 lists the federally and/or State of California listed endangered and threatened species or species proposed for listing that are currently present or were historically present within the boundaries of the San Diego NWR. These maps and table are followed by a description of each of these species, the habitats that support them, information about their life history, and their current status on the Refuge.

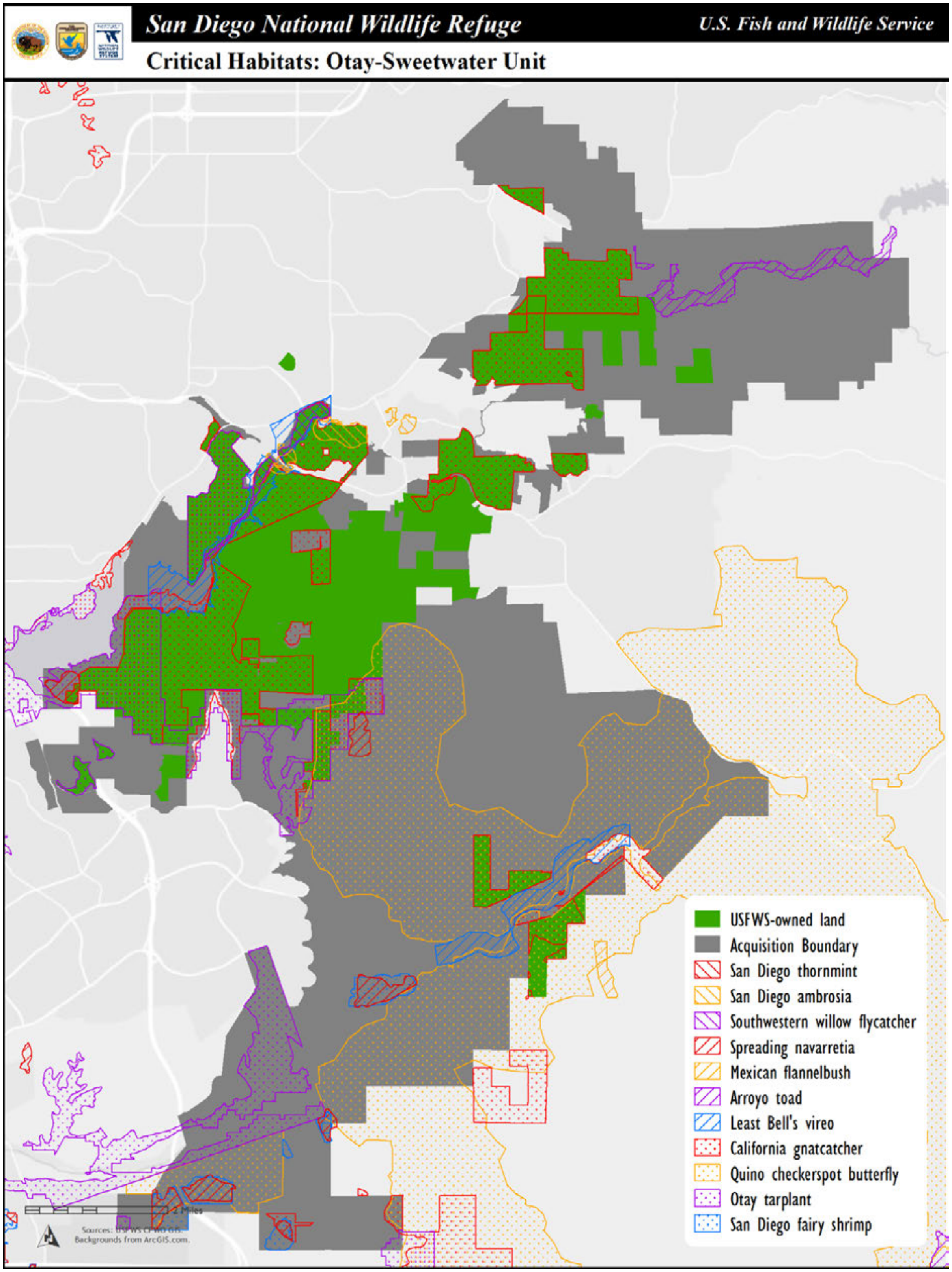

Figure 4-19. Designated Critical Habitat - Otay-Sweetwater Unit

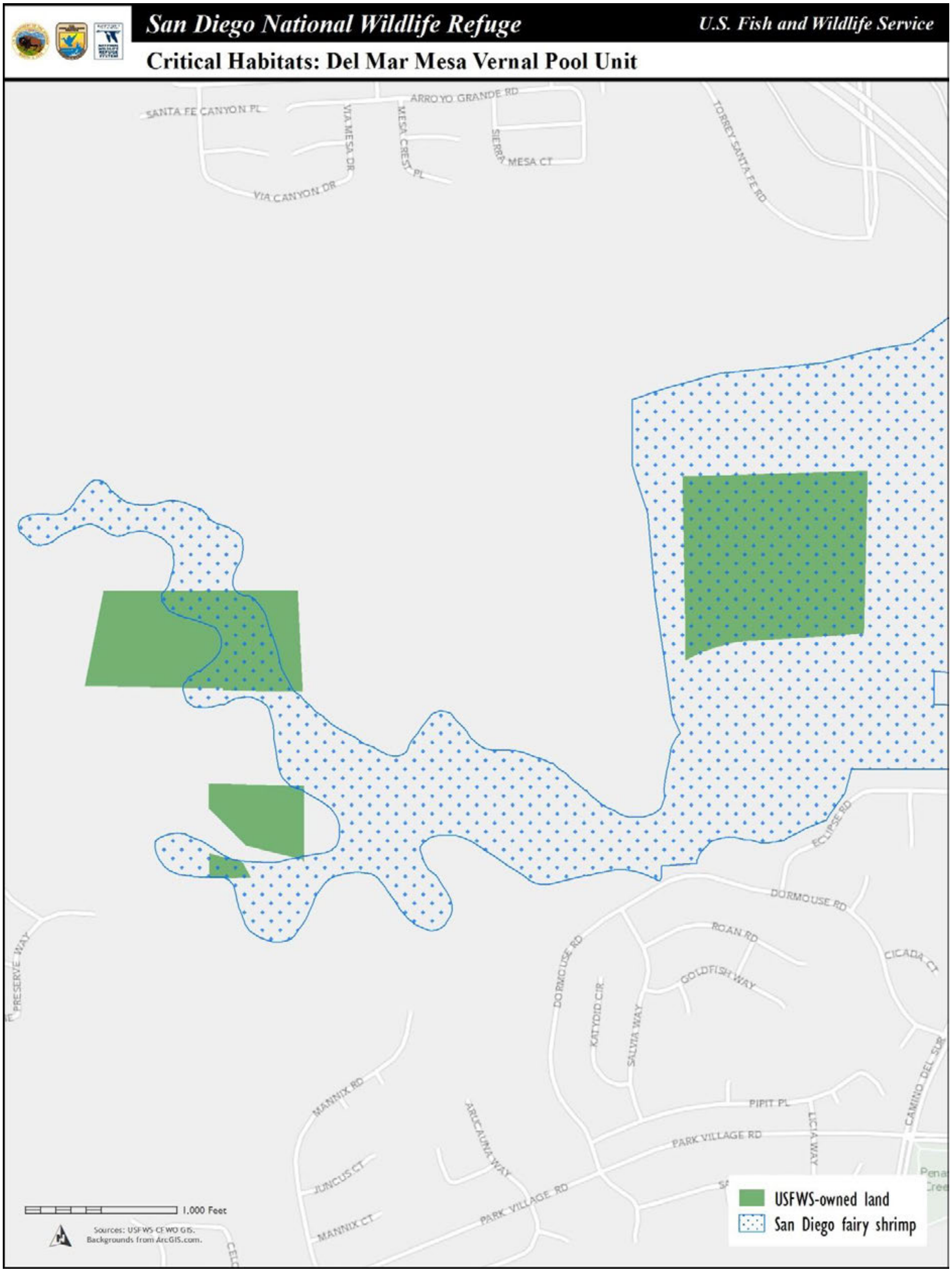

Figure 4-20. Designated Critical Habitat - Del Mar Mesa Vernal Pool Unit

Table 4-6 Federal and/or State Listed and Candidate Species Currently Present or Suitable Habitat Present on the San Diego NWR				
Common Name	**Scientific Name**	**Status**	**Type of Organism**	**Habitat or Soil Type on the Refuge**
Least Bell's Vireo	*Vireo bellii pusillus*	FE/SE	Bird	Riverine and floodplain habitats and adjacent native shrubland (Otay-Sweetwater Unit only)
California Coastal Gnatcatcher	*Polioptila californica californica*	FT	Bird	Coastal sage scrub
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	FE/SE	Bird	Historically, but not currently present on the Otay-Sweetwater Unit; typically nests in riparian habitats
Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	PT/SE	Bird	Not currently present; suitable riparian habitat on the Otay-Sweetwater Unit
San Diego Ambrosia	*Ambrosia pumila*	FE	Plant	Coarse sandy loam near drainages and upland areas on clay slopes (Otay-Sweetwater Unit only)
San Diego Thornmint	*Acanthomintha ilicifolia*	FT/SE	Plant	Open, isolated patches of clay soil (Otay-Sweetwater Unit only)
Otay Tarplant	*Deinandra conjugens*	FT/SE	Plant	Open areas with high clay content soils (Otay-Sweetwater Unit only)
Mexican Flannelbush	*Fremontodendron mexicanum*	FE/SR	Plant	Intermittent drainages with southern mixed chaparral (Otay-Sweetwater Unit only)
Del Mar Manzanita	*Arctostaphylos glandulosa ssp. crassifolia*	FE	Plant	Presence on the Refuge unknown; possibly in southern maritime chaparral on the Del Mar Mesa Vernal Pool Unit
Encinitas Baccharis	*Baccharis vanessae*	FT/SE	Plant	Presence on the Refuge unknown; possibly in chaparral in the Otay Lakes and Mesa area
San Diego Mesa Mint	*Pogogyne abramsii*	FE/SE	Plant	Vernal pools (Del Mar Mesa Vernal Pool Unit only)
Otay Mesa Mint	*Pogogyne nudiuscula*	FE/SE	Plant	Vernal pools (Otay-Sweetwater Unit only)
San Diego Button-celery	*Eryngium aristulatum var. parishii*	FE/SE	Plant	Vernal pools
Spreading Navarretia	*Navarretia fossalis*	FT	Plant	Vernal pools
California Orcutt Grass	*Orcuttia californica*	FE/SE	Plant	Vernal pools (Otay-Sweetwater Unit only)
San Diego Fairy Shrimp	*Branchinecta sandiegonensis*	FE	Invertebrate	Vernal pools

Table 4-6
Federal and/or State Listed and Candidate Species Currently Present or Suitable Habitat Present on the San Diego NWR

Common Name	Scientific Name	Status	Type of Organism	Habitat or Soil Type on the Refuge
Riverside Fairy Shrimp	*Streptocephalus woottoni*	FE	Invertebrate	Not documented on the Refuge as of 2013; suitable vernal pool habitat on the Otay-Sweetwater Unit
Quino Checkerspot Butterfly	*Euphydryas editha quino*	FE	Invertebrate	Shrublands with appropriate primary/secondary host plants (Otay-Sweetwater Unit only)
Hermes Copper	*Hermelycaena (Lycaena) hermes*	FC	Invertebrate (butterfly)	Spiny redberry in coastal sage scrub/southern mixed chaparral (Otay-Sweetwater Unit only)
Arroyo Toad	*Anaxyrus (Bufo) californicus*	FE	Amphibian	Historically occurred on the Otay-Sweetwater Unit; typically found in slow streams next to uplands
California Red-legged Frog	*Rana draytonii*	FT	Amphibian	Historically occurred on the Otay-Sweetwater Unit; typically occurs in riparian and other aquatic habitats

FE – Federally endangered; FT – Federally threatened; PT – Proposed for listing as federally threatened;
FC – Federal candidate species; SE – State endangered; SR – State rare

4.3.6.1 Least Bell's Vireo (*Vireo bellii pusillus*)

Listing and Conservation Status

The least Bell's vireo was added to the State of California's list of endangered species in 1980. It was listed as endangered by the Service on May 2, 1986 (51 FR 16474), due to a significant range-wide decline in population related to extensive habitat loss and degradation associated with urban development, exotic plant invasion, and expansion of agricultural practices into riparian zones. Brood parasitism by the brown-headed cowbird was also identified as an issue. A draft recovery plan was prepared in March 1998 (USFWS 1998b), but was never finalized. In the five-year review for the least Bell's vireo (USFWS 2006b), the Service 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 breeding locations throughout southern California, and the success of regional efforts to conserve and manage suitable breeding habitat for the species throughout its range (UFSWS 2006b).

The final rule describing the areas designated as critical habitat for the least Bell's vireo was published in the *Federal Register* on February 2, 1994 (59 FR 4845). This critical habitat encompasses approximately 38,000 acres (15,378 hectares) in 10 areas in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, and San Diego counties, California. The physical and biological features essential to the conservation of this species, referred to as primary constituent elements, include riverine and floodplain habitats (particularly willow-dominated riparian woodland with dense understory vegetation maintained, in part, in a non-climax stage by periodic floods or other agents) and adjacent coastal sage scrub, chaparral, or other upland plant communities (USFWS 1994).

Within the Otay-Sweetwater Unit, critical habitat for the least Bell's vireo has been designated along the Sweetwater River. This portion of the vireo's critical habitat extends along the river floodplain from the northeastern end of Sweetwater Reservoir to about one mile (1.6 kilometers) east of the intersection of Highways 54 and 94 (refer to Figure 4-19). Critical habitat for the least Bell's vireo has also been designated along Jamul/Dulzura Creek to the north of the Lower Otay Reservoir, just outside the Refuge boundary.

The least Bell's vireo is a covered species in two landscape level habitat conservation plans: the San Diego County Multiple Habitat Conservation Plan and the San Diego MSCP. These plans designate large reserve systems that include substantial habitat for the least Bell's vireo and include requirements for monitoring and management actions beneficial to the long-term conservation of the species. Public lands and lands to be conserved through habitat conservation planning efforts include 7,071 acres of riparian habitat.

Species and Habitat Description

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 1998b). This subspecies has indistinct white spectacles and two faint wing bars, with males and females having identical plumage. Male least Bell's vireos are easily distinguished by their song, which consists of a rapid series of harsh, slurred notes that increase in intensity as the song progresses (Grinnell and Storer 1924, Pitelka and Koestner 1942, Barlow 1962, Beck 1996). Phrases of the least Bell's vireo song are alternatively slurred upward and downward and exhibit a "question-and-answer" quality (Grinnell and Storer 1924, Beck 1996). The least Bell's vireo is in the family Vireonidae and is one of four subspecies of Bell's vireo (*Vireo bellii*) that have been recognized (AOU 1957), with each subspecies believed to be isolated from one another throughout the year (Hamilton 1962, USFWS 1998b).

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, Salata 1983a, USFWS 1998b). The understory in these areas is typically dominated by mulefat, California wild rose, poison oak, sandbar willow, young individuals of other willow species, and several perennial species (USFWS 1998b). Important canopy species include mature arroyo and Goodding's willows and occasional cottonwoods, western sycamore, or coast live oak. Least Bell's vireos primarily forage and nest in riparian habitat, but they may also use adjoining upland scrub habitat (Salata 1983a, Salata 1983b, Kus 2002).

Least Bell's vireos primarily feed on invertebrates, especially lepidopteran larvae, within willow stands or associated riparian vegetation (Miner 1989, Brown 1993), while also occasionally foraging beyond the limits of riparian vegetation, entering adjacent coastal sage scrub, chaparral, and oak woodland vegetation. Foraging in these upland habitats usually occurs within 100 feet (30.5 meters) of the edge of riparian vegetation (Salata 1983a, Salata 1983b, 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 (Salata 1983a, Salata 1983b, Miner 1989).

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 1998b).

Nest site fidelity is high among adults, with individuals typically returning to established breeding territories year after year (Greaves and Labinger 1997, Salata 1983a, Salata 1983b) and in many cases establishing nests in the same shrub that was used in the previous year (Kus 2002). On average, 20 percent of first-time breeders select nesting sites away from their natal drainages (Kus 2002).

Male least Bell's vireos establish and defend breeding territories through singing and physically chasing intruders (Barlow 1962, Beck 1996, USFWS 1998b). Territories range in size from 0.5 to 7.5 acres (0.2 to 3.0 hectares) (USFWS 1998b); however, to date, no significant factors have been identified that account for the variability in territory size throughout this vireo's breeding range (Newman 1992, Kus 2002).

Nest building commences a few days after pair formation, typically in late March, with the female selecting a nest site location and both sexes constructing the nest (Pitelka and Koestner 1942, Barlow 1962, USFWS 1998b). Nests are typically suspended in forked branches about three feet (one meter) above the ground (Nolan 1960, Barlow 1962). No clear preference is indicated for any particular plant species as the nest host (USFWS 1998b). Typically, three to four eggs are laid on successive days shortly after nest construction (Kus 2002). The eggs are incubated by both parents for about 14 days with the young remaining in the nest for another 10 to 12 days (Pitelka and Koestner 1942, Nolan 1960, Barlow 1962). Each nest appears to be used only once, with new nests constructed for each nesting attempt (Greaves 1987). Least Bell's vireos may attempt up to five nests within a breeding season, but they are typically limited to one or two successful nests within a given breeding season (USFWS 1998b).

Fledgling least Bell's vireos expand their dispersal distances from about 35 feet (10.7 meters) the first day to about 200 feet (61 meters) several weeks after fledging (Hensley 1950, Nolan 1960). This distance has been shown to increase to at least one mile (1.6 kilometers) prior to their first fall migration (Gray and Greaves 1984).

Multiple long-term monitoring studies indicate that approximately 59 percent of nests successfully produce fledglings, although on average only 1.8 chicks fledge per nest (USFWS 1998b). Although least Bell's vireo nests appear to be more accessible to terrestrial predators because of their relatively low placement (Franzreb 1989), western scrub-jays (*Aphelocoma californica*) account for the majority of documented depredation events (Peterson et al. 2004). Predation rates can exceed 60 percent of least Bell's vireo nests in a given area within a year (Kus 1999), but typical nest predation rates average around 30 percent (Franzreb 1989), which is comparable to predation rates for other North American passerines (Martin and Clobert 1996, Grishaver et al. 1998, Ferree 2002).

Nest parasitism by cowbirds is another major source of failure for least Bell's vireo nests (Franzreb 1989, USFWS 1998b, Kus 1999, Kus 2002, Griffith and Griffith 2000, Sharp 2002); nests that are parasitized are either abandoned 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). Parasitism of least Bell's vireo nests may exceed 42 percent in some locations (Kus 1999), but extensive cowbird trapping and focused nest monitoring can substantially reduce parasitism or its effects (Franzreb 1989, USFWS 1998b, Griffith and Griffith 2000, Kus 2002).

Some individual least Bell's vireos have been documented to live at least seven years (Brown 1993, USFWS 1998b), but the average lifespan for this species is substantially lower. First-year survivorship has been estimated to average approximately 25 percent (Greaves and Labinger 1997, USFWS 1998b), which is typical for small passerines. Annual survivorship in subsequent years is estimated to be approximately 47 percent (USFWS 1998b). Annual survival of females appears to be slightly lower than that for males, presumably due to the higher energetic costs of egg production by females (USFWS 1998b).

The least Bell's vireo population in the U.S. has increased tenfold since its listing in 1986, and the number of known territories has increased from 291 to 2,968. 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. Population growth has been greatest in San Diego and Riverside counties, with lesser but significant increases in Orange, Ventura, San Bernardino, and Los Angeles counties.

At the time of the listing in 1986, greater than 99 percent of the remaining least Bell's vireos were concentrated in southern California (Santa Barbara County and southward), with San Diego County containing 77 percent of the population (USFWS 1986). Greater than 99 percent of least Bell's vireos still remain in southern California, south of the Tehachapi Mountains and northwestern Baja California (Wilbur 1980, Garrett and Dunn 1981, Franzreb 1989), although the populations are now more evenly distributed with 54 percent of the total population occurring in San Diego County and 30 percent of the population occurring in Riverside County (USFWS 2006b). 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 2006b).

Several large, regional habitat conservation plans in southern California have addressed the effects of urban development on this species. These plans are expected to provide long-term protection of core occurrences of least Bell's vireos in western Riverside, Orange, and San Diego counties. In addition, compliance-driven and voluntary riparian restoration activities throughout the historic range may have contributed to an increase in riparian habitat since the listing of the least Bell's vireo (USFWS 2006b). In addition, habitat quality has been improved in some areas by removing invasive plant species such as giant reed, salt cedar, perennial pepperweed, and non-native palms.

Cowbird trapping has proven to be a successful tool in halting least Bell's vireo population declines over the short term within a limited area. However, Kus and Whitfield (2005) believe trapping may not be the best method for long-term recovery of the least Bell's vireo because maintaining cowbird populations at low levels may not allow the least Bell's vireo to evolve resistance to cowbird parasitism. Other studies conducted by Sharp and Kus (2006) indicate that managing for dense understory cover may reduce parasitism of least Bell's vireos. Additional research, which is ongoing, will likely provide land managers with a combination of options for addressing the impacts of cowbird nest parasitism on least Bell's vireos.

Status of the Species within the Refuge

In the early 1990s, the portion of the Sweetwater River that now occurs within the Refuge was believed to support a core population of the endangered least Bell's vireo. From 1987 through 1991, this area supported an average of 30 pairs of vireos, with 30 to 48 territories identified within the reach of the Sweetwater River between the Sweetwater Authority boundary and the Cottonwood golf course. From 2001 through 2011, there has been a significant downward trend in the number of territories identified in this same area. As previously discussed, cowbird parasitism is not the likely cause of the local decline. The observed decline in vireo numbers is highly localized. Vireo populations on adjacent habitat on Sweetwater Authority property, immediately downstream of San Diego NWR, have not declined; however, they were affected by loss of habitat due to wildfire. The spatial pattern of decline suggests that the cause is not a wide-ranging phenomenon such as brood parasites or disease but rather is limited to the habitat on the Refuge. Possible causes for this slow steady decline include successional changes in the riparian vegetation structure in the area and human disturbance.

In addition to the moderate number of vireo territories along the Sweetwater River, the Refuge supports low numbers of territories in small disjunct patches of suitable habitat, such as Steele Canyon Creek, Coon Canyon to the west of San Miguel Mountain, and at Mother Miguel Pond.

4.3.6.2 California Coastal Gnatcatcher *(Polioptila californica californica)*

Listing and Conservation Status

The Service listed the coastal California gnatcatcher as threatened on March 30, 1993 (58 FR 16742), stating that the "habitat and range of the gnatcatcher [had] been significantly reduced," and further noting that coastal sage scrub was "one of the most depleted habitat types in the United States" (58 FR 16751). At the time of listing, 58 to 61 percent of coastal sage scrub habitat had been lost in the three counties that supported about 99 percent of the U.S. gnatcatcher population (58 FR 16751). The primary causes for habitat destruction were identified as urban and agricultural development. In addition, wildland fire was identified as a temporary impact that could also lead to permanent habitat degradation. Fragmentation and nest parasitism were also cited as threats.

A final rule establishing critical habitat for the gnatcatcher was published in the *Federal Register* on December 19, 2007 (72 FR 72010) and went into effect on January 18, 2008. As a result, 197,303 acres (79,846 hectares) of Federal, State, local, and private land divided among 11 critical habitat units was designated as critical habitat, including approximately 14,898 acres (6,029 hectares) within Unit 1 (South San Diego County).

The Service completed a five-year review of the coastal California gnatcatcher in September 2010 and concluded that no change in the listing status of the gnatcatcher was warranted for several reasons, including the fact that the threat of habitat type conversion increased throughout the range of the gnatcatcher since its listing in 1993.

On October 26, 2011, the Service issued a 90-day finding on a petition to delist the coastal California gnatcatcher (76 FR 66255), finding that the petition did not present substantial scientific or commercial information to indicate that delisting of the subspecies may be warranted.

The coastal California gnatcatcher is also designated as a Bird Species of Special Concern by the State of California and is a focal species under California's Natural Community Conservation Planning (NCCP) program. It is also a covered species under the San Diego MSCP, as this MSCP proposes to conserve 68 percent (57,874 acres) of habitat supporting core gnatcatcher populations (City of San Diego 1998), some of which is included within the Refuge. Several subregional coastal sage scrub focused habitat conservation plans, which specifically address the conservation of this species, have been approved or in the late planning stages throughout southern California.

Species and Habitat Description

The coastal California gnatcatcher is a small, long-tailed member of the thrush family (Muscicapidae) that is endemic to cismontane southern California and northwestern Baja California, Mexico (Atwood 1980, Atwood 1991, AOU 1983). Its body plumage is dark blue-gray above and grayish-white below, while the tail is mostly black. The male has a distinctive black cap that is absent during the winter, and both sexes have a slight white eye-ring. Its distinctive call is a rising and falling kitten-like mew note. The gnatcatcher is distinguished from the black-tailed gnatcatcher (*Polioptila melanura*) by its darker body plumage, less extensive white on tail feathers (rectrices 5 and 6), and longer tail.

The gnatcatcher is found on the coastal slopes of southern California, from southern Ventura southward through Los Angeles, Orange, Riverside, San Bernardino, and San Diego counties into Baja California, Mexico, to approximately 30 degrees North latitude near El Rosario (AOU 1957, Atwood 1980). Within its range, the distribution of coastal California gnatcatcher is further defined by relatively narrow elevation limits (Atwood and Bolsinger 1992). In general, inland populations of the gnatcatcher can be found below the 1,640-foot (500-meter) elevation, and coastal populations tend to be found below an elevation of 820 feet (250 meters) (Atwood and Bolsinger 1992). Relatively isolated populations also remain in portions of its former range in Los Angeles, San Bernardino, and southern Ventura counties (USFWS 2010b).

This gnatcatcher typically occurs in or near coastal sage scrub, a habitat characterized by relatively low growing, dry-season deciduous, and succulent plants. Characteristic plants of these communities include California sagebrush, California buckwheat, laurel sumac, lemonade berry, bush penstemon, and various species of sage (*Salvia* spp.) (Atwood 1990, Beyers and Wirtz 1997, Braden et al. 1997a, Weaver 1998). Because the distribution of coastal sage scrub is patchy and its structure and composition is variable throughout the range of the species, gnatcatchers are not uniformly distributed within available coastal sage scrub. Rather, gnatcatchers occur most frequently within California sagebrush dominated stands of coastal sage scrub (Atwood 1990, Atwood et al. 1998, Beyers and Wirtz 1997), particularly on mesas, gently sloping areas, and along the lower slopes of the coast ranges (Atwood 1990).

Gnatcatchers are found in moderately dense stands of coastal sage scrub (Atwood 1980). Beyers and Wirtz (1997) found that nesting territories typically have greater than 50 percent shrub cover and an average shrub height that exceeds 3.3 feet (one meter). The relative density of shrub cover influences gnatcatcher territory size, with territory size increasing as shrub cover decreases, probably due to limited resource availability. Gnatcatchers will use sparsely vegetated coastal sage scrub as long as perennial shrubs are available, although there appears to be a minimum cover threshold below which the habitat becomes unsuitable (Beyers and Wirtz 1997).

Gnatcatchers also use chaparral, grassland, and riparian plant communities when these communities occur adjacent to or are intermixed with coastal sage scrub (Campbell et al. 1998). The use of non-coastal sage scrub habitat is thought to be most common in areas where gnatcatchers in high density are adjacent to productive non-coastal sage scrub habitat areas. Both adults and juvenile gnatcatchers have been observed foraging in non-coastal sage scrub habitats for extended periods of time, especially from midsummer to fall, when volume and quality of drought-deciduous coastal sage scrub foliage declines (Campbell et al. 1998, Preston et al. 1998a). Use of these habitats appears to be less frequent during the breeding season; however, breeding territories have been documented in non-sage scrub habitats (e.g., chaparral, grassland, ruderal habitats). Potential factors contributing to the gnatcatcher's use of alternative habitats may include more abundant food resources, higher survival rates during dispersal, fire avoidance, and cooler microclimate during hot weather (Campbell et al. 1998).

Other parameters that contribute to the quality of habitat for the gnatcatcher include slope, aspect, temperature, and precipitation. In an evaluation of a model used to predict habitat quality for the gnatcatcher, Winchell and Doherty (2008) found higher gnatcatcher occupancy probabilities corresponded with areas that had less than 40 percent slopes, annual precipitation of less than or equal to 13.2 inches (33.5 centimeters), and an average January minimal temperature of greater than or equal to 41 °F. Slope, temperature, and precipitation were also found to have a stronger influence on occupancy than patch size (Winchell and Doherty 2008).

Several studies have suggested that gnatcatchers nest infrequently on very steep slopes (greater than 40 percent) (Bontrager 1991) and Grishaver et al. (1998) demonstrated that nests were more likely to be successful on shallow slopes (less than 19.9 percent slope) than on steeper slopes. However, over a landscape of varied topography, steep slopes are part of gnatcatcher territories. Nesting may be less frequent on steep slopes because these areas are more prone to erosion than gradual slopes and are therefore less likely to meet the minimum vegetation cover threshold necessary for the habitat to be considered suitable for the gnatcatcher (Beyers and Wirtz 1997). The grade of the slope may also affect the type of plant community present, thereby reducing the suitability of the area for nesting. North- and east-facing slopes tend to support chaparral rather than coastal sage scrub communities, whereas gnatcatchers are primarily found in coastal sage scrub (Weaver 1998).

The gnatcatcher is primarily insectivorous, and its diet appears to consist of small arthropods, especially leaf-hoppers (Homoptera), and spiders (Araneae), while true bugs (Hemiptera) such as wasps, bees, and ants (Hymenoptera) are minor components (Burger et al. 1999). Both adults and young consume more sessile than active prey items (Burger et al. 1999).

Gnatcatchers are non-migratory and exhibit strong site tenacity (Atwood 1990). Pairs strongly defend territories during the breeding season against other gnatcatchers and predators, and some will defend territories throughout the year (Preston et al. 1998a). Breeding season territories range in size from less than 2.5 acres (one hectare) to 25 acres (10 hectare) (Atwood et al. 1998, Preston et al. 1998a), with mean territory size generally greater for inland populations than coastal populations (Preston et al. 1998a). During the non-breeding season, gnatcatchers have been observed to wander in adjacent territories and unoccupied habitat increasing their home range size to approximately 78 percent larger than their breeding territory (Preston et al. 1998a).

Most gnatcatchers first breed at one year of age (Atwood and Bontrager 2001). The gnatcatcher breeding season extends from late February through early August, with the peak of nesting attempts occurring from mid-March through mid-May (Grishaver et al. 1998, Atwood and Bontrager 2001). Nests are constructed over a 4- to 10-day period and are most often placed in perennial species of coastal sage scrub about three feet (1.2 meters) above the ground (Atwood 1990).

Gnatcatchers typically lay clutches of three to five eggs (Atwood 1990, Galvin 1998, Grishaver et al. 1998), and clutch sizes may be influenced by the amount of precipitation immediately preceding nest initiation (Patten and Rotenberry 1999). The egg incubation period is 14 days, and the nestling period is 10 to 15 days (Grishaver et al. 1998). Both sexes participate in all phases of the nesting cycle, and gnatcatcher pairs may produce more than one brood in a nesting season (Atwood 1990, Grishaver et al. 1998).

Juveniles remain within their natal territories up to five weeks after fledging from the nest (Grishaver et al. 1998), with juveniles subsequently dispersing to find their own foraging and nesting territories. Juveniles have been observed to disperse up to 6.2 miles (10.0 kilometers) from their natal territory (Atwood and Bontrager 2001), but they generally disperse less than 1.9 miles (3.0 kilometers) on average (Bailey and Mock 1998, Galvin 1998, Atwood and Bontrager 2001). Dispersing gnatcatchers are apparently able to traverse highly human-modified landscapes for at least short distances (Bailey and Mock 1998). Juveniles begin to establish territories as early as late spring, and territories are established by the end of October (Preston et al. 1998a).

Similar to other passerine species, gnatcatcher mortality is highest for the youngest age class, with much of this attributable to predation of young in nests (Atwood 1990, Braden et al. 1997b) and high mortality rates among dispersing juveniles, as indicated by low re-sighting of banded birds (Bailey and Mock 1998, Galvin 1998). Sources of mortality for gnatcatchers have not been well studied, although physiological stress during cold, wet winter months when food availability may be low is probably the main source of mortality among adults and dispersing juveniles (Atwood 1990, Atwood and Bontrager 2001).

Mean average survivorship of gnatcatchers during their first year is estimated to be 29 percent, with annual survivorship for adults 57 percent, although there is probably a high annual variation within and between populations (Atwood and Bontrager 2001). The oldest documented individual was a female at least eight years old (Atwood and Bontrager 2001).

Gnatcatchers develop vocalizations within two weeks of fledging (Grishaver et al. 1998). Male gnatcatchers call more frequently than females; the greatest vocalization rates occur in February, just prior to nest building (mean 238 vocalizations per hour) and lowest in June during brooding of nestlings (mean 67 vocalizations per hour) (Preston et al. 1998b). Calls have been recorded in association with mobbing potential predators, during pair interactions (i.e., pair bonding, copulation, nest building, or delivery of food to nestlings), and following the loss of a mate during the breeding season (Preston et al. 1998b, Atwood and Bontrager 2001).

Since the listing of the gnatcatcher, the Service has worked with proponents of development projects to offset the loss of occupied or potential gnatcatcher habitat. This has been achieved through conservation, enhancement, and/or restoration of coastal sage scrub. Several regional habitat conservation plans, including the San Diego MSCP, have been designed, in cooperation with the USFWS and CDFW, to provide long-term protection of gnatcatchers in Orange County, San Diego County, and Western Riverside County through the conservation and management of relatively large contiguous blocks of habitat. In San Diego County, the Otay-Sweetwater Unit protects important blocks of gnatcatcher habitat, with the majority of this habitat designated as critical habitat supporting core populations of the species.

Status of the Species within the Refuge

Within the Otay-Sweetwater Unit, gnatcatcher populations occur in high-quality coastal sage scrub and persist in high densities. Prior to the Harris Fire in 2007, the Refuge supported approximately 6,175 acres (2,500 hectares) of high-quality coastal sage scrub. Today, in the aftermath of the fire, the Refuge supports only about 3,610 acres (1,460 hectares) of this high-quality habitat, which is distributed in areas such as the lower slopes of McGinty Mountain, the north side of the Las Montañas area, the ridge and associated slopes along the south side of the Par Four area, and the slopes to the west of the Sweetwater River south of Highway 94.

The gnatcatcher population on the Refuge has not been monitored since 2001, well before portions of the Refuge's gnatcatcher habitat were lost to the Otay Fire of 2003 and the Harris Fire of 2007. Studies conducted by Preston et al. (1998a) on the territorial behavior of the California gnatcatcher concluded that the average size of a gnatcatcher territory in high-quality coastal sage scrub habitat is 14.8 acres (six hectares). Using this information, along with an estimate of the high-quality coastal sage scrub habitat still present on the Refuge, it is assumed that suitable habitat on the Refuge could have supported roughly 243 pair of gnatcatchers in 2011.

4.3.6.3 Southwestern Willow Flycatcher *(Empidonax traillii extimus)*

Listing and Conservation Status

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). This species is also covered under the San Diego MSCP, because 76 percent (4,900 acres) of potential habitat for this species is to be conserved. Some of these conserved lands are included within the Refuge.

The decision to list this subspecies as endangered under the ESA was based on extensive loss and modification of breeding habitat, with consequent reductions in population levels. This situation was compounded by increases in brood parasitism by the brown-headed cowbird, resulting in reduced reproductive success and further reductions in population levels (USFWS 2002a). 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. Pending preparation of a five-year review for this subspecies was announced in 2008, but the review has yet to be completed.

Critical habitat for this species was first designated in 1997 (62 FR 44228) and was subsequently revised when the final rule was published in the *Federal Register* on October 19, 2005 (70 FR 60886). As a result of a lawsuit over the 2005 critical habitat designation, the Service agreed to reconsider the critical habitat designations for the flycatcher; on August 15, 2011, a proposed rule to revise the critical habitat designations was published in the *Federal Register* (76 FR 50542). The Service issued the final rule regarding revised critical habitat in the *Federal Register* (78 FR 344) on January 3, 2013. As a result, approximately 160 acres of the Refuge has been designated as critical habitat for the southwestern willow flycatcher. Specifically, the riparian habitat that extends along the Sweetwater River from approximately 0.5 miles east of the Sweetwater Reservoir to just west of the intersection of Jamacha Road and Willow Glen Drive has been designated as critical habitat for the flycatcher.

Species and Habitat Description

The southwestern willow flycatcher, a recognized subspecies of the willow flycatcher (*Empidonax traillii*), 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 2002a). 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 song is a sneezy "fitz-bew," the call a repeated "whitt" (Unitt 1987). Although males are the primary singers, females also sing occasionally (Sogge et al. 1997; USFWS 2002a).

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 2002a). 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 2002a, Sogge et al. 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 support 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, as it has been observed nesting in habitats with great variability in dominant plant species (both native and exotic), as well as variability in the size and shape of the breeding patch and the height and structure of the tree and/or shrub canopy (USFWS 2002a). 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. The males establish and defend their territories through singing and aggressive interactions. These territories tend to get smaller once a breeding pair is established. Breeding territory size is not consistent and can vary widely depending upon differences in population density, habitat quality (including vegetation density and food availability), and nesting stage (Sogge et al. 2010). Both sexes can breed beginning in their second year (Sogge et al. 2010).

Willow flycatchers are generally considered monogamous during the breeding season (Sedgwick 2000); however, some populations have a relatively high degree of polygyny (i.e., a male having more than one breeding female in its territory). Polygynous males generally have two females in their territory, but up to four have been recorded (Sogge et al. 2010). Willow flycatchers usually begin building nests within a week or two after pair formation. 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).

Status of the Species within the Refuge

The southwestern willow flycatcher does not currently breed within the Refuge, nor were the habitats within the Refuge occupied at the time this species was listed. Over the years several surveys have documented a single flycatcher territory at the upper end of the Sweetwater Reservoir, including surveys conducted between 1997 to 1999 (Sogge and Durst 2008).

Between May and July 1998, a pair unsuccessfully nested in this area. The following year, only a male was detected in the area, but surveys conducted in 2000 and 2001 indicated that the male did not return after 1999 (Unitt 2004). Within the segment of the Sweetwater River that extends through the Refuge, southwestern willow flycatcher surveys have been conducted incidental to least Bell's vireo surveys in various years (1987-1993, 1995, 1996, 1998, 2001, 2002, 2005, and 2007-2011). No southwestern willow flycatcher territories were identified on the Refuge during these surveys (pers comm. John Martin, San Diego NWR). Small numbers of willow flycatchers of undetermined subspecies are sometimes encountered during surveys but do not remain to establish territories. These birds may include individual *E.t. extimus* that use the Refuge as migratory stopover habitat and continue north to nest in other riparian habitat areas (e.g., Marine Corps Base Camp Pendleton).

Although this flycatcher is not currently nesting on the Refuge, areas of suitable habitat are present along the Sweetwater River. The Service states in the proposed rule to revise the critical habitat designations for this subspecies (76 FR 50542) that "because riparian vegetation typically occurs in floodplain areas that are prone to periodic disturbance, suitable habitats will be ephemeral and their distribution dynamic in nature. Suitable habitat patches may become unsuitable through maturation or disturbance (though this may be only temporary, and patches may cycle back into suitability). Therefore, it is not realistic to assume that any given suitable habitat patch (occupied or unoccupied) will remain continually occupied and/or suitable over the long-term.

Unoccupied suitable habitat plays a vital role in the recovery of the flycatcher, because it provides suitable areas for breeding flycatchers to: (a) colonize as the population expands (numerically and geographically), and (b) move following loss or degradation of existing breeding sites. Indeed, many sites will likely pass through a stage of being suitable but unoccupied before they become occupied. Potential habitats that are not currently suitable will also be essential for flycatcher recovery, because they are the areas from which new suitable habitat develops as existing suitable sites are lost or degraded." Based on this analysis, the segment of the Sweetwater River between the Sweetwater Reservoir and the golf course to the north should be and is considered important habitat for the recovery of the southwestern willow flycatcher.

4.3.6.4 Yellow-billed Cuckoo *(Coccyzus americanus occidentalis)*

Listing and Conservation Status

The Service was petitioned on May 20, 1986, to list the subspecies throughout California, Washington, Oregon, Idaho, and Nevada (52 FR 2239). The Service considered the entire subspecies throughout its range as a candidate species for listing as Category 2, comprising species for which listing is possibly appropriate but for which conclusive data are not available to support a proposed rule. A 12-month finding on December 29, 1988, found the listing not warranted (53 FR 52746), but on February 17, 2000, a 90-day finding found substantial evidence for listing. The 12-month finding dated July 25, 2001, found that listing was warranted but precluded by higher listing priorities. On October 26, 2011, another 12-month finding also reached a warranted but precluded finding.

On October 3, 2013, the Service published a proposed rule in the *Federal Register* (78 FR 61622) announcing a proposal to list the yellow-billed cuckoo in the western portion of the United States, Canada, and Mexico (western yellow-billed cuckoo) as a threatened distinct population segment under the ESA. The comment period was reopened on December 26, 2013 (78 FR 78321) to provide additional time for comments. Listing is considered warranted based on several factors including the curtailment, degradation, fragmentation, and loss of habitat for the western yellow-billed cuckoo, which is ongoing and, absent changes in the landscape, hydrology, or other factors, this habitat will likely continue to be negatively impacted or lost into the future. The State of California listed this species as threatened in 1971, and reclassified the species as endangered on March 26, 1988.

Species and Habitat Description

The yellow-billed cuckoo is a member of the family Cuculidae whose approximately 128 members share the common feature of a zygodactyl foot, in which two toes point forwards and two toes point backwards. The yellow-billed cuckoo is a medium-sized bird of about 12 inches (30 centimeters) in length, and weighing about two ounces (60 grams). The species has a slender, long-tailed profile, with a fairly stout and slightly down-curved bill, which is blue-black with yellow on the basal half of the lower mandible. Plumage is grayish-brown above and white below, with rufous primary flight feathers. The tail feathers are boldly patterned with black and white below. The legs are short and bluish-gray, and adults have a narrow, yellow eye ring. Juveniles resemble adults, except the tail patterning is less distinct, and the lower bill may have little or no yellow. Males and females differ slightly. Males tend to have a slightly larger bill, and the white in the tail tends to form oval spots, whereas in females the white spots tend to be connected and less distinct.

The yellow-billed cuckoo is a Neotropical migrant bird that winters in South America and breeds in North America. In the western U.S., this bird breeds in large blocks of riparian habitats, particularly woodlands with cottonwoods and willows (Ehrlich et al. 1988). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (Hughes 1999). At the landscape level, the amount of cottonwood-willow-dominated vegetation cover in the landscape and the width of riparian habitat appeared to influence cuckoo distribution and abundance. Clutch size is usually two or three eggs, and development of the young is very rapid, with a breeding cycle of 17 days from egg laying to fledging of young. Although yellow-billed cuckoos usually raise their own young, they are facultative brood parasites, occasionally laying eggs in the nests of other yellow-billed cuckoos or of other bird species (Hughes 1999).

The Service considers the yellow-billed cuckoos that occur in the western United States as a distinct population segment. Based on historic accounts, the species was widespread and locally common in California in the 1930s, with the species widely distributed in suitable river bottom habitats (Grinnell and Miller 1944, Small 1994). Yellow-billed cuckoos nested primarily in coastal counties from San Diego County near the Mexico border to Sonoma County in the San Francisco Bay region, in the Central Valley from Kern County through Shasta County, and along the lower Colorado River (Dawson 1923, Grinnell and Miller 1944, Gaines and Laymon 1984, Small 1994). Laymon and Halterman (1987a) estimate that in California, the species' range is now about 30 percent of its historical extent. There is clearly a broad unanimity among modern investigators that a catastrophic decline of the cuckoo in California occurred following the start of the major era of development beginning about the mid-1800s (Gaines and Laymon 1984, Laymon and Halterman 1987b, Launer et al. 1990). The yellow-billed cuckoo was never common in San Diego County. The closest breeding record to the Refuge is for Bonita in 1932 (Unitt 2004); the species is now only a rare and sporadic summer visitor (Unitt 2004).

Status of the Species within the Refuge

No populations of this species are currently present within the Refuge; however, suitable habitat is present along the Sweetwater River in the Otay-Sweetwater Unit of the Refuge.

4.3.6.5 San Diego Ambrosia *(Ambrosia pumila)*

Listing and Conservation Status

The Service listed San Diego ambrosia as endangered on July 2, 2002 (67 FR 44372). The species was listed following an analysis of historical and remaining occurrences within the known species range. At the time of listing, of the approximately 50 known historical occurrences in the United States, it was believed that there remained only 15 extant native occurrences. The loss of this species is attributed to destruction, fragmentation, and degradation of habitat, primarily by construction and maintenance of highways and utility easements; residential, commercial, and recreational development; potential competition, encroachment, and other negative impacts from non-native plants; mowing and disking for fuel modification; and trampling, including soil compaction by horses, humans, and vehicles. Nearly all U.S. populations occur in sites that are disturbed and frequently affected by secondary impacts (e.g., trampling, competition from non-native plants). One of the most serious threats to this species is ground disturbance that results in the establishment of non-native, invasive weeds in the immediate vicinity of established ambrosia populations (USFWS 2010c).

A recovery plan has not yet been developed for this species, but a five-year review for the species was completed in July 2010 (USFWS 2010c). The five-year review recommended no change in the status of San Diego ambrosia. The critical habitat that was designated for this species on November 30, 2010 (75 FR 74546), includes various locations on the Otay-Sweetwater Unit. These areas are identified as Unit 7, Sweetwater River Watershed, and include approximately 28 acres (11 hectares) to the north and south of Highway 94 along the Sweetwater River floodplain and 118 acres (48 hectares) north of Highway 94 and south of the Sweetwater River in an area sometimes referred to as Par Four.

San Diego ambrosia is a covered species under the San Diego MSCP because of the conservation of 90 percent of the major population of this species (located in Mission Trails Regional Park) within the MSCP boundary. The populations of this species present on the Refuge are also acknowledged in the MSCP Plan, along with requirements for site-specific measures such as monitoring and protection from edge effects to achieve conservation of the species throughout the preserve.

Species and Habitat Description

San Diego ambrosia is a clonal, perennial herb in the Asteraceae (sunflower) family. Observations indicate that it is sensitive to seasonal conditions and variations, causing the amount of above ground mass to fluctuate from year to year. San Diego ambrosia spreads vegetatively by means of slender, branched, underground root-like rhizomes from which new above ground stems (aerial stems or ramets) sprout each year (Nuttall 1840, Munz 1974, Payne 1993). Individual stems, which are densely covered with short hairs, are generally 2 to 12 inches (5 to 30 centimeters) tall but may grow to 20 inches (50 centimeters). All aerial stems growing from the same root system are genetically identical. The leaves of this species are pinnately divided into many small segments and covered with short, soft, gray-white, appressed (lying flat on surface) hairs. San Diego ambrosia can be distinguished from other species of *Ambrosia* in the area by its twice divided leaves, lack of hooked spines on the involucres (cup-like structures), and lack of longer stiff hairs on the stems and leaves (USFWS 2010c).

San Diego ambrosia flowers from May through October and is thought to be wind-pollinated (Payne 1976). This plant species is monoecious (possessing separate male and female flowers on the same plant). Male flowers, which have no petals, are yellow to translucent and are borne in clusters on terminal flower stalks. Female flowers, which also have no petals, are yellowish-white and occur in clusters in the axils of the leaves below the male flower clusters (USFWS 2010c). Female flowers produce a dry, single-seeded fruit called an achene.

Genetic research confirms the presence of multiple stems of multiple genotypes at nine plots across three populations in San Diego and western Riverside counties (McGlaghlin and Friar 2007), suggesting that sexual reproduction has occurred sometime in the past. This research indicates that closely associated stems within an occurrence are not always clones of a single genotype but can consist of distinct genotypes. Other studies related to genetics and seed viability indicate that sexual reproduction likely occurs infrequently; however, little information is available regarding the timing and extent of this sexual reproduction (Dudek & Associates 2000).

San Diego ambrosia is endemic to southern California from northwestern Riverside County, south through western San Diego County, to northwestern Estado de Baja California, Mexico (CNDDB 2010). It is generally found at or below elevations of 1,600 feet (487 meters) in Riverside County and at 600 feet (183 meters) in San Diego County (CNDDB 2010). The species generally occurs in open habitats in coarse substrates near drainages and in upland areas on clay slopes. San Diego ambrosia also occurs in a variety of associations dominated by sparse grasslands or marginal wetlands, such as river terraces, pools, and alkali playas (Munz 1974).

Protection of sandy loam or clay soils (regardless of disturbance status) is essential to the conservation of this species. Such soils include (but are not limited to) Placentia (sandy loam), Diablo (clay), and Ramona (sandy loam) soil series that occur near a river, creek, or other drainage, or within the watershed of a vernal pool. This species may also be supported on these soils when they occur on an upper terrace (flat or gently sloping areas of 0 to 42 percent slopes). The species may be located in a grassland or ruderal habitat type, or in openings within coastal sage scrub, on the soil types and topography described here when provided with adequate sunlight and airflow for wind pollination (USFWS 2010c).

Status of the Species within the Refuge

San Diego ambrosia occurs in several locations within the Sweetwater River area of the Otay-Sweetwater Unit, including a relatively large occurrence in the northeastern portion of the Sweetwater River area along an existing trail off Par Four Drive. The other occurrences, which are much smaller, are located along the north side of Highway 94 to the west of Bright Valley Farms and to the south of Highway 94, just south of the old steel bridge. In 2008 and 2010, five San Diego ambrosia population groups were established on the Otay-Sweetwater Unit in an area to the east of the Sweetwater River floodway and the south of Highway 94. The closest population group is located about 900 feet (275 meters) to the south of Highway 94, and the remaining groups extend south in a relatively linear fashion, with the last group located approximately 2,100 feet (640 meters) to the south of Highway 94. The five populations were established using plants cultivated in a nursery from rhizomes collected from the natural occurrences on the Refuge. In total, 1,000 plants were installed and, to date, survival rates are very high, far exceeding the initial success criteria of 75 percent survival (RECON 2011).

Planted individuals have spread by underground rhizomes at least 0.5 meters from the planting site.

4.3.6.6 San Diego Thornmint *(Acanthomintha ilicifolia)*

Listing and Conservation Status

San Diego thornmint was listed as endangered by the State of California in 1982 and listed as threatened by the Service on October 13, 1998 (63 FR 54938). This species is also covered under the San Diego MSCP. A recovery plan has not yet been prepared for this species. A five-year review of the species status was completed in August 2009 (USFWS 2009a), which recommended no change in the current listing status of the species. Critical habitat was designated for this species on August 26, 2008 (73 FR 50496). The Otay-Sweetwater Unit includes portions of Unit 4 (Subunits 4A and 4C), which have been identified as some of the most stable populations of San Diego thornmint. Units 4A and 4C are located on southwestern slope of McGinty Mountain. The final rule designating these critical habitat areas identifies the need for special management to address threats to these populations from exotic plant species and recreational activities.

Species and Habitat Description

San Diego thornmint is an annual aromatic herb in the mint family (Lamiaceae). This low annual, with stems branching from the base, ranges from two to six inches (five to 15 centimeters) in height. It has white, two-lipped, tubular flowers with rose-colored markings on the lower lip (Jokerst 1993). Members of this genus have paired leaves and several sharp, spiny bracts (modified leaves) below whorled flowers. San Diego thornmint can be distinguished from other members of its genus by its flower, which has hairless anthers and style. The only other *Acanthomintha* species occurring in southern California (*A. obovata*) has four fertile, woolly, or pubescent anthers and is known from north Ventura County.

San Diego thornmint flowers from April to May (Munz 1974) and remains erect, retaining its distinct shape well into the dry season (Reiser 1996). San Diego thornmint is an outcrosser that is pollinated by insects; however, information regarding the plant's breeding system is limited. It has however been determined that other members of the genus *Acanthomintha* are self-compatible. During a pollinator study conducted from 2007 through 2009 (Klein 2009), it was observed that very few insects visited San Diego thornmint plants; based on the limited visitors, it appears that this species does not rely on any specific species for pollination. The dominant visitors, and more effective pollinators, were bees in the Families Apidae and Halictidae. This species may rely on animal vectors, in part, for seed dispersal.

This species, which can be found at elevations that range from sea level to 3,000 feet (915 meters), is endemic to San Diego County, California and northwestern Baja California, Mexico. In San Diego County, the species is known from 55 extant occurrences (USFWS 2009a). The occurrences are located across the county from Oceanside and San Marcos in the north, near the Sweetwater River and on Otay Mesa in the south, and to the north and east in Ramona and Alpine (Beauchamp 1986, USFWS 2009a). There are 13 historical occurrences in Baja California, Mexico; however, there is little data available on the current status of this species in Mexico (USFWS 2009a).

Populations of San Diego thornmint generally occur in openings within coastal sage scrub, chaparral, and native grassland habitats (Beauchamp 1986, Reiser 2001), where isolated patches of clay soils, referred to as "clay lenses," are present (USFWS 2009a). In fact, San Diego thornmint is believed to be restricted to gabbro soils derived from igneous rock and gray calcareous clay soils derived from soft calcareous sandstone (Oberbauer and Vanderwier 1991). Service data indicate that San Diego thornmint occurs on soils mapped as Las Posas, Olivenhain, Redding, Huerhuero, Altamont, Cieneba, and Linne (USFWS 2009a). The open areas of clay lenses where San Diego thornmint occurs can generally be described as areas of southeast- to west-facing gentle slopes with friable soil, meaning that the soil has a loose, crumbly texture. An analysis of 20 sites occupied by San Diego thornmint found that the slopes range from 0 to 25 degrees, with the majority of the sites having slopes less than 20 degrees (Bauder et al. 1994).

The texture and structure of the clay lenses are essential for supporting the seedling establishment and growth of San Diego thornmint. This soil provides many small pockets and deeper fissures where seeds from San Diego thornmint become lodged as they fall from decomposing plants (Bauder and Sakrison 1999). The seeds stay in the soils until the temperatures become cooler in the winter months and the soil becomes saturated with the winter rains (Bauder and Sakrison 1997). When the conditions are right, the seeds germinate and grow to mature plants. These plants do best when they are not crowded or shaded by other plants (Bauder and Sakrison 1999).

Populations of this species range from just a few individuals to several thousand plants. The majority of the known populations range from 50 to 2,000 plants. The abundance of standing individuals of San Diego thornmint fluctuates annually at each occurrence. At occurrences surveyed over a number of years, the size of an occurrence can differ by an order of magnitude (City of San Diego 2005). A uniform surveying methodology has not been used throughout the species range, and occurrences have not been surveyed consistently on an annual basis. Therefore, the abundance of San Diego thornmint is difficult to compare between sites and over time.

Currently, the greatest threat to San Diego thornmint is the invasion by non-native plants in the open areas that support this species. When exotic plant species become established, they can outcompete San Diego thornmint for light, water, nutrients, and space. Another threat to this species is trampling of vegetative material, compaction of soil, and ongoing recreational activities in the vicinity of extant populations of this plant. Fire also poses a potential threat to this species' habitat. Coverage of this species under the San Diego MSCP requires avoidance of impacts to all populations and the implementation of measures to protect populations from edge effects.

Status of the Species within the Refuge

San Diego thornmint is present in at least three locations on McGinty Mountain. An additional population is located immediately adjacent to the Refuge on land owned by The Nature Conservancy. The third Refuge population was identified in 2011 by San Diego Natural History Museum personnel during surveys conducted in association with the San Diego Plant Atlas. This previously unrecorded population appears to consist of 6,000 to 7,000 plants.

4.3.6.7 Otay Tarplant (*Deinandra conjugens*)

Listing and Conservation Status

Otay tarplant was listed as endangered by the State of California in 1979 and listed as threatened by the Service effective November 12, 1998 (63 FR 54938). A final rule designating approximately 6,330 acres (2,562 hectares) of critical habitat was published in the *Federal Register* on December 10, 2002 (67 FR 76030). Three critical habitat units have been designated for Otay tarplant in San Diego County with Unit 1, the Sweetwater/Proctor Valley

Critical Habitat Unit, encompassing large areas of the Otay-Sweetwater Unit of the Refuge (refer to Figure 4-19). Unit 1 contains populations in the northern and eastern extent of Otay tarplant's historical distribution, which is considered essential for its conservation (67 FR 76030). The final recovery plan for Otay tarplant was issued in December 2004 (USFWS 2004b).

Designated critical habitat is intended to include sufficient habitat to maintain self-sustaining populations of a listed species throughout its range. The three units designated as critical habitat for Otay tarplant contain the physical and biological features determined to be essential to the conservation of this species, including soils with a high clay content (generally greater than 25 percent) or clay intrusions or lenses that are associated with grasslands, open coastal sage scrub, or maritime succulent scrub communities between 80 and 1,000 foot (24 to 305 meter) in elevation (67 FR 76040). As part of the critical habitat designation, the Service also determined whether the areas within the geographical area occupied at the time of listing would require special management considerations or protection. Examples of special management actions that may be necessary to protect essential habitat features and thus prevent further declines and loss of populations of Otay tarplant include: 1) actions to prevent the degradation and/or type conversion of grasslands, open coastal sage scrub, or maritime succulent scrub into other unsuitable habitats; and 2) actions to restore degraded habitat areas. Threats include habitat degradation, fragmentation, or loss and competition with invasive non-native plant species.

Recovery objectives for this species include:

- stabilizing and protecting habitat that supports known populations of Otay tarplant within areas identified for conservation under the MSCP;
- identifying and protecting extant populations of Otay tarplant and available suitable unoccupied habitat that are important to maintain genetic diversity and connectivity between established reserves;
- reducing and managing threats (e.g., invasion and competition by non-native weeds, factors that reduce or limit genetic diversity within areas that preserve Otay tarplant populations); and
- conducting research (e.g., on Otay tarplant necessary to refine recovery criteria (USFWS 2004b).

The recovery plan also states that management plans should be developed for areas established to conserve Otay tarplant to address the biological and ecological needs of Otay tarplant. In addition, to ensure the long-term preservation of this species, habitat protection, management, and monitoring efforts must occur in perpetuity (USFWS 2004b).

Species and Habitat Description

Otay tarplant is an annual herbaceous plant in the Asteraceae (sunflower family). Individual plants are less than 16 inches (40.6 centimeters) tall, with lobed leaves and yellow flowers arranged in heads of 8 to 10 ray flowers and 13 to 21 disk flowers. This species has a branching stem with deep green or gray-green leaves covered with soft, shaggy hairs.

Otay tarplant occurs within the range of *Deinandra fasciculata* [= *H. fasciculata*] (fasciculated tarplant) and *Deinandra paniculata* [= *H. paniculata*] (San Diego tarplant) and can be distinguished from other members of the genus by its ridged phyllaries, black anthers (part of the flower that produces pollen), and the number of disk and ray flowers. The disk and ray flowers each produce different types of fruits (heterocarpy), which has been correlated to differential germination responses (Tanowitz et al. 1987).

The presence of Otay tarplant is strongly correlated with clay soils, subsoils, or lenses (Bauder et al. 2002). Such soils typically support grasslands, but they may also support some woody vegetation. Much of the area with clay soils and subsoils within the historical range of Otay tarplant likely was once vegetated with native grassland, open coastal sage scrub, and maritime succulent scrub, which provided suitable habitat for Otay tarplant (USFWS 2004b). Based on GIS analysis, most current and historical Otay tarplant occurrences are found on clay soils or lenses in one of the following soil series: Diablo, Olivenhain, Linne, Salinas, Huerhuero, Auld, Bosanko, Friant, and San Miguel-Exchequer rocky silt loams (Bauder et al. 2002).

Otay tarplant, as with most other tarplants, is self-incompatible (Keck 1959, USFWS 2004b); therefore, gene flow among plant populations through pollination is important for its long-term survival (Ellstrand 1992). The movement of pollen among occurrences of Otay tarplant is critical to maintaining genetic diversity between extant populations and within the species. As a result, smaller populations of Otay tarplant are believed to be essential to the survival and conservation of the species because they may be strategically located between larger populations, facilitating gene flow among them. These smaller populations may also contain unique frequencies of self-incompatible alleles (USFWS 2004b). Likely pollinators of Otay tarplant include, but are not limited to, bee flies (*Bombylliidae*), hover flies (*Syrphidae*), digger bees (*Apidae*), carpenter and cuckoo bees (*Anthophoridae*), leaf mason and leaf cutting bees (*Megachilidae*), and metallic bees (*Halictidae*) (Krombein et al. 1979, Bauder et al. 2002).

Otay tarplant fruits are each one-seeded and are likely to be dispersed by small to large-sized mammals and birds based on the sticky nature of the remaining flower parts that are attached to the fruits (USFWS 2004b). Potential seed/fruit dispersal organisms known to occur in the region include but are not limited to southern mule deer, gray fox, coyote, black-tailed jackrabbit, bobcat, striped skunk, opossum (*Didelphis virginiana*), raccoon, and various small land birds.

A seed bank (a reserve of dormant seeds, generally found in the soil) is important for year-to-year and long-term survival of many annual or short-lived perennial species, including Otay tarplant (Rice 1989, Given 1994). The extent and nature of the seed bank can influence the number and location of standing tarplant in a population. Additional factors, including the amount and timing of rainfall, temperature, and soil conditions, also influence germination. As a result, the extent and distribution of observable standing plants may not coincide with the full extent of the seed bank. Large annual fluctuations in the number of standing plants of Otay tarplant in a given population have been documented. For example, within the San Miguel Mountain area, the number of standing plants of Otay tarplant has ranged from about 280,000 in one year to 1.9 million in another year (Merkel & Associates 1999, CNDDB 2002).

Otay tarplant has a narrow geographic and elevational range that is restricted to southwestern San Diego County and adjacent Baja California, Mexico. There are currently 34 extant occurrences distributed discontinuously in southwestern San Diego County (USFWS 2009b), including several located on the Refuge.

Otay tarplant's annual habit and self-incompatible breeding system may make this species vulnerable to threats associated with population fluctuations, reduced populations of appropriate pollinators, and declines in genetic variation. Maintenance of the genetic variability within the species, through cross-pollination, may be critical to this species' long-term survival. The extensive fragmentation of the remaining populations may exacerbate these threats by reducing connectivity between populations and potentially limiting suitable pollinators, and hence gene flow between populations (USFWS 2004b, USFWS 2009b). Although it is difficult to predict the exact effects of climate change on Otay tarplant, it is likely that changes in climate will exacerbate identified threats and may introduce new threats. Five factors associated with a changing climate that may affect the long-term viability of Otay tarplant occurrences in its current habitat configuration are: 1) drier conditions that may result in a lower percent germination and smaller population sizes; 2) higher temperatures may inhibit germination; 3) a shift in the timing of the annual rainfall that could favor non-native species; 4) changes in the timing of pollinator life cycles that may become out-of sync with the timing of flowering; and 5) drier conditions that may result in increased fire frequency, making the ecosystems in which Otay tarplant currently grows more vulnerable to the threats of subsequent erosion and non-native or native plant invasion.

Status of the Species within the Refuge

Otay tarplant occurs in several locations within the San Miguel Mountain area of the Otay-Sweetwater Unit, as well as on a portion of the Jamacha parcel, located in the Sweetwater River area. Surveys conducted in 2010 of known San Diego tarplant populations on the Refuge documented a population on the Jamacha parcel covering approximately two acres (0.8 hectare); a population of approximately 800 very large plants on the Shinohara site, near the southwestern most portion of the Otay-Sweetwater Unit; and a population on the lower northeastern slopes of Mother Miguel Mountain covering approximately1.2 acres (0.5 hectares). A 6.9-acre (2.8-hectar) area on the lower northwestern slopes of Mother Miguel Mountain was documented in 2008 but was not present during the 2010 survey.

At the southwestern edge of the San Miguel Mountain area (see Figure 4-15) is a 67-acre (27-hectare) boot-shaped parcel, referred to as the San Miguel Ranch Otay Tarplant Preserve (also known as the Trimark parcel). From 2005 through 2010, an intensive invasive plant removal and Otay tarplant seeding program was implemented on portions of this parcel. In 2011, after completing this intensive management effort, Otay tarplant occupied about 13.4 acres of the site, the largest coverage of Otay tarplant on the site since the management effort began.

Incidental sightings of Otay tarplant in other areas of the Refuge have also been recorded in various years. One such site was identified in 2010 in the Sweetwater River area. All of the incidental sightings of this species on the Refuge have been small occurrences.

4.3.6.8 Mexican Flannelbush *(Fremontodendron mexicanum)*

Listing and Conservation Status

Mexican flannelbush was listed as a rare species by the State of California in July 1982. The Service listed this species as endangered in 1998. The final listing rule was published in the *Federal Register* (63 FR 54956) on October 13, 1998, and became effective on November 12, 1998. Mexican flannelbush was listed as endangered due to its small population size and the threat that an altered fire regime poses to the ultimate survival of this species. At the time of listing, only a single occurrence was believed to exist in the United States, and another single occurrence was believed to exist in Mexico (USFWS 2009c). A recovery plan has not yet been drafted for this species.

Approximately 228 acres (93 hectares) were designated as critical habitat for this species in a final rule published in the *Federal Register* on September 27, 2007 (72 FR 54984). None of the lands designated as critical habitat for this species are located on Refuge land.

A five-year review for this species was completed in August 2009. In addition to the threats identified at the time of listing, additional threats to Mexican flannelbush were identified as part of the review. These included competition with non-native invasive plant species and impacts from border control activities. It was determined, however, that because these threats could be managed, they represented only a moderate threat to the species. The five-year review recommended no change in the current status of Mexican flannelbush. Another recommendation in the review was to support and assist the San Diego NWR in the effort to introduce new populations of Mexican flannelbush to suitable unoccupied habitat within the Otay-Sweetwater Unit.

Species and Habitat Description

Mexican flannelbush is a small, perennial tree or shrub in the Malvaceae (mallow family); this species was included as part of the Sterculiaceae (cacao family) when it was listed. This evergreen plant, which can grow to a height of 5 to 20 feet (1.5 to 6.0 meters), has palmately (leaflets radiating from one point) lobed leaves one to two inches (25 to 50 millimeters) wide. Flowers, which are present from March to June (Munz 1974), can be up to about 2.7 inches (69 millimeters) wide and lack petals. The showy orange to dark yellow sepals are sometimes reddish toward the bases. The plants flower annually and produce seeds that are held on the plants in dry pods until the fall and winter months when the capsules open to release seeds.

The showy nature of the flower and the presence of nectar pits at the base of the sepals suggest that pollen is transferred from flower to flower by insect pollinators, but a focused pollination study has not been conducted. *Fremontodendron mexicanum* is distinguished from *F. californicum* by its orange sepals with basal pits generally lacking long hairs, and shiny black, glabrous (smooth) seeds that lack caruncles (outgrowths) (Kelman 1991).

Mexican flannelbush is endemic to southern California and northwestern Baja California, Mexico, with native populations occurring in intermittent drainages with closed-cone coniferous forest and southern mixed chaparral habitats. Generally found at elevations that range from sea level to 3,000 feet (1,000 meters), Mexican flannelbush often occurs on alluvial benches consisting of silty loam soils derived from metavolcanic and metabasic bedrock, associated with ephemeral drainages, as well as on the associated canyon slopes (USFWS 2009c). This species is thought to be a relict genus left over from approximately 60 million years ago when California had a more tropical climate (Kelman 1991). Apparently, at least two historical populations of this species have been extirpated; these were located at Boundary Monument near the coast and in the Jamul Mountains, both in San Diego County (USFWS 2009c). In the U.S., this species occurs partially in the BLM's Otay Mountain Wilderness Area and partially on private lands that are part of the historical Otay Ranch property.

This species, which grows in chaparral habitat, appears to have adapted to survive fires, as it has the ability to resprout from underground roots after a fire. Another fire adaption strategy of this species is the ability of its seeds to survive a fire and then sprout following the fire (USFWS 2007).

Habitat factors that support this species include: 1) alluvial terraces, benches, and associated slopes within 500 feet (152 meters) of streams, creeks, and ephemeral drainages where water flows primarily after peak seasonal rains with a gradient ranging from three to seven percent; and stabilized north- to east- facing slopes associated with steep (9 to 70 percent) slopes and canyons that provide space for growth and reproduction; and 2) silty loam soils derived from metavolcanic and metabasic bedrock, mapped as San Miguel-Exchequer Association soil series, that provide the nutrients and substrate with adequate drainage to support seedling establishment and growth.

In the United States, Mexican flannelbush is found only on the northwest side of Otay Mountain in southern San Diego County, California. To better document the range of this species, surveys were conducted from 2005 to 2007 on the northwest side of Otay Mountain in areas that were identified as potential habitat for Mexican flannelbush. As a result, occurrences were documented in Cedar Canyon (2,500 plants), Little Cedar Canyon (31 plants), and an unnamed canyon on Otay Mountain (3,500 plants). Therefore, rather than being limited to a single canyon on Otay Mountain, as was known at the time of listing, this species was found in three adjacent canyons, though its distribution is still extremely localized. All of the currently known extant natural occurrences of this species occur in an area approximately three miles (4.8 kilometers) from north to south and 3.5 miles (5.6 kilometers) from east to west. In 2009, the Service estimated that there were approximately 6,000 Mexican flannelbush plants on Otay Mountain.

Status of the Species within the Refuge

Mexican flannelbush was not known to be present on the Refuge at the time of listing in 1998. In 2005 and 2007, surveys on Otay Mountain identified a population of Mexican flannelbush in Little Cedar Canyon, and in 2014, Mexican flannelbush was document on the Otay-Sweetwater Unit, within the southern end of the Otay Lakes and Mesa management area (pers comm. John Martin, San Diego NWR).

In 2006, the San Diego NWR was awarded a Service Preventing Extinction Grant to fund a project on the Refuge that has resulted in the establishment of two new occurrences of Mexican flannelbush in suitable previously unoccupied habitat on the Refuge. To meet the purpose of this grant, which was to decrease the vulnerability of Mexican flannelbush to extinction, seeds were collected from specimens within the existing native populations, germinated and raised as seedlings in a nursery, and then planted in suitable habitat areas on the Refuge. Seeds were collected from the Little Cedar Canyon population in 2007. In 2009, approximately 70 specimens were planted in the San Miguel Mountain area in a canyon to the north of Mother Miguel Mountain. In 2010, an additional 140 plants were installed at two sites: one in the area of Wildman Canyon to the south of Mother Miguel Mountain and the other in a drainage extending north of the saddle between Mother Miguel and San Miguel Mountains. As of the summer of 2011, plant mortality was relatively low (25 to 30 percent), with many specimens measuring up to about three feet (one meter) in height. In February 2012, 33 of 80 plants remained alive at the Wildman Canyon site.

4.3.6.9 Del Mar Manzanita *(Arctostaphylos glandulosa ssp. crassifolia)*

Listing and Conservation Status

The Service issued a final rule to list Del Mar manzanita as endangered on October 7, 1996 (61 FR 52370). This species is not designated as an endangered, threatened, or rare species by the State of California, but is a covered species under the San Diego MSCP. A recovery plan has not been prepared for this species; however, recovery and protection actions for this species are addressed in various habitat conservation plans, including the San Diego MSCP (City of San Diego 1998a). No critical habitat has been designated for Del Mar manzanita. The five-year review for Del Mar manzanita, completed August 13, 2010 (USFWS 2010d), recommended no change in the current status of this species.

Species and Habitat Description

Del Mar manzanita is a perennial burl-forming shrub in the Ericaceae (heath family) that ranges from 3.3 to 4 feet (1 to 1.2 meters) in height. It has a smooth red bark and thick, leathery leaves that are dark grey-green, sometimes with a reddish margin. Compared to other subspecies, the globose fruits of Del Mar manzanita are small and markedly depressed, and the twigs lack glandular hairs. These are among the diagnostic features of the taxon (USFWS 2010d).

The small, urn-shaped flowers of Del Mar manzanita are white to pink in color and appear between late winter and early spring. Del Mar manzanita flowers, which are self-incompatible, are visited by flies, bees, and bee flies. The fruits of this plant produce an average of six seeds embedded in a hard resinous endocarp surrounded by a pulpy pericarp (USFWS 2010d). There does not appear to be any specialized seed dispersal mechanism, and the fruits generally fall close to the parent plant in late summer.

This shrub, which occurs within southern maritime chaparral in central coastal San Diego County, can regenerate from burls (lignotubers) and from seeds. Buds present on the burls will typically sprout after the shrub stems have been removed or damaged by fire or other means. Occasionally some buds will sprout in the absence of fire. Because the plant can regenerate from the burls, Del Mar manzanita is generally resilient to fire and can potentially be very long lived (USFWS 2010d).

Historically, Del Mar manzanita was believed to be restricted to sandstone terraces and bluffs along the immediate coast in San Diego County, California, from Carlsbad south to Torrey Pines State Reserve. Based on morphologic traits, researchers have since restricted the distribution to within three miles, or possibly six miles (5 to 10 kilometers), of the coast from Encinitas in San Diego County, south to Baja California (USFWS 2010d). In 1982, prior to listing, approximately 16,600 to 17,600 Del Mar manzanita plants were known from about 21 populations. Other populations likely existed before 1982, but their numbers were not quantified prior to their habitats being lost (USFWS 2010d). In 2010, there were 50 known populations of Del Mar manzanita in the United States. This species is known to occur in two locations within the Del Mar Mesa Preserve.

Status of the Species within the Refuge

Within the San Diego NWR, the only area in which Del Mar manzanita has the potential to occur is within the Del Mar Mesa Vernal Pool Unit. As of 2011, no directed searches for this species on Refuge lands have been conducted. There are known occurrences of Del Mar manzanita on lands located near the Refuge, but as of the writing of this document, there are no records of this species occurring on the Refuge.

4.3.6.10 San Diego Mesa Mint (*Pogogyne abramsii*)

Listing and Conservation Status

The Service listed San Diego mesa mint as endangered on September 28, 1978 (43 FR 44811), after determining that the continued existence of the species was being threatened by loss of habitat to housing development, highway construction, off-road vehicle use, illegal dumping, and agricultural uses (USFWS 1998a). This species was listed by the State of California as endangered in 1979. It is also a covered species under the San Diego MSCP. No critical habitat has been designated for this species.

The Service completed three status reviews for the species in 1985, 1987, and 1992. In all cases, the reviews recommended no change in status. A five-year review of the species was most recently completed on September 1, 2010 (USFWS 2010e). It, too, recommended no change in the status of this species. Additional recommendations included: 1) continued support for the conservation, management, and monitoring of San Diego mesa mint habitat to include acquisition of occupied sites; 2) development of a coordinated interagency invasive species prevention and eradication program for all vernal pool habitat where San Diego mesa mint is extant; 3) identification of the conditions and areas necessary to support all essential biotic interactions (e.g., pollination, seed dispersal, population movement) for the species; and 4) monitoring of restored/enhanced habitat to determine its suitability and impact in furtherance of recovery of the species (USFWS 2010e).

In 1998, the Service prepared the *Vernal Pools of Southern California Recovery Plan* ("vernal pool recovery plan") (USFWS 1998a), which addresses seven vernal pool species: San Diego mesa mint, Otay mesa mint, San Diego button-celery, spreading navarretia, California Orcutt grass, San Diego fairy shrimp, and Riverside fairy shrimp. The strategies for the recovery of the species addressed within the vernal pool recovery plan focus primarily on eliminating and reducing the primary threats to the habitats that support these species. This approach was necessary due to the complexity of vernal pool habitats and associated watershed, the wide geographic distribution of the various pool species, and the unique ecological parameters associated with each listed species (USFWS 1998a). The recovery goal for federally listed endangered species covered by this plan, including San Diego mesa mint, is to conserve and enhance southern California vernal pool ecosystems, with specific emphasis on stabilizing and protecting existing populations of the endangered species the pools support. Removing the listed species addressed in the vernal pool recovery plan from protection under the ESA would only be considered once populations have secure habitat, populations are stabilized or increasing (and where necessary, new populations are established), and populations are shown to be self-sustaining (USFWS 1998a).

Species and Habitat Description

San Diego mesa mint, an annual herb in the Lamiaceae (mint family), is restricted to vernal pool habitat in southern California. Plants can reach about one foot (30 centimeters) or more in height, and flowers are arranged in whorls that typically bloom from May or June through early July. Key characters of the genus *Pogogyne* include floral bracts and calyx lobes that are "conspicuously hirsute and bristlyciliate" (Howell 1931). The flowers are strikingly patterned with a rich rosy-purple limb and throat and white tube; the middle lobe of the lower lip has a yellow central area spotted with deep purple. The plants give off a strong, sweet mint odor.

In the past, San Diego mesa mint has been misidentified as Otay mesa mint, which also occurs in San Diego County. There are several distinct differences between the two species: San Diego mesa mint usually has two flowers per node, while Otay mesa mint has six or more; the vegetative portions of San Diego mesa mint develop a reddish tinge during maturation, while Otay mesa mint does not develop this reddish tinge until after the flowering period; San Diego mesa mint has a hairy calyx, while Otay mesa mint has a smooth calyx; and the bracts and leaves of San Diego mesa mint are narrower than Otay mesa mint (Howell 1931, Munz 1974, USFWS 1998a)

San Diego mesa mint is restricted to vernal pools (seasonal depression wetlands) in San Diego County, California. As described in greater detail earlier, vernal pools are ephemeral wetlands, occurring from southern Oregon through California into northern Baja California, Mexico, that require a unique combination of climatic, topographic, geologic, and evolutionary factors for their formation and persistence (USFWS 1998a). Vernal pools typically form in regions with Mediterranean climates where shallow depressions fill with water during fall and winter rains and then dry up when the water evaporates in the spring (Collie and Lathrop 1976, Holland 1976, Holland and Jain 1977, Holland and Jain 1988, Thorne 1984). Downward percolation of water within the pools is prevented by an impervious subsurface layer consisting of claypan, hardpan, or volcanic stratum (Holland 1976, Holland 1988).

Vernal pools containing San Diego mesa mint typically occur on coastal terraces at 328 to 656 feet (100 to 200 meters) in elevation on gravelly loams that are saturated or inundated seasonally and subsequently dry out and remain dry for about six to eight months through the summer. The surface substrates are predominately underlain by Redding soils with a subsoil of clay or a silica-cemented hardpan layer that prohibits drainage and creates a perched water table that forms the vernal pool.

The life cycle of the San Diego mesa mint is dependent on the function of the vernal pool ecosystem. San Diego mesa mint seeds germinate with the first significant fall and winter rains. As the season progresses, temperature increases and rainfall declines result in increased evaporation. More rapid growth of young plants is stimulated as the pools begin to dry out. Flowering commences in May and continues through June or July, and the pools become dry by early to mid-summer.

Field investigation involving the monitoring of insect visits to individual San Diego mesa mint plants on Del Mar Mesa found that Eurasian honey bee (*Apis mellifera*) and two anthophorid bees (*Exomalopsis nitens* and *E. torticornis*) were the most common visitors and most likely pollinators of these plants (Schiller et al. 2000). Schiller et al. (2000) also documented that San Diego mesa mint is self-fertile but has greater seed set when it is cross-pollinated.

Gene dispersal among San Diego mesa mint plants may occur via pollen or seed distribution (USFWS 2010e). Although none of the *Pogogyne* species have seed morphology associated with animal or wind dispersal, scattered occurrences of pool plants along well-worn trails that link individual pools over wide areas suggest large animals may contribute to seed dispersal (Cole 1995). Waterfowl use pools, especially the larger ponds or vernal lakes, and they are presumed to carry seeds from pool to pool (Proctor et al. 1967, Zedler 1987). Zedler and Black (1992) also found that San Diego mesa mint seeds germinated and grew from pellets of brush rabbits and Audubon's cottontail rabbits, which were collected from vernal pools on Del Mar Mesa and Miramar Mesa. They postulated that rabbit movement might be a potential mechanism for dispersal and genetic mixing of vernal pool obligate species. In addition, San Diego mesa mint seeds float, which may result in limited dispersal opportunities when pools interconnect or lakes fill their basins in years of greater than average precipitation (Scheidlinger 1981).

San Diego mesa mint is endemic to San Diego County, growing in vernal pools on the coastal central mesas of the county. The northern limit of its distribution is Del Mar Mesa. It also occurs to the south on Mira Mesa, Marine Corps Air Station (MCAS) Miramar, and Kearny Mesa, with a few scattered populations in western Tierrasanta. San Diego mesa mint populations have been extirpated from the Linda Vista area, from the vicinity of Balboa Park and Normal Heights, and from the area surrounding San Diego State University. Although most of these extirpated populations from the San Diego mesa are labeled as Otay mesa mint on herbarium collections, these specimens have not been annotated and should be considered San Diego mesa mint (USFWS 2010e).

No estimate of numbers of San Diego mesa mint plants is available; however, it is known to occur from approximately 19 acres (7.7 hectares) of vernal pool basins on MCAS Miramar and approximately 0.8 acre (0.32 hectares) outside the boundary of MCAS Miramar (City of San Diego 2004, MCAS Miramar 2006). This lack of an estimate for San Diego mesa mint plants is likely due to the difficulty of measuring temporal abundance at each occurrence. Local site conditions, rainfall, and freshwater pooling are likely the factors that most influence the numbers of standing plants and their local distribution (Schiller et al. 2000). Like most annual plants, the germination success of San Diego mesa mint differs annually depending on temperature, timing, and rainfall, as well as the reproductive success of previous cohorts, the number of seeds deposited in the soil seed bank, and the survivorship of the annual seedling cohort in the year the survey was conducted. In 2003, the City of San Diego conducted a survey of vernal pools within their jurisdiction, revealing that, of the 1,142 vernal pools surveyed, San Diego mesa mint was found in 373 pools with a mean percent cover per pool of 6.2 percent (City of San Diego 2004).

Threats to San Diego mesa mint are generally the same as threats to vernal pool habitat. These include: 1) direct destruction of vernal pools from human activity; 2) indirect threats that degrade or destroy vernal pools (e.g., altered hydrology, draining, competition by introduced species, habitat fragmentation); and 3) potential long-term, cumulative impacts, such as the effects of isolation on genetic diversity and locally adapted genotypes, air and water pollution, drastic climatic variations, and changes in nutrient availability (Bauder 1986).

San Diego mesa mint may also be affected by factors associated with climate change, although it is unclear how climate may change within it range. Potential changes may include: 1) drier conditions, resulting in fewer suitable pool complexes, a lower percent germination and smaller population sizes, and fewer and less reliable recovery cycles of abundant individuals; 2) higher temperatures, which could inhibit germination, speed desiccation of pools, and affect pollinator services; 3) a shift in the timing of the annual rainfall that favors non-native species; 4) changes in the timing of pollinator life cycles; and 5) drier conditions that could result in increased fire frequency. In a changing climate, conditions could change in a way that would allow both native and non-native plants to invade the habitat where San Diego mesa mint occurs (Bauder 2005).

As with other vernal pool species, conservation of San Diego mesa mint is dependent on maintaining hydrology and the surrounding watershed for the occupied vernal pools, as well as protecting adjacent upland habitats for pollinators. Due to its restricted range and small population size, conservation of San Diego mesa mint is dependent on preservation of extant populations as well as the reestablishment of populations of mint within other pools.

Status of the Species within the Refuge

San Diego mesa mint is known to occur in some of the vernal pools present within the Del Mar Mesa Vernal Pool Unit of the Refuge; however, as of 2011, annual surveys of these pools have not been conducted by Refuge staff.

4.3.6.11 Otay Mesa Mint *(Pogogyne nudiuscula)*

Listing and Conservation Status

Otay mesa mint was listed by the State of California as an endangered species in January 1987, and was federally listed as an endangered species on August 3, 1993 (58 FR 41384). The primary threats at the time of listing were habitat loss and degradation due to urban development, agricultural activities, off-road vehicle use, and trampling, as well as competition with invasive, non-native plants, alteration of the watershed, and drought. Recovery and protection actions for this species are included within the vernal pool recovery plan (USFWS 1998a), as described in the section addressing San Diego mesa mint. No critical habitat has been designated for this species. Otay mesa mint is a covered species under the San Diego MSCP.

The only review of the listing status for this species occurred during a five-year review completed by the Service in September 2010. Based on the results of the review, no change in the status of Otay mesa mint was recommended (USFWS 2010f).

Species and Habitat Description

Otay mesa mint is an annual herb in the mint family (Lamiaceae) that can reach approximately one foot (30 centimeters) or more in height with flowers arranged in whorls that typically bloom from May or June through early July. The plants usually give off a strong, turpentine mint odor. Leaves are spatulate, obtuse and subglabrous, and are approximately one inch (one to two centimeters) long with short petioles. Otay mesa mint typically has six flowers (occasionally more) per stem node. The flowers are purple with a white throat, and the calyx is glabrous to minutely pubescent (hairy). In the past, Otay mesa mint has been misidentified as San Diego mesa mint; the differences between the two species are described under San Diego mesa mint.

Otay mesa mint seeds germinate depending on the inundation and drying cycles of vernal pools, which is the habitat type to which this species is restricted (USFSW 2010f). For many vernal pool plant taxa, temperature and moisture affect the timing of plant germination (Myers 1975). The link between the onset of germination, temporal conditions associated with vernal pool inundation, temperature, and moisture are critical to the germination, maturation, flowering, and fruiting of this species. The interaction of these factors provides the plant favorable conditions to complete its life cycle in the spring rather than in the summer, autumn, or winter. Natural differences in the precipitation and the inundation/drying time of the vernal pool from year to year may result in significant differences in the distribution and abundance of this species, making it difficult to obtain an accurate measure of the population (USFWS 2010f). Additionally, a portion of the population is represented by seeds remaining in the seed bank and is not accounted for each year that surveys occur.

Otay mesa mint usually blooms after the vernal pool water evaporates (Munz 1974). The plants then produce fruit, dry out, and senesce in the hot, dry summer months. There is little documented information regarding pollination and seed dispersal mechanisms for this species. Observations in the field suggest that native syrphid flies (Syrphidae) and bee flies (Bombyliidae) are the most common pollinators (USFWS 2010f). Eurasian honeybees (Apidae) have also been seen pollinating Otay mesa mint. Research on San Diego mesa mint indicates that it is self-fertile (Schiller et al. 2000). Research is needed to determine if this is also the case Otay mesa mint.

Otay mesa mint is endemic in southern San Diego County, California, where it is only found in vernal pool (seasonal depression wetlands) habitat on Otay Mesa. At the time of Federal listing, this species was known to occur at four locations on Otay Mesa but currently is extant at only three locations on Otay Mesa. Historically, Otay mesa mint was found beyond Otay Mesa, with herbarium records indicating that it occurred at 10 locations in southern San Diego County, including University Heights, Balboa Park, and Mission Valley (USFWS 2010f). This species also occurred in Mexico at the eastern edge of the City of Tijuana, but is has likely been extirpated from its Mexican locations.

Little species-specific data exist detailing the habitat requirements for this species other than it is found exclusively associated with vernal pools. Vernal pools that support Otay mesa mint are found on Huerhuero or Stockpen soils (Beauchamp and Cass 1979). The life cycle of the Otay mesa mint is dependent on the function of the vernal pool ecosystem described earlier.

Threats to this species from human activities, non-native plant invasion, and climate change are similar to those described for San Diego mesa mint. Due to its restricted range and small population size, conservation of Otay mesa mint is dependent on preservation of extant populations, as well as reestablishment of populations of mint within other pools on Otay Mesa (USFWS 2010f). Since the listing of this species, a number of vernal pools containing Otay mesa mint have been restored by either creating new basins within historical habitat or enhancing existing habitat by reshaping the pool or transplanting inoculum containing Otay mesa mint seeds (USFWS 2010f). The long-term success of this practice is unknown, and suitable habitat for vernal pool restoration is limited.

Status of the Species within the Refuge

Prior to the 2011 growing season, Otay mesa mint seed (collected at the Cal Terraces vernal pool preserve on Otay Mesa) was introduced into nine pools within the vernal pool complex ("S" series) located just south of the Sweetwater Reservoir on a site identified as the Shinohara parcel, located within the Otay-Sweetwater Unit of the San Diego NWR. The seeds germinated and plants matured in all nine of the pools in which seed was introduced. Riverside fairy shrimp are also present in the vernal pool complex located on Caltrans property in Otay Mesa, property that is expected to be conveyed to the Refuge at some future date.

4.3.6.12 San Diego Button-Celery *(Eryngium aristulatum var. parishii)*

Listing and Conservation Status

The State of California listed San Diego button-celery as endangered in July 1979, and the Service listed this plant as endangered on August 3, 1993 (58 FR 41384). Recovery and protection actions for this species are included within the vernal pool recovery plan (USFWS 1998a), as described in the section addressing San Diego mesa mint. No critical habitat has been designated for San Diego button-celery. The five-year review for San Diego button-celery, completed September 1, 2010 (USFWS 2010g), recommended no change in the current status of this species. This species is also covered under the San Diego MSCP.

Species and Habitat Description

San Diego button-celery, in the family Apiaceae (parsley/carrot family), is a biennial or longer lived perennial gray-green herb that has a storage taproot. It has a spreading shape and reaches a height of 16 inches (40 centimeters) (Constance 1993). The stems and lanceolate leaves give the plant a prickly appearance. San Diego button-celery is one of three varieties of *Eryngium aristulatum* (Constance 1993). It is separated from *Eryngium aristulatum* var. *aristulatum* (common) by having styles in fruit that are about the same length as the calyx (outer whorl of protective structures around the flower), and from *Eryngium aristulatum* var. *hooveri* (Hoover's button-celery) by having bractlets (modified leaves) without callused margins (Constance 1993).

San Diego button-celery is a clay soil, surface and non-surface hardpan vernal pool obligate taxon. Zedler (1987) hypothesizes that the patchy distribution of button-celery may be attributed to the extreme desiccation which vernal pools undergo in summer; hence, the species favors pools with a deep clay subsoil that do not dry as rapidly or as completely as those with shallower or more coarsely textured soils. San Diego button-celery seems more tolerant of peripheral vernal pool habitat than most obligate vernal pool species. It is specifically adapted to surviving in vernally wet conditions due to the presence of aerenchyma tissue (air channels in the roots) that facilitate necessary gas exchange in submerged plants (Keeley 1998).

San Diego button-celery blooms from April to June; the small white flowers vary in length from 0.067 to 0.11 inch (1.7 to 2.8 millimeters) (Munz 1974, Constance 1993). Species-specific studies have not been conducted for San Diego button-celery regarding pollination, dispersal, population ecology, and genetics. It survives the dry summer and autumn months through dormant seeds and perenniating vegetative structures.

San Diego button-celery is believed to be insect pollinated; the species is known to be visited and possibly pollinated by wasp-like bees from the family Colletidea (i.e., *Hylaeus episcopalis episcopalis, Hylaeus polifolii, Hylaeus conspicuous,* and *Hylaeus mesillae cressoni*), leaf cutting bees from the family Megachilidae (i.e., *Heriades occidentalis, Ashmeadiella cactorum basalis,* and *Megachile brevis onobrychidis*), and bumble or honey bees from the family Apidea (i.e., *Anthophora urbana urbana* and *Ceratina acanthi*) (Krombein et al. 1979).

San Diego button-celery is restricted to southern coastal California, with few occurrences in northern Baja California, Mexico. The historical distribution of San Diego button-celery included a coastal swath from Mesa de Colonet and San Quintín in Baja California, Mexico, north to Los Angeles County, California, in the U.S. San Diego button-celery currently occurs in 14 geographic areas in Riverside and San Diego counties. The current status of the species in Mexico is unknown.

Within San Diego County, San Diego button-celery occurs in 10 regional locations: Camp Pendleton, Carlsbad, San Marcos, Ramona, Del Mar Mesa, Carmel Mountain, Mira Mesa, Marine Corps Air Station (MCAS) Miramar, Otay Lakes, and Otay Mesa. San Diego button-celery can be locally abundant in remnant vernal pools; however, the distribution of this variety has been dramatically reduced due to loss of most of the vernal pool habitat in San Diego County (Oberbauer and Vanderwier 1991). There is little data available regarding population size and trends. Surveys conducted in 2003 by the City of San Diego revealed that of the 69 sites surveyed, 28 contained San Diego button-celery.

<u>Status of the Species within the Refuge</u>

San Diego button-celery seed that was collected at the Cal Terraces vernal pool preserve on Otay Mesa was distributed within two pools at the Shinohara site in 2010. In 2011, both pools supported mature San Diego button-celery plants. San Diego button-celery is also present in some of the vernal pools within the Del Mar Mesa Vernal Pool Unit.

4.3.6.13 Spreading Navarretia (*Navarretia fossalis*)

<u>Listing and Conservation Status</u>

Spreading navarretia was listed as threatened on October 13, 1998 (63 FR 54975). This species is not listed by the State of California as a rare, threatened, or endangered species, but is a covered species under the San Diego MSCP. The Service published a final rule designating approximately 652 acres (264 hectares) as critical habitat for spreading navarretia in the *Federal Register* on October 18, 2005 (70 FR 60658). In 2007, the Center for Biological Diversity filed a lawsuit challenging the validity of the information and reasoning used to exclude areas from the 2005 critical habitat designation for spreading navarretia. As a result, on October 7, 2010, a final rule revising the critical habitat for this species was published in the

Federal Register (75 FR 62192). Effective November 8, 2010, approximately 6,720 acres (2,456 hectares) of habitat for spreading navarretia was included within the boundaries of the critical habitat designation. A portion of the critical habitat included in Subunit 5A, an area located to the southeast of Sweetwater Reservoir near the Shinohara vernal pools, extends into the Otay-Sweetwater Unit. Subunit 5F is located to the northeast of the Refuge in Proctor Valley.

Recovery and protection actions for this species are included within the vernal pool recovery plan (USFWS 1998a), as described in the section addressing San Diego mesa mint, and a five-year review was completed by the Service in August 2009. The review concluded that spreading navarretia still meets the definition of threatened and recommended no change in its listing status (USFWS 2009d).

Species and Habitat Description

Spreading navarretia, a member of the Polemoniaceae (phlox family), is a low, mostly spreading or ascending annual plant, four to six inches (10.2 to 15.2 centimeters) tall. The leaves are 0.4 to 2 inches (one to 1.5 centimeters) long and finely divided into slender spine-tipped lobes. The lower portions of stems are mostly hairless (glabrous), and the flowers are arranged in flat-topped, compact, leafy heads. The white to lavender-white petals (corolla) are joined at their bases to form a tube, although the tips (lobes) are free. The fruit is an ovoid, two-chambered capsule, with each seed covered by a layer that becomes sticky and viscous when the capsule is moistened.

The range of *N. fossalis* overlaps with two other species in the genus *Navarretia*: *N. intertexta* (needle-leaved navarretia) and *N. prostrata* (prostrate navarretia). Spreading navarretia is distinguished from the other two species by its linear corolla lobes, spreading or ascending position, flat topped inflorescences, calyx size and shape (sepals collectively), and the position of the corolla relative to the calyx (Day 1993).

Spreading navarretia is considered an obligate wetland species (found almost always in wetland areas) but is more tolerant of the ephemeral inundation of vernal pool habitat than a true wetland plant. Within San Diego County, spreading navarretia is typically found in vernal pools and depressions and ditches in areas that once supported vernal pools (Tierra Madre Consultants 1992, Day 1993, Reiser 1996).

Spreading navarretia depends on the inundation and drying cycles of its habitat for survival. This regime allows for germination and other life history phases of the plant. This annual species germinates from seeds left in the seed bank. For many vernal pool plant species, temperature and moisture affect the timing of plant germination (Myers 1975). Although not proven, it is likely that this species uses these same cues for germination. Most *Navarretia* species have indehiscent fruit or fruit with fibers that absorb water and expand to break open the fruit after a substantial rain (Spenser and Riesberg 1998). The timing of germination is important so that the plant germinates under favorable conditions in the spring rather than the summer, autumn, or winter.

The plant usually flowers in May and June as the vernal pool dries out. No studies have been conducted for this species regarding reproduction. Specific data regarding pollinators and seed viability are lacking. The species is capable of self-pollination, but it can also outcross to other plants. Outcrossing can be an important factor in regaining the genetic diversity lost with the disappearance of occurrences. Upon fruiting, this species fades rapidly and can be difficult to detect late in the dry season or in dry years. The number of individuals of spreading navarretia at a given population site varies annually in response to the timing and amount of rainfall and temperature (USFWS 2009d).

Spreading navarretia is distributed from northwestern Los Angeles County and western Riverside County, south through coastal San Diego County, California, to San Quintín in northwestern Baja California, Mexico, from near sea level to 4,200 feet (1,280 meters) (Day 1993; Munz 1974). Currently there are 48 extant occurrences of spreading navarretia in the U.S., with nearly 60 percent of the known populations concentrated in three locations: Otay Mesa in southern San Diego County; along the San Jacinto River in western Riverside County; and near Hemet in Riverside County (Bauder 1986, Bramlet 1993, CNDDB 1999). Smaller populations are scattered in southern Riverside County, Los Angeles County, and coastal San Diego County. In Mexico, spreading navarretia is known from fewer than 10 populations clustered in three areas: along the international border; on the plateaus south of the Rio Guadalupe; and on the San Quintín coastal plain (Moran 1977).

Range wide, comprehensive surveys for spreading navarretia have not occurred, but some survey work has been completed to various areas within this species range. In 2003, the City of San Diego conducted a survey of vernal pools within their jurisdiction. Of the 1,142 vernal pools surveyed, spreading navarretia was found in 99 pools with a mean percent cover per pool of 2.4 percent (City of San Diego 2004).

Threats to this species are similar to those described for other listed vernal pool species: habitat destruction; indirect effects related to altered hydrology, competition with invasive species, and habitat fragmentation; and cumulative impacts related to isolation of genetic diversity, pollution, climate change, and changes in nutrient availability (Bauder 1986).

Status of the Species within the Refuge

Spreading navarretia seed that was collected from an adjacent vernal pool restoration site on Sweetwater Authority lands was sown in three pools on the Shinohara site in 2010; in 2011, mature plants were present in all three of the pools. This species is not present in the pools on the Del Mar Mesa Vernal Pool Unit.

4.3.6.14 California Orcutt Grass *(Orcuttia californica)*

Listing and Conservation Status

California Orcutt grass was listed by the State of California as an endangered species in September 1979, and was federally listed as an endangered species on August 3, 1993 (58 FR 41384). The primary threats at the time of listing are similar to those described previously for other listed vernal pool species, including habitat loss and degradation, invasion of weedy non-native plants, alteration of the watershed, and drought. Recovery and protection actions for this species are included within the vernal pool recovery plan (USFWS 1998a), as described in the section addressing San Diego mesa mint. No critical habitat has been designated for this species. This species is a covered species under the San Diego MSCP.

The only review of the listing status for this species occurred during a five-year review completed by the Service in March 2011. Based on the results of the review, no change in the listing status of California Orcutt grass was recommended (USFWS 2011a).

Species and Habitat Description

California Orcutt grass, a member of the grass family (Poaceae), is a small, inconspicuous, prostrate, sparsely hairy, tufted annual grass. Reeder (1982) describes it as reaching about four inches (1.6 centimeters) in height, with bright green leaves that secrete sticky droplets that taste bitter. Pink inflorescences (flowers) are borne from April through June and consist of seven spikelets arranged in two ranks, with the upper spikelets overlapping on a somewhat twisted axis. California Orcutt grass can be distinguished from other species in the genus by the length (no longer than 0.2 inches [5 millimeters]) and shape (sharp-pointed) of the teeth of lemma (bract enclosing the floret); prostrate culms (stems), length of the caryopsis (fruit); and spikelets that are remote on the axis below, crowded toward the apex.

The leaf and root anatomy and physiology of this plant is adapted to the conditions that occur within the wettest, longest lasting portion of vernal pools (Munz 1974, Reeder 1993). The presence of aerenchyma tissue for submerged gas exchange described by Keeley (1990) as Crassulacean Acid Metabolism (CAM) photosynthesis makes this species specifically adapted to survive in vernally wet conditions. Its seeds germinate in the saturated and/or submerged soil of vernal pools. As the pools that support California Orcutt grass dry up and the plant becomes more exposed, the plant structure, which began the season nearly prostrate, produces more erect glandular pubescent stems. During this drying period, the plants also produce flowers and subsequently set seed (USFWS 2011a). Like most grasses, California Orcutt grass flowers are wind pollinated; however, this plant species relies on fungi to play a role in stimulating germination (Griggs 1976, Griggs 1981, Keeley 1988).

This species is an obligate vernal pool species and often occurs in pools with a loamy soil surface and clay hardpan bottom that restricts or precludes drainage from the pool site. This species is less abundant at the shallow periphery of vernal pools that are subject to more rapid changes in moisture and are generally more abundant in portions of pools that retain water for the longest period of time (longer inundation time).

The historic distribution of California Orcutt grass ranged from Ventura County to northern Baja California, Mexico, below 2,300 feet (700 meters) in elevation. At the time of listing, it was thought to be restricted to four general localities in California: Santa Rosa Plateau, Skunk Hollow, and Salt Creek (now identified as the Stowe Pools) in Riverside County, and Otay Mesa in San Diego County. The species was likely never widespread compared to other obligate vernal pool plant species because deeper pools with longer inundation times (longer seasonal ponding) are less common in southern California. In 2011, California Orcutt grass was considered to be extant at 28 occurrences: 3 occurrences in Ventura County, 3 occurrences in Los Angeles County, 9 occurrences in Riverside County, and 13 occurrences in San Diego County (USFWS 2011a). The population size of this species within these occurrences fluctuates at any given time with rainfall variability, so the number and distribution of occupied pool complexes is the appropriate unit for assessing California Orcutt grass populations.

The threats and conservation needs identified for San Diego button-celery are also applicable to California Orcutt grass.

Status of the Species within the Refuge

California Orcutt grass seed that was collected at the Cal Terraces vernal pool preserve on Otay Mesa was distributed in four pools on the Shinohara site in 2010. In 2011, one of the seeded pools supported mature specimens of this species. This species does not occur in the vernal pools on the Del Mar Mesa Vernal Pool Unit.

4.3.6.15 Encinitas Baccharis (*Baccharis vanessae*)

Listing and Conservation Status

Encinitas baccharis was listed as endangered by the State in 1987 and federally listed as threatened in 1996 (61 FR 52370). There is currently no recovery plan and no critical habitat rules have been published. Encinitas baccharis is a covered species under the San Diego MSCP with a requirement for area specific management directives that address the autecology and natural history of the species and include measures to reduce the risk of catastrophic fire and ensure appropriate male to female plant ratios (City of San Diego 1997). The Service completed a 5-year review for this species in 2011 and concluded that no change in the current listing status of the species was warranted (USFWS 2011b).

Species and Habitat Description

Encinitas baccharis, a member of the Asteraceae (sunflower) family, is a slender-stemmed, dioecious (separate male and female plants) shrub measuring 1.6 to 4.3 feet (0.5 to 1.3 meters) in height. Because this species is dioecious, both sexes must be in close proximity for pollination and subsequent seed production to occur. This species can be distinguished from other members of the genus by its numerous, erect, glabrous stems; linear, entire leaves with only one principal vein; and its delicate, narrowly tapered phyllaries (bracts that form the inflorescence), which are reflexed at maturity. The dark green leaves, which are thread-like, are narrower in width than the portion of the twig adjacent to the leaf (USFWS 2011b). The flower heads (capitulae) are cylindrical receptacles each containing clusters of tiny, whitish, flowers, with each flower head containing 15 to 22 flowers. The blooming period is between August and November.

Encinitas baccharis is probably pollinated by both wind and insects, and the pollinated flowers develop one-seeded dry fruits (achenes) that are each attached to a cluster of bristly hairs (a pappus), which facilitate wind dispersal (USFWS 2011b). The Service's 5-year review for this species (USFWS 2011b) notes that no Encinitas baccharis seedlings have been observed in the field since 1991, and the factors that may be limiting reproduction are currently unknown.

This species of *Baccharis* is unusual among the California species of *Baccharis* because it occurs mainly in chaparral rather than in riparian environments, washes, or otherwise disturbed lands (USFWS 2011b). It is found in several types of chaparral habitats distributed below 3,000 feet (914 meters) in areas where maritime climate prevails. Encinitas baccharis is difficult to locate in the field when not in flower. Plants may be confused with other co-occurring taxa (e.g., peak rush rose [*Helianthemum scoparium*], broom baccharis). For these reasons, it is possible that additional occurrences exist within the species' range, even in heavily urbanized areas. Surveys for this species should be conducted during the months when the species is in flower to facilitate detection and accurate identification.

Status of the Species within the Refuge

No occurrences of this species have been recorded on the San Diego NWR. There are 30 known extant occurrences, but none occurs within or in proximity to the Del Mar Mesa Vernal Pool Unit. Two small populations are known from Otay Mountain and are presumed extant, but no populations have been identified on lands included within the Otay-Sweetwater Unit.

4.3.6.16 San Diego Fairy Shrimp (Branchinecta sandiegonensis)

Listing and Conservation Status

The Service listed the San Diego fairy shrimp, an invertebrate species, as endangered on February 3, 1997 (62 FR 4925). This species was listed as endangered because 90 to 97 percent of the vernal pool habitat on which the San Diego fairy shrimp depends and the watersheds that sustain the vernal pool habitat has been damaged or destroyed by a variety of human-caused activities, primarily urban development and agricultural conversion (62 FR 4925). In addition, the remaining vernal pools were vulnerable to disturbance due to a range of human activities associated with development, agriculture, and recreation. Recovery and protection actions for this species are included within the vernal pool recovery plan (USFWS 1998a), as described earlier in the section addressing San Diego mesa mint. This species has not been listed by the State of California as a rare, threatened, or endangered species, but is covered under the San Diego MSCP.

Critical habitat was first designated for this species in October 2000 (65 FR 63438), at which time a total of approximately 4,025 acres (1,629 hectares) in the counties of San Diego and Orange were included within the boundaries of designated critical habitat. As a result of a lawsuit, the areas designated for critical habitat were reconsidered, a proposed rule was issued on April 22, 2003 (68 FR 19888), and a final rule was published on December 12, 2007 (72 FR 70648).

Today, approximately 3,082 acres (1,248 hectares) in the counties of San Diego and Orange are included within the boundaries of designated critical habitat including lands within the Del Mar Mesa Vernal Pool Unit of the Refuge (Critical Habitat Unit 4, Subunits 4 A/B).

In September 2008, the Service completed a five-year review addressing the status of the San Diego fairy shrimp (USFWS 2008b). The five-year review recommended no change in the status of the San Diego fairy shrimp.

Species and Habitat Description

The San Diego fairy shrimp is a small, freshwater crustacean in the family Branchinectidae of the Order Anostraca. The species was originally described by Fugate (1993) from samples collected on Del Mar Mesa, San Diego County. Male San Diego fairy shrimp are distinguished from males of other *Branchinecta* species by differences found at the distal (located far from the point of attachment) tip of the second antennae. Females are distinguishable from females of other species of *Branchinecta* by the shape and length of the brood sac, the length of the ovary, and by the presence of paired dorsolateral (located on the sides, toward the back) spines on five of the abdominal segments (Fugate 1993). Adult male San Diego fairy shrimp range in size from 0.35 to 0.63 inch (8.9 to 16 millimeters), and adult females are 0.31 to 0.55 inch long (7.9 to 14 millimeters). A genetic study based on mtDNA sequencing of San Diego fairy shrimp across its range found two evolutionary significant units (genetic clades A and B) (Bohonak 2005).

San Diego fairy shrimp are generally restricted to vernal pools and other non-vegetated ephemeral (i.e., containing water for a short time) basins 2 to 12 inches (5.1 to 30.5 centimeters) in depth in coastal southern California and northwestern Baja California, Mexico (USFWS 2008b). This habitat is essential to the hatching of San Diego fairy shrimp cysts. Their cysts cannot hatch in perennial (i.e., containing water year round) basins because the re-wetting of dried cysts is one component of a set of environmental stimuli that trigger hatching (Eriksen and Belk 1999). Temperature, water chemistry, and other factors may also play a role in trigger hatching (USFWS 2008b). San Diego fairy shrimp, which feed on algae, diatoms, and particulate organic matter (Parsick 2002), are usually observed from January to March when seasonal rainfall fills vernal pools and initiates cyst hatching. Individuals hatch and mature within 7 to 14 days of rainfall filling a pool, depending on water temperature (Hathaway and Simovich 1996, Simovich and Hathaway 1997). This hatching period may be extended in years with early or late rainfall.

Cysts produced from successful reproduction are dropped to the pool bottom or remain in the brood sac until the female dies and sinks. Cysts are capable of withstanding temperature extremes and prolonged drying. Only a portion of the cysts may hatch when pools refill in the same or subsequent rainy seasons; therefore, cyst "banks" develop in pool soils that are composed of cysts from several years of breeding. This partial hatching of cysts allows the San Diego fairy shrimp to persist in its extremely variable environment (USFWS 2008b). The ability of this species to develop and maintain cyst banks is vital to the long-term survival of San Diego fairy shrimp populations (Ripley et al. 2004).

The range of the San Diego fairy shrimp includes Orange and San Diego counties in southern California and northwestern Baja California, Mexico (Brown et al. 1993, USFWS 1998a). As of 2008, 137 complexes occupied by San Diego fairy shrimp have been identified in the U.S. (USFWS 2008b). It is currently not possible to survey San Diego fairy shrimp populations for changes in numbers of individuals and demographic trends over time due to the small size and life history traits of San Diego fairy shrimp. Research into the development of population assessment methods is, however, being pursued (USFWS 2008b).

Status of the Species within the Refuge

Areas identified as occupied by San Diego fairy shrimp at the time of listing included the pools within the Del Mar Mesa Vernal Pool Unit and remnant pools on the Shinohara parcel in the Otay-Sweetwater Unit. In 2011, presence of the species was documented within 27 restored or enhanced vernal pools on the Shinohara site in the San Miguel Mountain area of the Otay-Sweetwater Unit.

4.3.6.17 Riverside Fairy Shrimp *(Streptocephalus woottoni)*

Listing and Conservation Status

The Service listed the Riverside fairy shrimp, an invertebrate species, as endangered on August 3, 1993 (58 FR 41384). Listing was deemed necessary because the habitat on which this species is dependent, vernal pools, and the species' overall range had been greatly reduced. At the time the listing rule was written, only five vernal pool complexes within the U.S. and two complexes in Mexico were known to be occupied by Riverside fairy shrimp (USFWS 2008c). Recovery and protection actions for this species are included within the vernal pool recovery plan (USFWS 1998a), as described in the section addressing San Diego mesa mint. This species has not been listed by the State of California as a rare, threatened, or endangered species, but is covered under the San Diego MSCP.

Critical habitat was first designated for this species in May 2001 (66 FR 29384), at which time approximately 6,870 acres (2,790 hectares) in Los Angeles, Orange, Riverside, San Diego, and Ventura counties, California, were designated as critical habitat. As a result of a lawsuit, the areas designated for critical habitat were required by the court to be reconsidered. On April 27, 2004, a proposed rule was issued in the *Federal Register* (69 FR 23024) and a final rule was published on April 12, 2005 (70 FR 19154). The final rule, which became effective on May 12, 2005, designated approximately 306 acres (124 hectares) within Ventura, Orange, and San

Diego counties, California, as critical habitat. None of this acreage is located within the boundaries of the San Diego NWR.

On January 14, 2009, the Center for Biological Diversity filed a lawsuit challenging the 2005 designation of critical habitat. As a result, the Service published a proposed rule on June 1, 2011, to once again revise the areas designated as critical habitat for this species (76 FR 31686). This proposed rule incorporates new information specific to Riverside fairy shrimp genetics across the species' range that was not available when the 2005 critical habitat designation was made final (70 FR 19154; April 12, 2005). In addition, it considered new information on the status and distribution of Riverside fairy shrimp that became available since the 2005 final critical habitat designation for this species. As currently proposed, approximately 2,678 acres (1,084 hectares) of critical habitat would be designated for this species. The proposed areas of critical habitat include habitat known to support Riverside fairy shrimp as well as surrounding upland areas (the contributing watershed) that contain the physical and biological features essential to support Riverside fairy shrimp. None of the lands within the San Diego NWR are proposed for inclusion in the areas being considered for designation as revised critical habitat for Riverside fairy shrimp.

The five-year review completed for this species in September 2008 recommended no change in the status of the Riverside fairy shrimp (USFWS 2008c).

Species and Habitat Description

The Riverside fairy shrimp is a small freshwater crustacean in the Family Streptocephalidae of the Order Anostraca. The species was first collected in 1979 by Clyde Eriksen and formally described as a new species in 1990 (Eng et al. 1990). Riverside fairy shrimp, like all fairy shrimp in general, have stalked compound eyes, no carapace (hard outer shell), and 11 pairs of phyllopods (swimming legs that also function as gills). They swim or glide upside down by means of complex beating movements of the legs that pass, wave-like, in an anterior to posterior direction. The Riverside fairy shrimp can be distinguished from similar species by its red-colored cercopods (anterior appendages), which occur on all of the ninth and 30 to 40 percent of the eighth abdominal segments (Eng et al. 1990). Adult Riverside fairy shrimp may grow to a length of 0.5 to 1.0 inches (13 to 25 millimeters) (Eng et al. 1990).

Riverside fairy shrimp are restricted to vernal pools and vernal pool-like ephemeral basins (e.g., ruts in dirt roads and stock ponds). In contrast to San Diego fairy shrimp, Riverside fairy shrimp prefer deep—greater than 9 inches (22.9 centimeters) in depth—vernal pools that range in temperature from 50 to 77°F and remain filled for extended periods of time (Eng et al.199, Eriksen and Belk 1999). Water within pools supporting Riverside fairy shrimp may be clear, but more commonly it is moderately turbid (Eriksen and Belk 1999). Typically, pools supporting this species have low total dissolved solids and alkalinity (means of 77 and 65 parts per million, respectively), in association with pH at neutral or just below (7.1 to 6.4) (Eng et al. 1990, Gonzalez et al. 1996, Eriksen and Belk 1999).

Riverside fairy shrimp may also be found in disturbed vernal pool habitats where basins have been compacted or artificially deepened, which allows the basins to hold water for longer periods. Although basins supporting populations often appear to be artificially created or enhanced, such basins are located within soils that are capable of seasonal ponding and are often surrounded by naturally occurring vernal pool complexes (USFWS 2008c). These "artificial basins" function in the same manner as naturally occurring vernal pools by filling with late fall, winter and/or spring rains that gradually dry up during the spring and/or summer (USFWS 1998a).

Riverside fairy shrimp are non-selective filter-feeders that filter suspended solids from the water column. Protozoa, rotifers, bacteria, algal cells, and bits of detritus between 0.3 to 100 microns may be filtered and ingested (Eng et al. 1990, Eriksen and Belk 1999). Riverside fairy shrimp are preyed upon by a wide variety of wildlife, including beetles, dragonfly larvae, other arthropods, frogs, salamanders, toad tadpoles, shorebirds, ducks and other migratory birds, and even other fairy shrimp (Eriksen and Belk 1999).

Freshwater crustaceans, including Riverside fairy shrimp, have a two-stage life cycle and spend the majority of their life cycle in the cyst stage (Templeton and Levin 1979, Schaal and Leverich 1981). After hatching, Riverside fairy shrimp require 48 to 56 days to reach sexual maturity in contrast with other fairy shrimp that can reach maturity in less than two weeks (Hathaway and Simovich 1996). Fairy shrimp mate upon reaching maturity, and female Riverside fairy shrimp produce between 17 and 427 cysts (eggs) over their lifetime (Simovich and Hathaway 1997).

The cysts are dropped by the females to settle into the mud at the bottom of the pool, or they remain in the brood sac until the female dies and sinks to the bottom (Eriksen and Belk 1999). The cysts will hatch in 7 to 12 days when water temperatures are between 50 to 77°F (Hathaway and Simovich 1996). A small percentage of cysts are likely to hatch in a season, thus providing a mechanism for survival if the inundation period is too short in a given year (Simovich and Hathaway 1997). Fairy shrimp cysts may persist in the soil for several years until conditions are favorable for successful reproduction (Simovich and Hathaway 1997).

Riverside fairy shrimp occurs within Riverside, Orange, and San Diego counties in California, as well as northern Baja California, Mexico. Its known localities are below 2,100 feet (640 meters) elevation and are within 50 miles (80 kilometers) of the Pacific Ocean. As of 2011, Riverside fairy shrimp were presumed to occupy 60 or fewer pool complexes throughout southern California.

The loss and modification of vernal pool habitat continues to be a significant threat to the Riverside fairy shrimp, especially in areas where urbanization is expected to expand. Acquisition of land and conservation easements have resulted in the preservation of vernal pool habitat for the species, but the trend of habitat loss and degradation continues, particularly on private lands. Additionally, even preserved lands are often subject to invasion by non-native plants and other impacts that lower the quality of habitat for Riverside fairy shrimp (USFWS 2008c).

Riverside fairy shrimp habitat is also threatened by indirect effects of development (including human access and disturbance impacts, runoff, illegal dumping, and water and air pollution) resulting from the proximity of Riverside fairy shrimp habitat to development. Non-native plants also threaten Riverside fairy shrimp throughout the range of the species. Riverside fairy shrimp habitat is naturally fragmented, but development projects continue to further fragment and isolate vernal pools within and between complexes, which may disrupt the population dynamics of the species. Conservation measures beyond habitat preservation, such as habitat and species management and monitoring, are necessary to ensure the long-term sustainability and persistence of this species throughout its range (USFWS 2008c).

Status of the Species within the Refuge

As of 2011, this species has not been documented anywhere on the Refuge, although suitable habitat to support this species does exist at the Shinohara site. It is presumed to be present in one or more pools on lands in Otay Mesa that Caltrans may be conveying to the Service for inclusion in the Refuge at some future date.

4.3.6.18 Quino Checkerspot Butterfly (*Euphydryas editha quino*)

Listing and Conservation Status

The Quino checkerspot butterfly was listed as endangered on January 16, 1997 (62 FR 2313). This subspecies was added to the endangered species list as a result of significant declines in both species distribution and abundance caused primarily by human actions that degraded, fragmented, and destroyed habitat essential for this subspecies' survival (USFWS 2003b). The Quino checkerspot butterfly is not included on the State of California's list of rare, threatened, or endangered species.

A final rule designating approximately 171,605 acres (69,440 hectares) in Riverside County and San Diego County, California, as critical habitat for the Quino checkerspot butterfly was published in the *Federal Register* on April 15, 2002 (67 FR 9476), and the *Quino Checkerspot Butterfly Recovery Plan* ("Quino recovery plan") was approved in 2003. Following the filing of a lawsuit by the Homebuilders of Northern California, *et al.* challenging the merits of the 2002 critical habitat designation, the Service agreed in 2005 to reevaluate the areas designated as critical habitat for this species. As a result, on June 17, 2009 (74 FR 28776), the Service published a final revised critical habitat rule that designated approximately 62,125 acres (25,141 hectares) of critical habitat for this butterfly in San Diego and Riverside counties. Only a small portion of the Refuge, an area adjacent to Proctor Valley Road, has been designated as critical habitat for this butterfly. On August 18, 2009, the Service completed a five-year review for this subspecies and recommended no change in the status of the Quino checkerspot butterfly (USFWS 2009e).

Species and Habitat Description

The Quino checkerspot butterfly is a recognized subspecies of Edith's checkerspot butterfly (*Euphydryas editha*) and a member of the Nymphalidae family, the brush-footed butterflies. The Quino checkerspot butterfly differs from the other Edith's checkerspot subspecies in size, wing coloration, and larval and pupal phenotypes (Mattoni et al. 1997). Among the other subspecies of Edith's checkerspot, the Quino checkerspot butterfly is moderate in size with a wingspan of approximately 1.5 inches (38 millimeters). The dorsal (top) side of its wings is covered with a red, black, and cream colored checkered pattern; the ventral (bottom) side is mottled with tan and gold. The abdomen generally has bright red stripes across the top. Quino checkerspot butterfly larvae are black, and they have a row of nine orange-colored tubercles (fleshy/hairy extensions) on their back. Pupae are extremely cryptic and are mottled black and blue-gray (USFWS 2003b).

Quino checkerspot butterfly habitat is characterized by patchy shrub or small tree landscapes with openings of several meters between large plants, or a landscape of open swales alternating with dense patches of shrubs; such habitats are often collectively termed "scrublands." Quino will frequently perch on vegetation or other substrates to mate or bask, and they require open areas to facilitate movement (USFWS 2009e). In fact, open areas within a given vegetation community seem to be critical landscape features for Quino checkerspot butterfly populations (USFWS 2003b). Optimal habitat appears to contain little or no invasive exotic vegetation and a well-developed cryptogamic crust. Sustained drought conditions can lead to extirpation of local populations, and broad scale climate anomalies may lead to phenological incompatibility between Quino checkerspot butterfly and their host plants.

The life cycle of the Quino checkerspot butterfly typically entails one generation of adults per year, with a four- to six-week flight period occurring between January and May, depending on weather conditions (USFWS 2003b). During the flight period, adult butterflies move about and search for nectar sources, mates, and oviposition sites. Females lay multiple masses of 20 to 150 eggs, with a single female capable of producing more than 1,000 eggs (USFWS 2003b).

After hatching from eggs, the small, cryptic, larvae normally consume the plant on which they hatch and then move in search of additional plants (USFWS 2003b). Food plants dry up as summer approaches. In their third or fourth instar, larvae enter into an obligatory diapause. Diapause is a low-metabolic resting state that may last for a year or more, depending on conditions. Diapause allows larvae to survive the regular seasonal climatic extremes and to better survive times of extended adverse conditions, such as drought. After termination of diapause, larvae become active and feed. They then enter their pupal stage and within two to six weeks transform into adults and emerge as butterflies. The butterflies feed, disperse, mate, reproduce, and then die. Adults live for a period of approximately 10 to 14 days.

Adult butterflies will only deposit eggs on species they recognize as host plants. The primary host plants or larval food sources for the Quino checkerspot butterfly are dwarf plantain (*Plantago erecta*), white snapdragon (*Anterrhinum coulterianum*), woolly plantain (*Plantago patagonica*), and Chinese houses (*Collinsia concolor*). Larval Quino checkerspot butterfly may also use other species of native plantain (*Plantago* sp.), as well as purple owl's clover (*Castilleja exserta*) and thread-leaved bird's beak (*Cordylanthus rigidus*), as primary or secondary host plants (USFWS 2003b). The use of purple owl's clover and thread-leaved bird's beak however is rare, and these species alone are not believed to support Quino breeding (USFWS 2003b).

Newly hatched pre-diapause larvae cannot move more than an inch or so (a few centimeters) during the first two instars, restricting their development during this stage to the individual host plant where the eggs were deposited. Older pre-diapause larvae usually wander independently in search of food and may switch to feeding on a different species of host plant (USFWS 2003b). Larval Quino checkerspot butterfly are thought to diapause in or near the base of native shrubs. While the use patterns of primary and secondary larval host plants are not fully understood, there is evidence that both may be necessary for the survival of Quino checkerspot butterfly larvae (USFWS 2003b). Quino checkerspot butterflies, which use a number of flowering plants as nectar sources, appear to prefer flowers with a platform-like surface on which they can remain upright while feeding (USFWS 2003b).

Adult Quino checkerspot butterflies are sedentary by nature and generally fly close to the ground. Many experts familiar with the Quino checkerspot butterfly believe that populations separated by more than two miles may be demographically isolated. These butterflies may, however, travel greater distanced when influenced by abiotic factors, such as weather (Ehrlich and Murphy 1987). In addition, it appears that Quino checkerspot butterfly populations have evolved to respond to shifting habitat patch suitability. Adult Quino checkerspot butterfly are also known to congregate on hilltops, ridgelines, and other prominent geographic features; however, whether this behavior (referred to as "hilltopping") is related to mating has yet to be confirmed (Mattoni et al. 1997).

Quino checkerspot butterfly population density appears to fluctuate dramatically in response to annual climate variability (Murphy and White 1984). This population variability likely leads to extirpation and recolonization of local populations or metapopulation structure. Because local populations of Quino checkerspot butterfly are likely susceptible to extirpation, it is important to maintain connectivity among local populations to allow for recolonization from nearby local populations (USFWS 2003b).

The Quino checkerspot butterfly was historically found from the coastal slopes of Los Angeles, Orange, and San Diego counties, as well as northern Baja California, Mexico, east to southwestern San Bernardino County and the western edge of the upper Anza-Borrego desert. Today, the Quino checkerspot butterfly is only known from western Riverside County, southern San Diego County, and northern Baja California, Mexico. Significant areas of remaining Quino checkerspot butterfly habitat are now protected through inclusion in habitat conservation plan preserve areas.

Status of the Species within the Refuge

The pattern of occurrence of the Quino checkerspot butterfly on the Otay-Sweetwater Unit is small numbers of butterflies in a given location with inconsistent numbers from year to year. This inconsistency may be the result of annual variations in climate, including the amount and timing of rainfall, as well as the range of temperatures in a given year. Historically, this species has been documented in small numbers on at least 13 distinct locations within this unit, including on hilltops and ridges within the Sweetwater River and San Miguel areas, and within the Otay Lakes and Mesa area. In 2009, seven Quino checkerspot butterflies were documented on the Otay-Sweetwater Unit. There are at least eight areas of high-quality habitat (hilltops or ridgelines in open-canopy coastal sage scrub, with primary and secondary larval host plants, abundant and diverse nectar sources, and minimal annual weed invasion) on the Refuge. This species is not known to occur in the Del Mar Mesa Vernal Pool Unit.

4.3.6.19 Hermes Copper *(Hermelycaena [Lycaena] hermes)*

Listing and Conservation Status

On April 14, 2011, the Service determined in a 12-month finding that listing of the Hermes copper butterfly as endangered or threatened is warranted (76 FR 20918). However, due to higher priority actions to amend the lists of endangered and threatened wildlife and plants, the Hermes copper butterfly was added to the Service's candidate species list with the intent of developing a proposed rule to list the butterfly as priorities allow. This species is not included on the State of California's list of rare, threatened, or endangered species.

Species and Habitat Description

The Hermes copper butterfly is a small, brightly colored butterfly approximately 1.0 to 1.25 inches (2.5 to 3.2 centimeters) in length, with one tail on the hindwing. On the upperside, the forewing is brown with a yellow or orange area enclosing several black spots, and the hindwing has orange spots that may be merged into a band along the margin. On the underside, the forewing is yellow with four to six black spots, and the hindwing is bright yellow with three to six black spots.

Hermes copper butterfly is endemic to the southern California region, primarily occurring in San Diego County, California, and a few records of the species have been documented in Baja California, Mexico (Faulkner and Klein 2005). The species inhabits coastal sage scrub and southern mixed chaparral (Marschalek and Deutschman 2008) and is dependent on its larval host plant, spiny redberry, to complete its lifecycle.

Adult Hermes copper butterflies lay single eggs on spiny redberry stems where they hatch and feed until pupation occurs at the base of the plant. Hermes copper butterflies have one flight period occurring in mid-May to early July, depending on weather conditions and elevation (Faulkner and Klein 2005).

Adult Hermes copper butterflies have been known to feed on flower nectar in coastal sage scrub and chaparral ecosystems, particularly on the flowers of chamise, California buckwheat, slender sunflower (*Helianthus gracilentus*), poison oak, and short-podded mustard (*Hirshfeldia incana*). This butterfly is rarely observed far from its nectar source or host plant (Faulkner and Klein 2005, Marschalek and Deutschman 2008).

Historical data indicate Hermes copper butterflies ranged from Fallbrook, California, in northern San Diego County to 18 miles (29 kilometers) south of Santo Tomas in Baja California, Mexico, and from Pine Valley in eastern San Diego County to Lopez Canyon in western San Diego County. Range-wide species surveys have not been completed; therefore, it is difficult to assess the extent of occupation throughout the historical range.

Threats to this species include degradation, fragmentation, and loss of suitable habitat due to development and other human activity. Another potential threat is increased fire frequency. As indicated previously, Hermes copper butterflies are dependent upon spiny redberry, a wide-ranging perennial coastal sage scrub and chaparral-associated species, as its larval host and for completion of its lifecycle (Thorne 1963). The habitats in which this plant is found have been subject to multiple fires in recent years. If this pattern of increased fire frequency continues, it is possible that suitable larval host plant or nectar plant availability for Hermes copper butterflies could be significantly reduced. However, to date, no quantitative studies have been conducted to test this hypothesis. Extensive wildfires in 2003 and 2007 eliminated the species from large portions of its former range in San Diego County, such that the vast majority of the species' current known distribution lies in an area between the footprints of the Cedar Fire of 2003 and the Harris Fire of 2007. A fire of large magnitude occurring in this area (which has not burned since 1970) could potentially eliminate over 80 percent of the locations where the species is currently known to occur (Deutschman et al. 2011).

Status of the Species within the Refuge

Prior to the 2007 Harris Fire, this species occurred in various locations throughout the Otay-Sweetwater Unit; however, surveys conducted in 2010 only observed this species in appropriate intact habitat on McGinty Mountain and the northern portion of Las Montañas, lands that were not burned in the Harris Fire. Surveys conducted at sites within the Harris Fire footprint that were known to be occupied prior to the fire were negative (Deutschman et al. 2010). The results of the 2010 survey, which included a single day maximum count of 26 of these butterflies on McGinty Mountain (Deutschman et al. 2010), suggests that there is an abundant population of Hermes copper in this area. General observations of the species indicate that this species is slow to recolonize areas of habitat that have burned, so it will likely be some time before Hermes copper are once again present in historically occupied sites on the Otay-Sweetwater Unit. Hermes copper has not been documented in the Del Mar Mesa Vernal Pool Unit (Deutschman et al. 2010).

4.3.6.20 Arroyo Toad (Anaxyrus californicus)

Listing and Conservation Status

The Service listed the arroyo toad as endangered on December 16, 1994 (59 FR 64859), citing the extensive loss of essential native habitat as the primary reason for the decline in numbers of this species. From about 1920 through 1980, significant areas of arroyo toad habitat were lost to dam and reservoir construction, urban development, major road construction, expanding agricultural practices, and new recreational facilities, all of which contributed to the extirpation of some arroyo toad populations and significant reductions in the size of other arroyo toad populations (USFWS 1999b). This species is not included on the State of California's list of rare, threatened, or endangered species, but is a covered species under the San Diego MSCP.

The Service completed the *Arroyo Southwestern Toad (Bufo microscaphus californicus) Recovery Plan* ("arroyo toad recovery plan") in September 1999, and a five-year review for the arroyo toad was completed on August 3, 2009 (USFWS 2009f). The five-year review concluded that the level of threat to the arroyo toad remains basically the same as when it was listed in 1994. Although some threats such as habitat loss due to dam construction have diminished, other threats, including habitat alteration due to invasive non-native plants (e.g., tamarisk and *Arundo*), and the introduction of non-native predators such as bullfrogs, green sunfish, and African clawed frogs, are now substantial threats to the arroyo toad (USFWS 2009f). Threats identified subsequent to listing of the arroyo toad include the chytrid fungus disease and wildfire suppression activities. Despite continued threats to the species, the status of the arroyo toad has improved since it was listed, and new conservation measures have been implemented that are providing benefits for the arroyo toad. As a result, the five-year review recommended that this species be downlisted to threatened status.

Critical habitat was designated for the arroyo toad on February 7, 2001 (66 FR 9474), but it was vacated by court order on October 30, 2002, and remanded for redesignation. On April 13, 2005, a final rule redesignating critical habitat was published in the *Federal Register* (70 FR 19562). In 2007, a complaint was filed challenging the 2005 critical habitat designation and as a result, critical habitat for this species was once again revised and a final rule was published in the *Federal Register* on February 9, 2011 (76 FR 7245). Approximately 2.9 acres of designated critical habitat for arroyo toad occurs within the Refuge boundary along a portion of the Sweetwater River located in the McGinty Mountain management area.

Species and Habitat Description

The currently recognized nomenclature for the arroyo toad is *Anaxyrus californicus* (Frost et al. 2006, Crother 2008), while at the time of listing, the species was known as *Bufo microscaphus californicus*. This change does not alter the description or distribution of the animal.

The arroyo toad is a small, dark-spotted toad of the family Bufonidae. The parotoid glands, located on the top of the head, are oval-shaped and widely separated. A light or pale area or stripe is usually present on these glands and on top of the eyes. The toad's underside is buff-colored and usually without spots (Stebbins 1985). Recently metamorphosed individuals will easily blend with the substrate and are usually found adjacent to water.

The habitat requirements for arroyo toads include shallow, slow-moving streams and riparian habitats with natural flooding regimes and areas of open, sparsely vegetated, sandy stream channels and terraces (USFWS 2009f). Optimal breeding habitat consists of low gradient stream reaches that have shallow pools with fine textured substrates (i.e., sand, gravel). Toads also use upland habitats consisting of alluvial scrub, coastal sage scrub, chaparral, grassland, and oak woodland during both the breeding and non-breeding seasons (Griffin et al. 1999, USFWS 2009f). Observations of this species indicate that these toads move approximately one mile (1,609 meters) within a stream reach and up to 0.9 mile (1,448 meters) away from the stream into native upland habitats (Sweet 1992, Holland and Goodman 1998). The extent to which this species moves within these areas may be regulated by topography and channel morphology (Holland and Sisk 2000). Toads are critically dependent on upland terraces and the marginal zones between stream channels and upland terraces during the non-breeding season, especially during periods of inactivity, generally late fall and winter (Sweet 1992). Adult and juvenile toads burrow into loose soils in stream terraces and in uplands, where they may remain during daylight hours or for longer periods during the dry season (Sweet 1992).

Toads typically breed from February to July on streams with persistent water (Griffin et al. 1999). Female toads must feed for a minimum of two months to develop the fat reserves needed to produce a clutch of eggs (Sweet 1992). Eggs are deposited, and larvae develop in shallow pools with minimal current and little or no emergent vegetation. The substrate in these pools is generally sand or fine gravel overlain with silt. Arroyo toads need breeding pools that are no more than six inches (15.2 centimeters) deep. Toad eggs hatch in four to five days, and the larvae are essentially immobile for an additional five to six days. They then begin to disperse from the pool margin into the surrounding shallow water, where they spend an average of 10 weeks.

After metamorphosis (June to July), the juvenile toads remain on the bordering gravel bars until the pool no longer persists (usually from eight to 12 weeks depending on-site and yearly conditions) (Sweet 1992). With some exceptions, male toads reach adulthood in one to two years, and females become sexually mature in two to three years. Outside of the breeding season, arroyo toads are essentially terrestrial and use a variety of upland habitats for foraging, burrowing, and dispersal that include but are not limited to sycamore cottonwood woodlands, oak woodlands, coastal sage scrub, chaparral, and grassland (Holland 1995, Griffin et al. 1999). During the non-breeding season, arroyo toads seek shelter during the day and other periods of inactivity by burrowing into the sandy areas of upland terraces. They also use the marginal zones between the stream channels and upland terraces for burrowing, especially during late fall and winter (Sweet 1992). Arroyo toads will go into aestivation in their burrows during the non-breeding season, starting in the later summer from approximately August through January (Ramirez 2003).

Toad larvae feed on loose organic material such as interstitial algae, bacteria, and diatoms but do not forage on macroscopic vegetation (Sweet 1992, Jennings and Hayes 1994). Juvenile toads rely on ants almost exclusively (USFWS 1999b). By the time they reach 0.7 to 0.9 inches (1.8 to 2.3 centimeters) in length, they expand their diet to include beetles and ants (USFWS 1999b). Adult toads probably consume a wide variety of arthropods, including ants, beetles, spiders, caterpillars, and others.

The toad was historically found in California from Monterey County to San Diego County and southward to the vicinity of San Quintín, Baja California, Mexico. They have been extirpated from an estimated 75 percent of their former range in the U.S. and in areas where they continue to occur, they are found primarily in small, isolated areas in the middle to upper reaches of streams. The current distribution of the toad in the United States is from the Salinas River Basin in Monterey County, south to the Tijuana River and Cottonwood Creek Basin along the border with Mexico. The current elevational range for most arroyo toad populations in San Diego County is about 1,000 to 4,600 feet (305 to 1,402 meters), although they were historically known to extend into the lower portions of most river basins (USFWS 1999b), and populations on Camp Pendleton extend down to just above sea level (Holland and Goodman 1998).

Toad populations vary considerably from year to year, depending on environmental conditions. Approximately threefold changes have been observed from one year to the next (Sweet 1993), and greater variations would likely be observed with more data on toad populations. Because female toads lay an average of approximately 5,000 eggs during the breeding season (Sweet 1992), there is the potential for rapid increases in population size given favorable conditions, but toad recruitment reflects the inherent variability of their environment. During years of drought, pools may dry before larvae have reached metamorphosis, and females may forego breeding altogether. If flooding occurs after eggs have been laid, a large percentage of the eggs and larvae can be lost. Finally, heavy predation pressure by birds, mammals, reptiles, and other amphibians on metamorphosing and newly metamorphosed juveniles can drastically reduce recruitment. Once toads have reached the subadult stage, survivorship is higher. Annual mortality of adults and subadults has been estimated between 35 percent and 70 percent (Sweet 1993, Holland and Sisk 2000, Holland and Sisk 2001), which would mean that few toads survive past five years in the wild.

Stream order, elevation, and floodplain width are important factors in determining the size and long-term viability of a toad population (Sweet 1992, Barto 1999, Griffin 1999). Streams with the greatest potential to support self-sustaining populations are typically of a high stream order (i.e., 3rd to 6th order), at low elevations below 3,000 feet (914 meters), with wide floodplains. Because of the dynamic nature of toad populations and their habitat, movements of individuals are likely important for colonizing areas where toads have been locally extirpated or where new habitat has been created due to flooding events or changes in human management.

Status of the Species within the Refuge

This species was last observed on the Otay-Sweetwater Unit in 1997 when several adults and a few larvae were identified on Sweetwater Authority lands between the upper end of the Sweetwater Reservoir and the Refuge boundary. Since then, annual surveys conducted through 2005 (with the exception of 2004, when no survey was conducted) have yielded no observations of the arroyo toad on the Refuge. Madden-Smith et al. (2005) identified an area of high-quality habitat on the Refuge within the McGinty Mountain area during surveys conducted in 2002 and 2003. This high-quality habitat, which is currently unoccupied, is located in the Sweetwater River floodway, just south of the Sycuan golf course. Good quality habitat for the arroyo toad was also identified during this study at the south end of the Cottonwood golf course. Arroyo toads are known to be present in Sloane Canyon, an area of the Sweetwater River located upstream of the Refuge.

4.3.6.21 California Red-legged Frog *(Rana draytonii)*

Listing and Conservation Status

The California red-legged frog was listed by the Service as threatened on May 23, 1996 (61 FR 25813). It has been extirpated from 70 percent of its former range. The California red-legged frog is threatened within its remaining range by a wide variety of human impacts, including urban encroachment, construction of reservoirs and water diversions, introduction of exotic predators and competitors, livestock grazing, and habitat fragmentation. A five-year review of the status of this species was initiated in May 2011 (76 FR 30377); however, it was not yet completed at the writing of this document. The California red-legged frog is not included on the State of California's list of rare, threatened, or endangered species, but is included as a covered species under the San Diego MSCP because 70 percent of its potential habitat will be conserved.

A recovery plan for the red-legged frog was approved in 2002, and critical habitat was first designated for this species in March 2001 (66 FR 14626). The Service's critical habitat designation was challenged in court, and a final rule redesignating critical habitat for this species are published in the *Federal Register* in April 2006 (71 FR 19244). After questions were raised about the integrity of scientific information used to develop the 2006 final rule on critical habitat, the Service reviewed the results of the 2006 critical habitat designation and determined that is was necessary to once again review the critical habitat designation for this species. In accordance with a consent decree, the Service on March 17, 2010 published a final rule redesignating critical habitat for the red-legged frog. No portions of the Refuge are designated as critical habitat for the red-legged frog.

Species and Habitat Description

The California red-legged frog, which is the largest native frog in the western United States (Wright and Wright 1949), was referred to as *Rana aurora draytonii* at the time of its listing as a federally threatened species. Today, the accepted taxonomic name for the California red-legged frog is *Rana draytonii*.

This frog is named for its largely red abdomen and hind legs. Its back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Adult red-legged frogs can range from 1.5 to 5.1 inches (4 to 13 centimeters) in length (Stebbins 1985), with adult females attaining a significantly longer body length than males (Hayes and Miyamoto 1984).

These frogs may breed from November through April, with males appearing at breeding sites from two to four weeks before females (Storer 1925). To attract females to breeding sites, males frequently call in small groups of two to seven individuals, although in some instances they may call individually (USFWS 2002c). A pair in amplexus (breeding position) moves to an oviposition site (the location where eggs are laid), and the eggs are fertilized while being attached to a brace such as emergent vegetation (e.g., bulrushes, cattails) or roots and twigs. The egg masses, which contain about 2,000 to 5,000 dark reddish brown eggs measuring about 0.08 to 0.11 inches (2.0 to 2.8 millimeters) (Storer 1925), float on the surface of the water (Hayes and Miyamoto 1984).

Eggs hatch in 6 to 14 days depending on water temperatures, and tadpoles typically require 11 to 20 weeks to develop into terrestrial frogs (USFWS 2002c). Egg predation is infrequent, but egg mortality can occur in higher salinity environments. Most predation occurs during the tadpole stage (Licht 1969). Male red-legged frogs reach sexual maturity at about two years of age, while females reach maturity at about three years of age (Jennings and Hayes 1985). These frogs have a potential life span of 8 to 10 years (Jennings et al. 1992).

The diet of California red-legged frogs is highly variable. The larvae are thought to be algal grazers, while adult frogs forage most commonly on invertebrates. Larger adult frogs may also prey on the Pacific tree frog (*Hyla regilla*) and California mouse (USFWS 2002c).

The California red-legged frog, which is endemic to California and Baja California, Mexico, occupies a combination of habitats, including a variety of aquatic habitats used as breeding sites and ponds, riparian areas, or other aquatic habitats that are used during the rest of the year (Fellers and Kleeman 2007). This frog can be found at elevations that range from sea level to about 5,200 feet (1,500 meters). Nearly all sightings have occurred below 3,500 feet (1,050 meters) (CNDDB 2001). Historically, the California red-legged frog was known in 46 counties in California, with a range that extended from coastal Marin County inland to Shasta County and southward into northwestern Baja California, Mexico (USFWS 2002c). At the time of listing, the taxon had been extirpated from 24 counties in California.

Breeding adults are often associated with deep (greater than two feet [0.7 meter]) still or slow moving water and dense, shrubby riparian or emergent vegetation (Hayes and Jennings 1988), but frogs have also been observed in shallow sections of streams that are not cloaked in riparian vegetation. While frogs successfully breed in streams, high flows and cold temperatures in streams during the spring often make these sites risky environments for eggs and tadpoles. These frogs are also known to breed in artificial impoundments such as stock ponds; however, management of hydroperiod, pond structure, and vegetative cover and control of non-native predators, may be necessary to ensure a persistent population at these sites.

Research on the habitat requirements of this taxon indicate that during periods of wet weather, starting with the first rains of fall, some individuals may make overland excursions through upland habitats. Most of these overland movements occur at night (USFWS 2002c). The manner in which California red-legged frogs use upland habitats is still being researched.

These frogs spend considerable time resting and feeding in riparian vegetation when it is present. It is believed that the moisture and cover of the riparian plant community provide good foraging habitat and may facilitate dispersal in addition to providing pools and backwater aquatic areas for breeding. In the summer, California red-legged frogs may disperse from their breeding habitat to forage and seek summer habitat if water is not available. This summer habitat could include spaces under boulders or rocks and organic debris, such as downed trees or logs, small mammal burrows, moist leaf litter, or large cracks in the bottom of dried ponds (USFWS 2002c). Although not all populations of red-legged frogs disperse into other habitats, recent research indicates that for those populations that do disperse, management and protection of all habitats, including breeding, nonbreeding, and dispersal corridors, as well as the establishment of adequate buffers around these habitats, is necessary to maintain such populations (Fellers and Kleeman 2007).

Status of the Species within the Refuge

The California red-legged frog has been extirpated from San Diego County; therefore, no populations of this species are currently present within the Refuge. Historically, this taxon did occupy portions of the Sweetwater River watershed, including portions of the watershed located within the Otay-Sweetwater Unit of the Refuge. The recovery plan for this species identifies portions of the Sweetwater River within the boundaries of the Refuge as one of the core areas within southern California where recovery actions for this species will be focused (USFWS 2002c). The recovery plan includes this area of the Refuge as an area where restoration of habitat to support the red-legged frog is feasible and pilot reestablishment efforts are most likely to be successful. USGS is investigating reintroducing red-legged frogs to San Diego County, including at a site on the Refuge.

4.3.7 MSCP-Covered Species and Other Special Status Species

4.3.7.1 MSCP-Covered Species

The San Diego MSCP, a comprehensive habitat planning program for about 900 square miles in southwestern San Diego County, provides a framework for both protecting the species and habitat diversity of southwestern San Diego and accommodating urban development within the region. With respect to species and habitat conservation, the intent of the MSCP is to protect interconnected blocks of different vegetation communities and habitat types to maximize protection of the region's most sensitive species. To achieve this goal, a preserve area was defined that would include a range of habitat types interconnected by conserved corridors of native vegetation. The need to consider the habitat requirements of 85 species of plants and animals (City of San Diego 1998a) was essential to the design of the preserve. The lands within the San Diego

NWR are considered part of the overall MSCP-preserved lands system and their acquisition by the Federal government represents the Service's contribution to the implementation of the MSCP.

Local jurisdictions and special districts are responsible for implementing their respective portions of the MSCP through subarea plans, which describe specific implementing mechanisms. The combination of the subregional MSCP Plan and the required subarea plans serves as a multiple species Habitat Conservation Plan pursuant to Section 10(a)(1)(B) of the Federal Endangered Species Act and a Natural Community Conservation Plan (NCCP) pursuant to the California Natural Community Conservation Planning Act of 1991 and the State Endangered Species Act. The subarea plans are intended to contribute collectively to the conservation of the preserve and its connecting corridors and form the basis for the contract, or "Implementing Agreement," between the local jurisdiction/special district and wildlife agencies (the Service and CDFW). The management goals, objectives, and policies included within these subarea plans are also reflected in the management strategies implemented on the San Diego NWR.

The City of San Diego MSCP Subarea Plan established a Multi-Habitat Planning Area (MHPA) that is designed to address the needs of the indicator species described in the MSCP Plan and delineate core biological resource areas and corridors targeted for conservation. The Del Mar Mesa Vernal Pool Unit is located within the City's MHPA (City of San Diego 1997), and the majority of the Otay-Sweetwater Unit is included within the South County Segment of the San Diego County MSCP Subarea Plan.

Of the 85 species covered by the City of San Diego and County of San Diego MSCP Subarea Plans, 56 species (including the 17 federally listed species already addressed in this chapter) have been observed or have the potential to occur within the San Diego NWR (Table 4-7). Quino checkerspot butterfly is a covered species under the Chula Vista MSCP Subarea Plan and as of 2012, the County of San Diego was processing an amendment to the South County MSCP Subarea Plan to add this species to the list of species covered by that Subarea Plan.

Table 4-7[1] San Diego MSCP-covered Species Observed or Expected to Occur within the San Diego NWR			
Common Name	**Scientific Name**	**Habitat**	**Observed or Expected**
Otay manzanita	Arctostaphylos otayensis	Southern mixed chaparral	Observed
Encinitas baccharis	Baccharis vanessae	Southern maritime chaparral	Expected at Del Mar Mesa Unit
Orcutt's brodiaea	Brodiaea orcuttii	Grasslands, vernal pools	Expected
Dunn's mariposa lily	Calochortus dunnii	Southern mixed chaparral, coastal sage scrub	Observed
Wart-stemmed ceanothus	Ceanothus verrucosus	Southern maritime chaparral	Observed
Tecate cypress	Cupressus forbesii	Southern mixed chaparral, closed-cone coniferous forest	Observed
Variegated dudleya	Dudleya variegata	Coastal sage scrub, grassland	Observed
Palmer's ericameria	Ericameria palmeri	Riparian terraces, coastal sage scrub	Observed
San Diego barrel cactus	Ferocactus viridescens	Coastal sage scrub	Observed
Gander's pitcher-sage	*Lepichinia ganderi*	Southern mixed chaparral	Observed
Felt-leaved monardella	*Monardella hypoleuca ssp. lanata*	Chamise chaparral, southern mixed chaparral	Observed
San Diego goldenstar	*Muilla clevelandii*	grasslands	Observed
Dehesa beargrass	*Nolina interrata*	Southern mixed chaparral in gabbro soils	Observed
Snake cholla	*Opuntia parryi var. serpentina*	Coastal sage scrub	Observed
San Miguel savory	*Satureja chandleri*	Southern mixed chaparral	Observed
Gander's butterweed	*Senecio ganderi*	Southern mixed chaparral in gabbro soils	Observed
Narrow-leaved nightshade	*Solanum tenuilobatum*	Coastal sage scrub	Observed
Parry's tetracoccus	*Tetracoccus dioicus*	Southern mixed chaparral	Observed
Thorne's hairstreak	*Callophrys gryneus thornei*	Southern mixed chaparral, closed-cone coniferous forest, within 1 km of Tecate cypress	Observed on nearby Otay Mountain, coextensive with Tecate cypress (Lucas et al. 2013)
Southwestern pond turtle	*Actinemys marmorata pallida*	Rivers, streams, ponds, lakes, and associated uplands	Observed
Orange-throated whiptail	*Cnemidophorus hyperythrusbeldingi*	Coastal sage scrub	Observed
San Diego horned lizard	*Phrynosoma coronatum blainvillei*	Coastal sage scrub, chaparral	Observed
Northern harrier	*Circus cyaneus*	Grasslands, coastal sage scrub	Observed
Cooper's hawk	*Accipiter cooperii*	Oak riparian woodland, cottonwood/willow riparian forest, urban fringe with tall trees	Observed

Table 4-7[1] San Diego MSCP-covered Species Observed or Expected to Occur within the San Diego NWR			
Common Name	**Scientific Name**	**Habitat**	**Observed or Expected**
Swainson's hawk	*Buteo swainsoni*	Grasslands, coastal sage scrub. On the Refuge, primary habitat feature is probably San Miguel Mountain	Observed
Ferruginous hawk	*Buteo regalis*	Grasslands, coastal sage scrub	Observed
Golden eagle	*Aquila chrysaetos*	Chaparral, coastal sage scrub, grasslands, vertical rock outcrops for nesting	Observed
American peregrine falcon	*Falco peregrinus*	Forages over any non-forested area; suitable nesting habitat (tall vertical cliffs) probably does not occur on the Refuge	Observed
Burrowing owl	*Athene cunicularia*	Grasslands, coastal sage scrub	Observed
Cactus wren	*Campylorhynchus bruneicapillus*	Coastal sage scrub including cactus over one meter tall	Observed
Western bluebird	*Sialia mexicana*	Grassland, coastal sage scrub at margins of riparian forest or woodland	Observed
California rufous-crowned sparrow	*Aimophilia ruficeps canescens*	Coastal sage scrub, chaparral	Observed
Tricolored blackbird	*Agelaius tricolor*	Nests in emergent aquatic vegetation in lakes and ponds, forages in grasslands	Expected
American badger	*Taxidea taxus*	Grasslands, coastal sage scrub	Historically observed
Mountain lion	*Felis concolor*	Forests, woodlands, chaparral, coastal sage scrub	Observed
Southern mule deer	*Odocoileus hemionus fuliginata*	Forests, woodlands, chaparral, coastal sage scrub	Observed

[1] MSCP-covered species that are also listed as threatened or endangered species under the Federal ESA are discussed in the section titled Federally and State Listed Endangered and Threatened Species.

4.3.7.2 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 2008d).

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 including the Bird Conservation Regions (BCR) of the United States and Canada, along with 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. The determination of which species are included on the lists for each of these geographic scales was made using assessment scores based on several parameters including population trend, threats, distribution, abundance, and the importance of an area to a species. These assessment scores were developed by Partners in Flight, a coalition of Federal and State government agencies, non-governmental organizations, and private interests out of concern for the sharp declines in many North American landbirds.

Birds of Conservation Concern supported by the San Diego NWR are included in the BCR 32 (Coastal California) List, USFWS Region 8 List, and the National List. Table 4-8 lists the Birds of Conservation Concern that have been observed on the San Diego NWR.

Table 4-8 Birds of Conservation Concern Documented on the San Diego NWR						
Common Name	Scientific Name	Foraging Habitat(s)	Abundance on the Refuge[1]	Included on BCC List		
				BCR 32	Region 8	U.S.[2]
Bald eagle	*Haliaeetus leucocephalus*	Wetlands	Rare (winter)	Yes	Yes	Yes
Swainson's hawk	*Buteo swainsoni*	Uplands	Rare (spring migrant))	No	No	Yes
Peregrine falcon	*Falco peregrinus*	Uplands, wetlands, aerial	Uncommon	Yes	Yes	Yes
Burrowing owl	*Athene cunicularia hypugaea*	Grasslands	Uncommon	Yes	Yes	No
Costa's hummingbird	*Calypte costae*	Coastal sage scrub	Uncommon (spring, summer); Occasional (fall, winter)	Yes	Yes	Yes
Rufous hummingbird	*Selasphorus rufus*	Uplands	Common (spring migrant); Uncommon (fall migrant)	No	No	Yes
Allen's hummingbird	*Selasphorus sasin*	Uplands	Rare (spring migrant)	Yes	Yes	Yes
Calliope hummingbird	*Stellula calliope*	Uplands	Rare (spring migrant)	No	Yes	Yes
Nuttall's woodpecker	*Picoides nuttallii*	Riparian and oak woodlands	Common	No	Yes	Yes
Olive-sided flycatcher	*Contopus cooperi*	Uplands	Occasional (spring, fall migrant)	No	Yes	Yes
Willow flycatcher	*Empidonax traillii*	Wetlands, riparian forest	Occasional (spring, fall migrant); Rare (summer breeder)	No	Yes	Yes
Loggerhead shrike	*Lanius ludovicianus*	Grassland, Coastal sage scrub	Uncommon	Yes	Yes	Yes
Horned lark	*Eremophila alpestris strigata*	Grasslands	Uncommon (spring, summer breeder); Common (fall, winter)	No	No	Yes
Oak titmouse	*Baeolophus inornatus*	Oak Woodlands	Uncommon	Yes	Yes	Yes
Cactus wren	*Campylorhynchus brunneicapillus*	Coastal sage scrub	Uncommon	Yes	Yes	No
Sage thrasher	*Oreoscoptes montanus*	Grassland, Coastal sage scrub	Rare (fall migrant); Occasional (winter)	No	Yes	No
Yellow warbler	*Dendroica petechia brewsteri*	Riparian forest	Common (spring, summer); Occasional (fall); Rare (winter)	Yes	Yes	No
Green-tailed towhee	*Pipilo chlorurus*	Chaparral, Coastal sage scrub	Rare (spring migrant)	No	Yes	No

Table 4-8 Birds of Conservation Concern Documented on the San Diego NWR						
Common Name	Scientific Name	Foraging Habitat(s)	Abundance on the Refuge[1]	Included on BCC List		
				BCR 32	Region 8	U.S.[2]
Brewer's sparrow	*Spizella breweri*	Grassland, Coastal sage scrub	Occasional (fall migrant)	No	Yes	Yes
Black-chinned sparrow	*Spizella atrogularis*	Chaparral	Common (spring, summer); Rare (fall)	Yes	Yes	Yes
Sage sparrow	*Amphispiza belli*	Coastal sage scrub, chamise chaparral	Uncommon	No	Yes	No
Tricolored blackbird	*Agelaius tricolor*	Wetlands	Occasional (fall, winter)	Yes	Yes	Yes
Lawrence's goldfinch	*Carduelis lawrencei*	Grassland, Coastal sage scrub	Uncommon	Yes	Yes	Yes

[1] Present year-round unless otherwise noted. [2] National List

Source: USFWS 2008d

California Department of Fish and Wildlife Special Status Species

CDFW maintains a list a special mammals, birds, reptiles, amphibians, and fish (CDFW 2016a) that are considered to be of greatest conservation need in California. The list includes species, subspecies, or distinct populations of a species native to California that generally fall into one or more of the following criteria:

- Officially listed or proposed for listing under the State and/or Federal ESA;
- 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 2016b). Those plants identified as "Special Plants" represent all the plant taxa inventoried by the Department of Fish and Wildlife's California Natural Diversity Database (CNDDB), regardless of their legal or protection status. Special plant taxa, which can include vascular plants, high priority bryophytes (e.g., mosses, liverworts, hornworts), and lichens, are species, subspecies, or varieties that fall into one or more of the following 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 that meet the criteria for listing, even if not currently included on any list, per the California Environmental Quality Act Guidelines;

4) BLM, USFWS, or U.S. Forest Service Sensitive Species;
5) taxa listed in the CNPS'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 that is declining in California at a significant rate.

Presented in Table 4-9 are plant and animal species, identified as Special Species by CDFW that have been observed on the Refuge or have the potential to occur on the Refuge based on their habitat needs and historic distribution.

Table 4-9
California Special Species Observed or with the Potential to Occur on the San Diego NWR[1]

Scientific Name	Common Name
INSECTS	
Cicindela senilis frosti	senile tiger beetle
REPTILES	
Anniella pulchra pulchra	silvery legless lizard
Aspidoscelis hyperythra	orange-throated whiptail
Phrynosoma coronatum blainvillii	coast (San Diego) horned lizard
BIRDS	
Agelaius tricolor	tricolored blackbird
Asio flammeus	short-eared owl
Athene cunicularia	burrowing owl
Aythya americana	redhead
Circus cyaneus	northern harrier
Cistothorus palustris clarkae	Clark's marsh wren
Dendroica petechia	yellow warbler
Lanius ludovicianus	loggerhead shrike
Passerculus sandwichensis rostratus	large-billed savannah sparrow
Pelecanus erythrorynchos	American white pelican
Xanthocephalus xanthocephalus	yellow-headed blackbird
MAMMALS	
Lepus californicus bennettii	San Diego black-tailed jackrabbit
PLANTS	
Atriplex coulteri	Coulter's saltbush
Atriplex serenana var. davidsonii	Davidson's saltscale
Camissonia lewisii	Lewis' evening primrose
Centromadia parryi australis	southern tarplant
Lasthenia glabrata coulteri	Coulter's goldfields
Quercus dumosa	Nuttall's scrub oak

[1] Species previously listed in Table 4-6, 4-7, or 4-8 are not repeated here. Source: CDFW 2016a, 2016b

4.4 Cultural Resources

4.4.1 Introduction

Requirements for Federal agencies to identify, evaluate, and protect cultural resources are outlined in several Federal regulations (described further in Chapter 5 of this document), including the National Historic Preservation Act (NHPA) of 1966, as amended (PL 89-665; 50 STAT 915; 16 USC 470 et seq. 36 CFR 800). The NHPA sets inventory, nomination, protection, and preservation responsibilities for federally-owned cultural properties and directs Federal agencies to take into account the effects of their actions on items or sites listed or eligible for listing in the National Register of Historic Places (NRHP). The criteria used to evaluate eligibility to the NRHP, as contained in 36 CFR 60.4, includes, 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. A historical property must also retain the integrity of its physical identity that existed during the resource's period of significance. Integrity is evaluated with regard to the retention of location, design, setting, materials, workmanship, feeling, and association.

In accordance with the applicable cultural resource regulations, a preliminary overview of cultural resources within the San Diego NWR was prepared in 2010. This overview was prepared to assemble known information about the cultural resources located within and near the Refuge, 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. This document is retained at the San Diego NWR Complex office and at the the USFWS Region 8 Cultural Resources Team office.

The federally recognized tribes in San Diego County were initially contacted about the CCP process for the San Diego NWR in June 2006. At that time, comments regarding the process and any concerns related to tribal interests were solicited. No responses from the tribes were received, including any comments regarding traditional uses or the potential existence of sacred sites. All federally recognized tribes have also received Planning Updates that provided information to keep interested parties updated on the progress of the CCP. In 2010, Refuge staff met with representatives of the Sycuan Band of the Kumeyaay Nation to review the CCP process and discuss potential management alternatives. Discussions with the Sycuan Band of the Kumeyaay Nation and the Kumeyaay-Diegueño Land Conservancy are ongoing regarding potential access onto the Refuge through lands they manage. Refuge staff looks forward to a continuing relationship with the Sycuan Band, other tribes, and various Kumeyaay organizations in ensuring the protection of cultural resources on Refuge lands.

4.4.2 Cultural Context

No single classification has been agreed upon for the different periods of prehistory and history. Over time, researchers have used different terms to describe what they view as distinct periods in the overall cultural context of San Diego County, but the cultural background of San Diego County continues to evolve as new information becomes available. In consultation with the Kumeyaay Nation, they provide an alternate view and do not recognize this separation of time, but rather view San Diego's cultural context as a continuum in which the Kumeyaay people have been here since time began.

Early Native American History

The following presentation of Native American history in the region is based on our current understanding of the archaeological record. More information about the Kumeyaay perspective, their history, and management of the land is provided in Shipek (1987), Blackburn and Anderson (1993), Shackley (2004), Anderson (2005), Miskwish (2007), and Carrico (2008).

The earliest recognized period of California prehistory is referred to as Paleo-Indian. In the San Diego region, this period is usually considered to date from at least 10,000 years before present until 8,500 to 7,200 years before present (Comeau et al. 2014). The sites that have been documented from this period are identified as belonging to the San Dieguito Complex (Rogers 1938, 1939, 1945). Well-made scraper planes, choppers, scraping tools, crescentics, elongated bifacial knives, and leaf-shaped points, suggest an emphasis on hunting (Warren et al. 1993).

The period beginning at least 7,200 years ago, possibly as early as 9,000 years before present is referred to as the Archaic Period, and is considered to have lasted until about 2,000 years ago (Comeau et al. 2014). Sites from this time are identified by some as belonging to the La Jolla Complex. This cultural tradition appears to have two distinct subdivisions in Southern California. The first, found along the coastal areas of Southern California, had an economy that relied largely on gathering wild resources, such as shellfish and seeds, along the coast; farther inland, hunting and gathering techniques were replaced with horticultural and agricultural techniques (Comeau et al. 2014). During this phase, a reliance on seed and nut resources is suggested by the presence of grinding implements such as manos and metates. Coastal sites from this period are frequently characterized by large deposits of marine shell (True 1980) and fire hearths (Comeau et al. 2014).

The Late Archaic, also referred to as the Late Prehistoric Period, is defined as approximately 2,000 years before present to Spanish contact (1769). This period is characterized by higher population densities and elaborations in social, political, and technological systems. Economic systems diversify and intensify during this period, with the continued elaboration of trade networks, the use of shell-bead currency, and the appearance of more labor-intensive, but effective, technological innovations. This period is recognized archaeologically by small pressure-flaked projectile points and the use of mortars and pestles for grinding seeds and acorns. Archaeological evidence indicates that the manufacture and use of ceramic vessels for cooking, storage, and other applications. Tizon Brownware pottery, ceramic figurines reminiscent of Hohokam styles, ceramic "Yuman bow pipes," ceramic rattles, miniature pottery, various cobble-based tools (e.g., scrapers, choppers, hammerstones), and bone awls all characterize this period.

4.4.3 Ethnohistory

At the time of European contact, a fairly large, stable population of Kumeyaay (also known as Kamia, Ipai, Tipai, and Diegueño) people occupied the region of what is now Southern California. The Kumeyaay lived in semi-sedentary, politically autonomous villages or rancherias. A settlement system typically consisted of two or more seasonal villages with temporary camps radiating away from these central places (Cline 1984). A wide range of tools was made of locally available and imported materials. Acorns were an important food source for the Kumeyaay, along with upland game in the hills and fish and shellfish in coastal areas.

A wide range of tools was made of locally available and imported materials. Preferred stone types were locally available metavolcanics, cherts, and quartz. Obsidian was imported from the deserts to the north and east. Fine baskets were produced and pottery was made using the paddle-and-anvil technique. Most were a plain brown utility ware called Tizon Brownware, while others were decorated (May 1978; Meighan 1954; Spier 1923).

The manner in which the lands within the Refuge were used by the Kumeyaay people can be inferred from artifact and feature characteristics and how the various plants and animal resources were used is provided in ethnographic accounts. Based on the information available, uses on the land within the Refuge included processing sites, short-term field camps, and long-term habitation areas or villages (Zepeda-Herman 2010).

4.4.4 Euro-American History

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

Spanish colonists settled in San Diego in A.D. 1769, when the Mission San Diego de Alcalá and Presidio de San Diego were founded. Historical records from the Spanish Period indicate that missionary contact with the native inhabitants of the Jamacha Valley (portions of which are now located within the present day Refuge) first occurred in 1775 at the village of Jamacha (Van Wormer 1984). It was during this time that the Mission San Diego de Alcalá claimed ownership of the Jamacha Valley. The economy of the Spanish settlers was based on cattle grazing. Missions were major population centers, and mission cattle roamed freely over open range.

European contact substantially and pervasively stressed the social, political, and economic fabric of the Kumeyaay culture (Shipek 1986, Shipek 1991), and disease, starvation, and a general institutional collapse caused emigration, birth rate declines, and high adult and infant mortality levels among the Kumeyaay people in San Diego County (Shipek 1991).

The citizens of Mexico began to revolt against the Spanish colonial authorities, and after more than a decade of conflict, Mexico gained independence from Spain in 1821. The Mexican government secularized the missions in 1834 and opened vast tracts of former mission lands for private use and settlement.

Doña Apolinaria Lorenzana lived at Mission San Diego de Alcalá from the time she was 12 years old. Because of her devotion to the church, the missionaries in 1840 made it possible for her to receive a grant for 8,881 acres of land located almost entirely within the Jamacha Valley. This land grant included portions of the Sweetwater River, Steele Canyon, and the lower western slopes of San Miguel Mountain, areas that are now located within the Refuge. According to historical records, Doña Apolinaria first occupied the Jamacha Valley in 1831, when the land was still under the control of the mission. Various improvements were made to the land after 1840, including construction of a house, corral, and lime kiln on the west side of the valley (Van Wormer 1984). Wheat and corn were planted in the valley to the east of the Sweetwater River, and other areas were set aside for grazing by sheep and goats (Van Wormer n.d.).

In 1848, Mexico ceded California to the United States after the Mexican–American War of 1846–1848. California became a state in 1850. American settlement in southern California was slow during the Gold Rush, when northern California experienced a dramatic population explosion (Rolle 1998). Due to the population increase in northern California, livestock prices increased, causing ranches in southern California to prosper. Rancho Jamacha, where the Second Infantry grazed livestock in the early 1850s, was purchased from Doña Apolinaria in 1853. The land soon became the property of four partners who used a portion of it to grow wheat, barley, oats, rye, and vegetables. In addition, they raised sheep, horses, cattle, mules, and hogs. This ranch is credited as being the first successful large-scale agricultural enterprise in San Diego County (Van Wormer 1984). However, by 1860, ranching was no longer a profitable business and operations at Rancho Jamacha ended.

By the late 1800s, the county witnessed the beginnings of a recognizable downtown San Diego area and the gradual development of a number of outlying communities such as the Jamacha Valley, many of which were established around previously defined ranchos and land grants. These communities were composed of an aggregate of people who lived on scattered farmsteads tied together through a common school district, church, post office, and country store (Hector and Van Wormer 1986, Pourade 1963). In 1980, Caltrans conducted an investigation of the area in and around Jamacha Road and Highway 94 for the presence of the Jamacha Adobe built by Doña Apolinaria Lorenzana; however, no evidence of the adobe was found (Mooney-Levine and Associates 1987).

Cultural resource surveys of the areas to the west of Mother Miguel Mountain on the San Miguel Mountain portion of the Otay-Sweetwater Unit have identified evidence of historic ranching and farming activity dating back to the early 1900s. Evidence of historic ranching activities is also present further to the east within the Las Montañas portion of the Otay-Sweetwater Unit. Land ownership searches for the site referred to as the "Barn at the Oaks" indicated that a ranch operated at this site between 1893 and 1928. Between 1928 and 1957, the barn and other structures around the barn were used for the Oaks School for Boys (Dudek & Associates 1996).

Extensive farming activity also occurred in the Jamacha Valley from the early 1900s through the 1940s. Crops included olives, oranges, grapes, walnuts, alfalfa, hay, melons, and a variety of vegetables (Van Wormer n.d.). Dairy and poultry farms were also present in the valley. This area began as relatively small farms, but by the 1940s, much of the land was sold to corporate interests. After World War II, the agricultural uses in portions of the Jamacha Valley were gradually replaced with residential development and golf courses. Van Wormer states, "By the late 1960s, the post-war population boom began to affect the Jamacha Valley."

A map of historic roads and trails in San Diego County between 1769 and 1885 (San Diego County Assessor 1955) indicates that the general alignment of present day Highway 94 (Campo Road) through Steele Canyon was the route of one or more stage lines between 1865 and 1885. This may also have been the route of Charles Wesley Grise's "Limited San Diego Imperial Valley Stage" that transported customers from San Diego to the Imperial Valley via a Cadillac touring car from 1911 to 1914 (Reider n.d.). Other roads were constructed on Refuge lands to access springs, mining sites, and ranching and farming areas. No roads conveyed under RS 2477 have been identified on Refuge lands.

In 1886, the San Diego Land and Town Company, a subsidiary of the Santa Fe Railroad, began construction of the Sweetwater Dam, which—when completed—would provide water to National City and new subdivisions in Chula Vista. Completed in March of 1888, the 90-foot-high dam was said to be the highest in the United States (Pourade 1964). During the 1890s, visitors from San Diego would board the National City and Otay Railroad traveling to the end of the line near the Sweetwater Dam and then take a burro or horse ride to the top of San Miguel Mountain. In 1890, there were proposals to construct an observatory and grand hotel on San Miguel Mountain, but the proposal never materialized (Brian F. Smith and Associates 1997). Lower Otay Dam was constructed in 1897.

Evidence of historic mining operations is also present on the Refuge, with most of this activity occurring on or in the vicinity of San Miguel and McGinty Mountains. Several shafts cut deep into the bedrock have been found on San Miguel Mountain, but information regarding the specific materials that were mined here is not available. McGinty Mountain is the site of Peg Leg Mine, also referred to on the Assessor Parcel Map as Cosmos Lode Mine. The material mined at this site was silicified alaskite aplite, which was used by the American Encaustic Tiling Company (known as the West Coast Tile Company prior to 1920) to manufacture a hard white tile known as "Kaospar" (County of San Diego 1963). The brand name "Kaospar" porcelain ware was originally used by California China Products Company of National City, which was known nationally for its design and firing of brilliant, polychromatic Hispano–Mooresque-style faience tile (Bevil 1999). In 1917, the California China Products Company was sold to West Coast Tile Company of Vernon, California, which was sold two years later to the American Encaustic Tiling Company of Zanesville, Ohio.

During the time that California China Products Company was manufacturing porcelain ware and tiles, they found that the primary source of material for producing their porcelain, El Cajon Mountain, was of inferior quality. As a result, they placed advertisements in local newspapers requesting that prospectors send clay samples to the company's laboratory for free testing (Bevil 1999). The silicified alaskite aplite deposit on McGinty Mountain was discovered in 1900 and operated until the early 1930s. This deposit was most actively mined during the 1920s. Based on the size of the excavations, it has been estimated that total production from this mine was approximately 6,500 to 7,000 tons. The rock was hauled by truck to El Cajon and then by train to the Los Angeles area (County of San Diego 1963). It is possible that prospecting for and extraction of manufacturing grade clays occurred elsewhere on the Refuge.

The Del Mar Mesa area was likely used to graze cattle and sheep during the 1800s and early 1900s when Rancho los Peñasquitos, which was located immediately to the south of the present day Del Mar Mesa Preserve, was an active cattle ranch in the 1800s and early 1900s. Public and private actions to ensure the preservation of the vernal pool habitat on Del Mar Mesa began in the early 1980s.

4.4.5 Cultural Resources Investigations and Research

As part of the cultural resources review, a record search prepared by the California Historical Resources Information System South Coastal Information Center (SCIC) in 1995 was updated in 2010. The 1995 record search included information about sites and past investigations, while the 2010 update only included site records and digital site boundaries for site located within the Refuge. According to the 1995 results from SCIC, there have been numerous cultural resource investigations within and adjacent to the Refuge. However, this information was not updated as part of the 2010 record search update. It is possible that additional investigations could have been conducted on Refuge parcels acquired after 1995.

The SCIC record search identified 151 prehistoric sites, 28 prehistoric isolates, 26 historic sites, and six multi-component sites within the San Diego NWR. The majority of sites contain lithic (stone) artifacts and/or debitage (stone flakes generated during the crafting of stone tools). Of the 211 sites, only about one-fourth of the sites have been evaluated for California Environmental Quality Act (CEQA) significance, and five have been evaluated for eligibility for listing on the National Register of Historic Places (NRHP). Record searches have not been conducted by the Service for those parcels obtained after 2010, including the Hidden Valley parcels.

4.4.5.1 Excavations

Fifty sites identified on the Refuge in the past have been evaluated for cultural significance, with 47 of them evaluated through excavations. One additional site (CA-SDI-14342) may also have been excavated, but there are discrepancies in the information available about this site. Further investigation is therefore required if any future actions could affect this site. Two of the 50 sites are historic sites, which are discussed in detail in this section.

Of the 50 sites that have been evaluated, five have been evaluated for listing on the NRHP and the other 45 have been evaluated for significance under CEQA criteria. Three of the 50 evaluated sites were not excavated, but a significance determination was made based on surface deposits. Data recovery excavations were completed at three of the 47 excavated and evaluated sites. Twenty-seven of the evaluated sites were determined not significant under CEQA, one site has been mitigated through excavation, 15 sites were determined significant under CEQA (one of these [SDI-12085H] was based on surface deposits), three sites were determined not eligible for listing on the NRHP, and four sites have an unknown status based on the current information and may require further investigation in the future.

The three sites (CA-SDI-186, -4757, and -4765) addressed through a data recovery program are located within the Sweetwater River area of the Refuge. These sites were determined to be significant under CEQA during earlier investigations (Berryman 1981, Berryman and Berryman 1987) conducted in association with a development proposal by a prior landowner. Mitigation for potential impacts to these sites, which was conducted in the 1990s, involved data recovery intended to further the understanding of the prehistory of the Jamacha/Sweetwater River Valley (Byrd and Serr 1993).

The data recovery of these three sites, as well as one other site located outside the Refuge boundary, was conducted in two phases. Phase I consisted of plotted surface artifacts, collecting diagnostic surface artifacts, and excavating a series of shovel test pits and units to obtain a representative data sample. During Phase II, additional units and mechanical trenches were excavated to increase data recovery rates and to attempt to find subsurface features. The results of the data recovery effort indicated that these sites were short term or seasonal base camps where tools were manufactured and plants and animals were prepared and consumed utilizing bedrock milling techniques. Temporally diagnostic and radiocarbon dates indicated that the three sites were occupied during the Archaic and Late Prehistoric Periods. Data from the sites indicate that the sites were repeatedly revisited over both time periods with no apparent period of abandonment (Byrd and Serr 1993).

Of the 50 sites evaluated on the Refuge, 31 sites were evaluated in 1991 and 1997 as part of the Rancho San Miguel Subdivision Project Sectional Planning Area Plan. These sites are located within the San Miguel Mountain and Sweetwater River areas of the Refuge. Twenty of the 31 sites were found not significant. The other 11 sites were found significant under the criteria in the California Register of Historical Resources but were not evaluated for eligibility to the NRHP. Test excavations consisted of units and shovel test pits at 28 sites. Excavations were not required to make significance determinations for the other three sites. CA-SDI-12085H, a historic site that was not excavated, was considered significant based on the potential for subsurface historic artifacts and features and its historic context as a dairy farm complex; however, the existing structures at this site were not considered significant (Brian F. Smith and Associates 1997).

In 1999, two of the historic sites in this area (CA-SDI-12056H and CA-SDI-12085H) were evaluated for eligibility for listing on the NRHP by a Service historian (Speulda 1999). A ranch and dairy farm complex, recorded as CA-SDI-12056H, was located on a narrow ridge along the western flank of Mother Miguel Mountain overlooking the Sweetwater Reservoir. The six structures of CA-SDI-12056H were constructed between 1930s and 1950s. This site was found to be ineligible (Speulda 1999), and the structures were subsequently demolished.

Down slope of the San Miguel Ranch complex (CA-SDI-12056H) is an abandoned building and foundations of a farm complex, recorded as CA-SDI-12085H. The one remaining building at this site was evaluated for eligibility to the NRHP in 1999. At that time, the building was considered so deteriorated that it no longer conveyed a link to the historic period in which it was built. Due to the lack of integrity of materials, the building was not considered eligible to the NRHP (Speulda 1999).

Three sites (CA-SDI-12823, -12824, and -12825) were evaluated for eligibility for listing on the NRHP as part of the Rancho San Diego Equestrian Center project (Glenn 1995). None of these sites were determined eligible for listing on the National Register. Other sites within the Refuge boundary have undergone evaluation as part of the CEQA process, but none of these sites have been evaluated for eligibility for listing on the NRHP.

4.4.5.2 Historic Sites Investigations

There are no known comprehensive historic site investigations that have been completed within the San Diego NWR. As previously addressed, two historic sites in the San Miguel Mountain area were evaluated for eligibility to the NRHP in 1999. Another historic structure, the Barn at the Oaks (CA-SDI-7928H), was researched as part of Las Montañas Resort and Country Club project. The Barn at the Oaks was determined potentially significant for its architectural style reminiscent of Dutch Revival hay barns of the Midwest and for its association as part of the Oaks School for Boys. As a result of this research, this site was added to the San Diego County Historic Property Listing (Number 021), but it is not listed on the NRHP. The exact date of the barn's construction is not known, but a 1937 lease specifically mentioned the presence of a barn on the property (Chace 1985). The Service implemented actions to stabilize this structure in 2008.

4.4.6 Sacred Sites

A record search of the California Native American Heritage Commission Sacred Land Files was conducted in 2010 by the Service in association with the CCP process. The response, dated March 16, 2010, found Native American cultural resources identified in the Jamul Mountains, Alpine, and Otay Mesa quadrangles. Early consultation with Native American tribes was recommended in order to avoid unanticipated discoveries.

4.4.7 Information Gaps

The Cultural Resources Review conducted for the Refuge identified several information gaps with respect to cultural resources. These include the lack of surveys boundaries and acreages for investigations completed on the Refuge after 1995; no evaluation of NRHP eligibility status for various sites within the Refuge; and incomplete information regarding the extent of buildings/structures on the Refuge. Because it is unclear how much of the Refuge has been surveyed and what areas still need to be surveyed, it must be assumed that there are numerous unrecorded sites located within the Refuge. (This is particularly true for parcels obtained after 2010.) Additionally, some previously surveyed areas may need an updated survey to assess current conditions and determine if any changes have occurred to the sites since last visited.

4.5 Social and Economic Environment

Elements of the social and economic environment include land use, public safety, traffic circulation, public utilities and easements; public access and recreational opportunities, vectors, economics and employment; and environmental justice.

4.5.1 Land Use

The San Diego NWR consists of six distinct areas, five within the Otay-Sweetwater Unit and a small grouping of parcels that represent the Del Mar Mesa Vernal Pool Unit. All of these areas are located within southwestern San Diego County, the most highly populated portion of the county. The Del Mar Mesa Vernal Pool Unit is situated within a larger open space preserve, the Del Mar Mesa Preserve, which includes conserved lands owned by various agencies. Protected within the Del Mar Mesa Preserve are sensitive and depleted vegetation communities and species unique to the San Diego region. The primary manager of these lands is the City of San Diego, which manages the area consistent with the Del Mar Mesa Preserve Resource Management Plan, adopted by the San Diego City Council in 2015.

The parcels within the Otay-Sweetwater Unit are located at the edges of urban development. To the north and west are developed lands within the unincorporated areas of San Diego County. The northern portion of the McGinty Mountain area is included within the county's Crest-Dehesa Community Plan area, while the southern end of the McGinty Mountain area, all of the Las Montañas and current areas within the Otay Mesa and Lakes areas, and a portion of the San Miguel Mountain area are located within the county's Jamul-Dulzura Subregional Plan area. The Sweetwater River area occurs primarily within the county's Valle De Oro Community Plan area, with the Jamacha parcel and the southwestern areas of San Miguel Mountain the located within the Spring Valley Community Plan area. The southernmost parcels in the San Miguel Mountain area are located adjacent to residential development in the City of Chula Vista.

4.5.1.1 Current Uses on the Refuge

The San Diego NWR is managed in accordance with the laws and policies of the NWRS and consistent with applicable guidance provided in the San Diego MSCP (City of San Diego 1998a). Management actions are directed at preserving, managing, and, when necessary, restoring habitat to support a range of listed and sensitive species. In addition, a significant amount of time is spent managing an array of issues related to trail use, illegal encampments, dumping, dogs on the Refuge, encroachment onto Refuge lands by adjacent landowners, land acquisition from willing sellers, and coordination with agencies and organizations, including those managing lands adjacent to the Refuge.

The primary use of the Refuge is as habitat to support native species, particularly listed and sensitive species. Other currently authorized uses and facilities on the Refuge are:

- hiking, mountain biking, and horseback riding on the County of San Diego's Sweetwater River Trail and Par Four Trail;
- guided hikes to support wildlife observation, interpretation, and environmental education;
- opportunities for wildlife photography;
- scientific research conducted in accordance with Refuge-approved special use permits;
- a trailhead and parking area on Jamul Drive that provides access to McGinty Mountain;
- a large metal storage building referred to as the Rice Barn off of Millar Ranch Road;
- a small metal storage building at the old San Miguel Ranch site;
- utility easements/utility maintenance roads that provide access for Refuge management;

- a portion of Millar Ranch Road that provides access for the Refuge, as well as for a number of private residences located at the base of San Miguel Mountain; and
- an access road in the Otay Lakes and Mesa area that is used by Refuge staff, BLM staff, and the Department of Homeland Security.

Currently, the Refuge offices, maintenance, and primary storage facilities are located off the Refuge on land owned and managed by CDFW. Completion of this CCP is intended, in part, to further refine, identify, and constrain authorized uses. Current uses that are not authorized include hunting, fishing, encampments, dumping, shooting, off-roading, falconry, running, woodcutting, dog training, insect collecting, glass-breaking, smoking, rock-painting, horticulture, paintball shooting, filmmaking, model-aircraft flying, and monument-building.

Opportunities to access the Refuge from adjacent public roads are limited, and only one formal parking area is provided on the Refuge. Other parking opportunities are available at the Steele Canyon Bridge off Highway 94 near Singer Land and at Sweetwater Summit Park. Both of these trail parking areas are maintained by the County of San Diego. The public also parks on public streets, such as Par Four Drive or Sloane Canyon Road, to access trails. Others enter the Refuge via unauthorized routes (e.g., through private property).

In 2010, we estimated that at least 16,000 people visited the Refuge based on a small study conducted near the old steel bridge. We expect that visitation is closer to 22,000 annually. In addition to those who visit the Refuge to use the trail system for wildlife-dependent recreational uses, exercise, and/or an escape from the surrounding urban setting, in fiscal year 2011, 420 volunteers (320 adults and 100 children), participated in 18 community outreach events, including four volunteer work days, five interpretive hikes, three events that combined interpretation and volunteer projects, one children's nature art/Refuge birthday event, and one Refuge volunteer recognition event.

4.5.1.2 Surrounding Land Uses

The majority of the lands surrounding the Refuge are either preserved lands, developed lands supporting residential and commercial uses, or lands proposed for development within the County or City of San Diego General Plans. In the Otay-Sweetwater Unit, the land uses in the vicinity of McGinty Mountain include residential development and lands conserved by either CDFW or the Kumeyaay-Diegueño Land Conservancy to the north, east, and west. Developed and undeveloped tribal lands are present to the north and east. To the south are conserved lands, a golf course, and residential development. There are also privately-owned undeveloped parcels in the general area.

The Las Montañas area is surrounded by residential development, privately-owned undeveloped parcels, and an area owned the Bureau of Land Management. Land uses in the vicinity of Par 4 include residential development and undeveloped lands to the east; golf course, commercial development, and residential uses to the north; commericial development and multi-family residential development to the west, and a high school and equestrian center to the south. To the west of the Sweetwater River area are the urbanized communities of Spring Valley and La Presa, with a combination of residential and industrial development. There small areas of residential development to the west.

The San Miguel Mountain area is bordered to the south by residential development, active parkland, a golf course, and an electrical substation. To the west is the Sweetwater Reservoir managed by the Sweetwater Authority. To the north are some residential areas, but primarily more Refuge land. To the west is Proctor Valley, which includes conserved lands, some existing residential development, and a large area referred to as Otay Ranch. This area is proposed for future development as part of the Otay Ranch General Development Plan. Some of the Otay Ranch parcels are proposed to become part of the Refuge in the future. At that time, amendments the CCP will be made to address specific management recommendations for these parcels.

The land uses proposed in the City of San Diego General Plan for areas around the Del Mar Mesa Vernal Pool Unit include several new developments that will border Refuge land to the east of the Del Mar Mesa Preserve.

The land uses proposed in the County of San Diego General Plan for the lands surrounding the Otay-Sweetwater Unit are consistent with the existing development that surrounds the Refuge. For those areas located adjacent to the Refuge that are currently undeveloped, the County General Plan Update designates much of the remaining undeveloped private lands as rural residential development with a density of one unit per 20 gross acres. The rural residential designation is intended to reflect and preserve the rural agricultural, environmentally constrained, and natural backcountry areas of the county. A few areas in the vicinity of the Jamul Mountains are designated as a specific plan area and some parcels to the southeast of the San Miguel Mountain area are designated semi-rural residential, permitting residential development at a density of 1 unit per 10 or 20 gross acres, depending upon the steepness of the slope on the parcel.

4.5.2 Recreational Opportunities

4.5.2.1 Trails

Some of the existing trails or pathways and interior roads on the Refuge have been used by the public for horseback riding, hiking, and mountain biking for many years. Other pathways have been created since the Harris Fire in 2007. The majority of these trails, dirt roads, and user-created pathways have not been formally accepted as Refuge trails and many do not meet accepted sustainability standards.

Two trails located on the Refuge have been officially approved and been evaluated through the NEPA process. These include the Sweetwater River Trail, a segment of the County of San Diego's Regional Trail System, and the Par Four Trail, located in the northern portion of the Sweetwater River management area. The Sweetwater River Trail, when fully constructed by the County, will connect the coast, near the Sweetwater Marsh Unit of the San Diego Bay NWR to the California Riding and Hiking Trail, which provides access to the deserts in eastern San Diego County. The Sweetwater River Trail currently extends through or adjacent to the Refuge from just north of Sweetwater Summit Park to Highway 94; from that point, the alignment switches to the west side of the Sweetwater River adjacent to existing commercial development and currently ends near the corner of Jamacha Road and Willow Glen Drive. The County proposes no other regional trails within current Refuge lands.

Many of the preserved lands that surround the Refuge also provide trails for public use, although some agencies, such as CDFW, restrict trail use to hiking only. Other opportunities for multiple use trail activities are provided within the various open space parks that extend through the county, including the Tijuana River Valley, Otay Valley Regional Park, San Diego River Park, San Dieguito River Park, Los Peñasquitos Canyon Preserve, and Mission Trails Regional Park. San Diego County identifies on their county trails website (http://www.sdcounty.ca.gov/parks/hikes.html) the trail system in San Diego County as "one of the most diverse trail systems in the nation." Recreational opportunities are also available on nearby BLM lands, including the Otay Mountain Wilderness (mountain bikes are not permitted in wilderness areas, but hiking and equestrian uses are permitted).

4.5.2.2 Hunting and Fishing

The Refuge is not currently open for hunting or fishing, although some illegal fishing activity (for non-native fish species; no native fish are present on the Refuge) is occurring along portions of the Sweetwater River. There are, however, several opportunities for hunting and fishing in the general vicinity of the Refuge, including the Otay Mountain Wilderness, where hunting, fishing, and non-commercial trapping are allowed under State and local laws. Other hunting areas include the Hollenbeck Canyon Wildlife Area, where pheasant and quail hunting is permitted per State regulations; Boden Canyon Ecological Reserve, where upland game hunting is permitted in accordance with the general hunting regulations and at such times and in specific areas as designated by CDFW; and the San Felipe Valley Wildlife Area, where deer and quail hunting area permitted in accordance with State regulations. The Cleveland National Forest is open to hunting of certain bird and game species, including deer, in accordance with the current season schedule and hunting regulations set by CDFW. Deer hunting is also permitted on some BLM lands located in eastern and northeast San Diego County.

Locally, Barrett Reservoir is open by reservation for waterfowl hunting on Wednesdays and Saturdays throughout the season established for the southern California zone, and turkey hunting is offered at Sutherland Reservoir on a Monday, Wednesday, and Saturday schedule for the fall season (November) and the spring season (end of March to beginning of May). In past years, San Diego County has conducted a youth turkey hunt at the Santa Ysabel East Open Space Preserve.

San Diego is considered a world-class spot for bass fishing, with a number of reservoirs available for fishing at various times of the year. Near the Refuge, shoreline fishing is allowed along a 2.5-mile stretch on the south side of Sweetwater Reservoir and along a 5-mile portion of the Loveland Reservoir shoreline. At Lower Otay Reservoir, fishing is permitted from boats, float tubes, waders, or the shoreline. At the Upper Otay Reservoir and Barrett Reservoir fishing is only permitted on a catch and release (zero kill) basis.

4.5.3 Traffic Circulation and Parking

Traveling to the Refuge can require use of regional transportation corridors (freeways), as well as various surface streets. In addition, activities associated with the Refuge, such as wildlife observation, trail use, and general refuge operations, involve the need for some off- and/or on-street parking for visitors who opt to use motor vehicles to get to the Refuge. Information regarding current and future traffic volumes and parking availability is provided to facilitate the evaluation of how changes in current uses and activities on the Refuge could affect traffic circulation and parking near the Refuge.

4.5.3.1 Traffic Circulation

The current vehicle trips generated as a result of refuge-related management and public use activities are estimated at less than 100 trips per day, with fewer trips generated during the work week. This is based on an estimated 22,000 visitors per year and an estimate of the number of employee and volunteer trips generated on a weekly basis. All of these trips are accommodated by a series of local streets located around the perimeter of the six Refuge areas, as well as Highway 94 to the west of the Otay-Sweetwater Unit and Highway 56 near the Del Mar Mesa Vernal Pool Unit.

The number of trips currently generated by the Refuge is considered inconsequential to the overall traffic flow within this portion of the county.

Table 4-10 presents current street classifications, design capacity at Level of Service (LOS) C, and current average daily traffic volumes (ADT) for those streets that provide access to the Refuge.

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

Table 4-10
Existing Traffic Volumes and Street Capacities in the Vicinity of the Refuge

Street Segment	Classification	Capacity (thousands)	ADT[3] (thousands)
McGinty Mountain Area			
Willow Glen Drive, between Jamacha Road and Steele Canyon Road	Major Road	30.8[1]	20.7
Willow Glen Drive, between Steele Canyon Road and Hillsdale Road	Major Road	30.8[1]	8.5
Willow Glen Drive, between Dehesa Road and Hillsdale Road	Community Collector	10.9[1]	6.4
Dehesa Road, between Willow Glen Drive and Sloane Canyon Road	Major Road	13.5[1]	13.2
Sloane Canyon Road	Local Public Road (single lane, unpaved road near the Refuge)	1.5[1]	no data
Model A Ford Lane	Private Road	no data	no data
Jamul Drive, between Steele Canyon Road and Lyons Valley Road	Light Collector (2 lanes)	10.9[1]	5.9
Las Montañas Area			
Highway 94 (Campo Road), between Steele Canyon Road and Vista Sage Lane	Major Road (2 lanes)	13.5[1]	18.2[4]
Vista Sage Lane	Local Private Road	no data	no data
Sweetwater River Area			
Highway 94 (Campo Road), between Jamacha Road and Steele Canyon Road	Major Road (2 lanes)	15	17.5[4]
Millar Ranch Road	Local Private Road (2 lanes)	no data	no data
Singer Lane (cul-de-sac)	Local Public Road	0.2[1]	no data
San Miguel Mountain Area			
Jamacha Boulevard, between Sweetwater Springs Boulevard to Highway 94(Campo Road)	Major Road (4 lanes)	33.4[1]	16.9
San Miguel Road, between Bonita Road and Proctor Valley Road	Local Public Road	8.7[1]	8.3
Proctor Valley Road, between Hunte Parkway and Melody Road	Light Collector (2 lanes)	1.5[1]	0.8

Table 4-10 Existing Traffic Volumes and Street Capacities in the Vicinity of the Refuge			
Street Segment	**Classification**	**Capacity (thousands)**	**ADT[3] (thousands)**
Otay Mesa and Lakes Area			
Otay Lakes Road, Chula Vista City Limits	Major Road to Village 13, Community Collector to the east	25[1] 10.9[1]	3.1 no data
Otay Lakes Road, east of Chula Vista City Limits	Community Collector (2 lanes)	10.9[1]	3.1
Del Mar Mesa Vernal Pool Unit			
State Route 56, between Black Mountain Road and Carmel Valley Road	Freeway (2 lanes)	no data (refer to text)	64-72[4]
Camino del Sur, southern terminus	Major Road (4 lanes)	30[2]	12.3
Black Mountain Road, between State Route 56 and Park Village Road	Major Road (4 lanes)	35[2]	34.6
Park Village Road	Major Road (4 lanes)	35[2]	8.9
Mannix Road	Collector (2 lane)	2.2[2]	no data

[1] County of San Diego Mobility Element Road Classifications (County of San Diego 2010a)
[2] City of San Diego Roadway Classifications (City of San Diego 1998b)
[3] San Diego Association of Governments (SANDAG) http://www.sandag.org/resources/demographics_and_other_data/transportation/adtv/index.asp), except as otherwise noted
[4] 2011 Traffic Volumes on the California State Highway System (Caltrans 2011)

The San Diego region-wide goal for an acceptable LOS on all freeways, roadway segments, and intersections is D; however, local jurisdictions, as well as Caltrans, have slightly different LOS objectives. For the County of San Diego, LOS D is the standard to maintain for Mobility Element roads, unless conditions exist that preclude improving a roadway beyond LOS E or F. For the most part, the roadways located in proximity to the Otay-Sweetwater Unit operate at LOS D or better. The one exception is the segment of Highway 94 between Singer and Vista Sage Lanes.

The Mobility Element of the County General Plan (County of San Diego 2010a) explains that retaining a LOS of E or F on Highway 94 from the Valle de Oro Community Planning Area boundary east to Melody Road represents an instance in which the county has determined that it is more appropriate to retain the existing road condition, in this case a two-lane road, rather than to increase the number of travel lanes. The adverse impacts of adding the additional lanes do not justify the resulting benefit of increased traffic capacity. As a result, this roadway is today and will continue to operate in the future at LOS E or F.

In the area surrounding the Del Mar Mesa Vernal Pool Unit, the surface streets that provide access to these parcels are all operating at LOS D or better. Highway 56 however operates at LOS E or F during weekday morning and evening peak traffic periods. SANDAG describes the segment of Highway 56 in the vicinity of Camino Del Sur as LOS E, with intermittent congestion along the east bound lanes, and a combination of LOS E and LOS F, with 0-2 hours of congested flow, in the west bound lanes.

4.5.3.2 Parking

Currently, refuge visitors have limited options for off-street parking of motor vehicles. There is a Refuge-maintained trail staging area off Jamul Drive that provides 17 parking spaces for visitors who wish to access the trails on McGinty Mountain. Off-street parking is available at the Summit Site of Sweetwater County Park, located at 3218 Summit Meadow Road to the west of the San Miguel Mountain area. From this parking area, visitors can access the Sweetwater River Trail, which extends through the Refuge along the Sweetwater River. Another parking area, maintained by the County Department of Public Works, provides access to the Sweetwater River Trail from the north. This parking area is located off Highway 94 at Singer Lane, near the old steel bridge.

4.5.4 Public Utilities and Easements

Electric Transmission. San Diego Gas & Electric Company (SDG&E) maintains utility rights-of-way, which often include access roads, throughout various parts of the Refuge, including within the Otay-Sweetwater Unit and Del Mar Mesa Vernal Pool Unit. All of these rights-of-way existed prior to acquisition of the underlying parcels for inclusion in the Refuge. Within the Otay-Sweetwater Unit, a transmission facility extends southwest to northeast through the Refuge. This facility currently contains a 230 kV electricity transmission line and electrical distribution lines. In about 2005, existing 138 kV and 69 kV circuits were relocated onto a new pole alignment within the existing right-of-way and the existing poles were modified or replaced to accommodate the 230 kV transmission line that connects the Miguel substation, located to the south of the Refuge, to the Mission substation in central San Diego.

The Miguel substation is located on lands owned by SDG&E that abut the southwestern Refuge boundary. A 500 kV transmission line, extending from the Miguel substation to the Imperial Valley/Arizona area, crosses Refuge land near the southeastern slopes of San Miguel Mountain and extends through lands included within the Refuge acquisition boundary to the east of the Refuge. Portions of the lands to the east of San Miguel Mountain may ultimately be developed, while other portions may be incorporated into the Refuge and/or managed as preserved lands by other government entities. In any case, SDG&E would continue to operate and manage this facility and the lands within the existing right-of-way.

A number of 69 kV electrical distribution lines also extend through various portions of the Otay-Sweetwater Unit including in the Millar Ranch Road area, north and south of SR 94 in the vicinity of the Sweetwater River, a portion of Las Montañas, and through the 74-acre Refuge parcel located north of Dehesa Road.

An electric transmission facility, managed and maintained by SDG&E, also extends north/south through the Del Mar Mesa Preserve. This facility crosses the two western most Refuge parcels on the Mesa. Currently, 138kV and 230kV transmission lines are included on the existing towers. An additional 230kV line is to be installed on the existing towers by 2017. Various maintenance roads, maintained by SDG&E for access to their transmission towers, extend across the western Refuge parcels. These roads are proposed as multiple use trails in the Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015).

All of SDG&E's lands, along with the operations and maintenance activities conducted in established easements and/or rights-of-way, are covered by the SDG&E Subregional NCCP (USFWS Take Permit PRT 809637, December 18, 1995) and their Implementing Agreement/California Endangered Species Act Memorandum of Understanding. The Implementing Agreement states that "implementation of the Subregional Plan is independent of other NCCP/HCP's and the Covered Species for which the Incidental Take is authorized under the

Take Authorizations is not dependent upon the implementation of such plans." These documents cover a total of 110 plant and animal species. In addition, the NCCP Subregional Plan mitigation measures relating to vernal pools were clarified in an agreement with SDG&E, USFWS, and CDFW, dated May 26, 2004.

Water Utilities. Also located within the Otay-Sweetwater Unit are several utility easement roads that provide access for the Otay Water District to maintain facilities constructed on inholding parcels, which are parcels surrounded by Refuge land that are owned by another entity. In some cases, communication facilities have been collocated on the existing water facilities.

In addition, the Sweetwater Authority maintains facilities that is part the URDS, including an intercept barrier and pipelines, within an easement located approximately one mile upstream of the reservoir.

Communications. AT&T maintains telephone lines on some of the existing power line routes on San Miguel, as well as separate routes through Las Montañas.

4.5.5 Economics and Employment

San Diego has a diverse economic base that includes a strong government sector (due in part to the presence of U.S. Navy and Marine Corps installations throughout the area) and active tourism-related industries. The service industry, which includes both personal and business services, employs the largest percentage of people in the region. According to the 2010 Census, some of the other leading industries in San Diego County include professional, scientific, and technical services; health care and social assistance; and manufacturing.

The estimated population in 2010 for the county was 3,095,313, with an estimated 1,061,789 total households. The largest portion of the Refuge, the Otay-Sweetwater Unit, is situated in southwestern San Diego County near the communities of Bonita, northeast and southeast Chula Vista, Rancho San Diego, Spring Valley, and southeastern El Cajon. The total estimated population for these areas in 2011 was 178,000 (SANDAG Data Warehouse, http://datawarehouse.sandag.org/, data extracted in November 2011).

Although the Refuge will not directly result in the generation of revenues for the region, the personnel employed to manage the Refuge, as well as the activities that occur on the Refuge (e.g., maintenance, new construction, recreation), provide positive economic benefits to the region. The Refuge employs three full-time staff members who actively manage, maintain, and protect the resources on the Refuge. Additional refuge complex personnel (e.g., firefighters, law enforcement, recreation and environmental education planners) are also employed in the San Diego Region. All employees contribute to the local economy by generating employment and sales taxes and by purchasing goods and services that support other jobs in the region. Goods and services purchased to support management activities on the Refuge also support the local economy.

The economic benefits of recreation (e.g., mountain biking, equestrian activities, hiking, wildlife observation, photography, hunting) are also well documented. The Outdoor Industry Foundation (2006) estimates that active outdoor recreation contributes $730 billion annually to the U.S. economy. Within California, outdoor recreational activities are estimated to contribute $46 billion annually to the State's economy, supporting 408,000 jobs and generating $3.1 billion in annual State tax revenue. There are also demonstrated economic benefits of outdoor recreation related to tourism, property values, and health care savings (Macdonald 2011).

With respect to wildlife observation, the USFWS (2008e) estimates that in 2006, roughly one out of three Americans 16 years or older (71 million people) participated in wildlife watching and that wildlife-related expenditures in 2006 were $45.7 billion nationwide. Of the 71 million people who participate in wildlife watching, 95 percent of them did so within one mile of their homes. In California, the estimated number of wildlife watchers in 2006 was 6.27 million people, resulting in an economic output of just under $7.9 million (USFWS 2008e).

The effect of preserving lands within the MSCP study area, including those lands that are currently part of the Otay-Sweetwater Unit of the San Diego NWR, as well as additional lands that could be included in the future per the approved acquisition boundary, on population and housing within the San Diego region were addressed in the Final Joint Environmental Impact Report (EIR)/EIS for the Issuance of Take Authorizations for Threatened and Endangered Species due to Urban Growth within the MSCP Planning Area (City of San Diego 1997). In this Joint EIR/EIS, three issues were analyzed: 1) the effects of the proposed action on planned/existing housing in the region; 2) effects of the proposed action on the distribution, density, or growth patterns; and 3) a generalized economic analysis of the overall MSCP Plan. The document concluded that implementation of the MSCP would not significantly affect planned or existing housing in the San Diego region. Based on a quantitative analysis of development shifts that were expected to occur with the implementation of the MSCP Plan, as well as analysis of measures incorporated into the MSCP Plan and Subarea Plans to minimize or avoid impacts to land use distribution and growth patterns, the Joint EIR/EIS identified no significant adverse effects on regional growth patterns. With respect to the generalized economic analysis, the Joint EIR/EIS concluded that the implementation of the overall MSCP Plan would result in net positive economic effects for the region (City of San Diego 1997).

4.5.6 Environmental Justice

On February 11, 1994, Executive Order 12898 ("Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations") was issued requiring that all Federal agencies achieve environmental justice by "identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." Environmental justice is defined as the "fair treatment for peoples of all races, cultures, and incomes, regarding the development of environmental laws, regulations, and policies.

Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies. To achieve meaningful involvement requires that all potentially affected individuals have an appropriate opportunity to participate in decisions about proposed activities that could affect their environment and/or health and that the concerns of all participants are considered in the decision making process.

The U.S. Department of Housing and Urban Development (HUD) defines low income as 80 percent of the median family income for the area, subject to adjustment for areas with unusually high or low incomes or housing costs. According to estimates developed by SANDAG, the median household income in 2010 for the areas surrounding the Refuge was: $66,046 for Bonita (zip code 91902); $73,957 for the northeast portion of the City of Chula Vista (zip code 91914); $54,780 for the southeast portion of the City of Chula Vista (zip code 91915); $70,578 for the Jamul area (zip code 91935); $43,243 for the community of Spring Valley (zip code 91977); $51,821 for Rancho San Diego (zip code 91978); and $44,953 for El Cajon (zip code 92019) (SANDAG Data Warehouse, http://datawarehouse.sandag.org/, data extracted in November 2011).

Additional information about the household incomes in these communities is provided in Table 4-11. The estimated countywide median household income for 2010 is $44,771. An income of $35,816 would represent 80 percent of the median family income for the region; therefore, based on the figures available, the communities immediately surrounding the Refuge would not meet the definition of low income.

San Diego County is about 4,260 square miles in size and in 2010 the estimated population was 3,095,313 (SANDAG, Fast Facts, http://datawarehouse.sandag.org/ data extracted 11/2011). SANDAG estimates that in 2010, approximately 49 percent of the population in San Diego County identified themselves as white, 31 percent as Hispanic, 10 percent as Asian, 5 percent as African-American, 0.5 percent as American Indian, 0.4 percent as native Hawaiian or other Pacific Islander, and 3 percent as two or more races. The ethnic composition of the communities located in proximity to the Otay-Sweetwater Unit, the largest part of the Refuge, is described in Table 4-12.

Table 4-11 Estimated Household Incomes for the Communities[1] around the Refuge in 2010								
	Chula Vista, Bonita (91902)	**Chula Vista, NE (91914)**	**Chula Vista, SE (91915)**	**Jamul (91935)**	**Spring Valley (91977)**	**Rancho San Diego (91978)**	**El Cajon (92019)**	**San Diego Region**
Occupied Households	5,632	4,173	6,843	2,754	18,625	2,744	14,664	1,068,797
Households with:								
Incomes less than $15,000 per year	357	108	346	256	2,263	236	1,951	145,352
Incomes from $15,000 to $44,999 per year	1,498	708	2,509	566	7,487	925	5,389	391,917
Incomes from $45,000 to $74,999 per year	1,306	1,321	2,264	639	5,276	805	3,378	263,494
Incomes from $75,000 to $99,999 per year	991	860	946	343	1,805	376	1,802	117,302
Incomes from $100,000 and above per year	1,480	1,176	778	950	1,794	402	2,144	150,732
Median Income	$66,046	$73,957	$54,780	$70,578	$43,243	$51,821	$44,953	$44,771

[1] Community boundaries are defined by zip code, and the data is based on estimates for the year 2010.
Source: SANDAG, Current Estimates for 2010, http://datawarehouse.sandag.org/, data extracted on 11/2011.

Table 4-12 Ethnic Composite of the Communities[1] in the Vicinity of the Refuge in 2010								
Ethnic Group	**Bonita (91902)**	**Chula Vista, NE (91914)**	**Chula Vista, SE (91915)**	**Jamul (91935)**	**Spring Valley (91977)**	**Rancho San Diego (91978)**	**El Cajon (92019)**	**San Diego Region**
American Indian	49 (<1%)	61 (<1%)	22 (<1%)	51 (<1%)	263 (<1%)	38 (<1%)	325 (<1%)	16,878 (<1%)
Asian	2,658 (15%)	1,642 (12%)	5,650 (26%)	164 (2%)	5,441 (9%)	411 (5%)	1,575 (3%)	333,673 (10%)
Black	442 (2%)	408 (3%)	1,022 (5%)	276 (3%)	7,583 (12%)	551 (7%)	1,534 (3%)	167,311 (5%)
Hawaiian and Pacific Islander	58 (<1%)	40 (<1%)	204 (1%)	15 (<1%)	500 (<1%)	52 (<1%)	151 (<1%)	14,681 (<1%)
Hispanic	6,588 (37%)	4,971 (36%)	8,525 (39%)	2,335 (26%)	20,620 (33%)	1,705 (21%)	7,816 (17%)	987,278 (31%)
White	7,610 (42%)	6,348 (47%)	5,493 (25%)	5,684 (64%)	24,776 (40%)	4,927 (60%)	31,476 (70%)	1,586,395 (49%)
Other	36 (<1%)	12 (<1%)	15 (<1%)	10 (<1%)	149 (<1%)	45 (<1%)	158 (<1%)	8,480 (<1%)
2 or More Races	544 (3%)	433 (3%)	796 (4%)	291 (3%)	2,958 (5%)	441 (5%)	1,987 (4%)	109,736 (3%)
Total Estimated Population	17,985	13,915	21,727	8,826	62,290	8,170	45,022	3,224,432

[1]Community boundaries are defined by zip code, and the data is based on estimates for the year 2010.
Source: SANDAG, Current Estimates for 2010, http://datawarehouse.sandag.org/, data extracted on 11/2011.

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5 Implementation

5.1 Introduction

Presented here are the details of how we will manage the San Diego NWR over the next 15 years. Implementation of the selected action, 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 the Refuge and the management undertaken on the Refuge plays in the larger conservation landscape. The San Diego NWR is just one component of the ongoing species conservation efforts in San Diego County, but as such, it plays a significant role in the long-term preservation of the habitats and species covered by the San Diego MSCP.

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 the San Diego NWR was 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 San Diego 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 Monitoring

Monitoring the effects of management actions on the Refuge's trust resources is an important component of the CCP, as is the documentation of the Refuge's 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, as well as 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, wildland fire, and climate change. Monitoring of federally listed species, MSCP-covered species, and other special status species is an ongoing management activity on the Refuge that will continue per available funding.

As described in Chapter 3 (Objective 2.7), a variety of new or expanded surveys and monitoring activities are proposed. These actions will be implemented by Refuge staff, other public, private, academic, and nonprofit partners, and researchers. They will 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 protected within the region-wide San Diego MSCP Preserve. Monitoring will also provide Refuge-specific data needed to evaluate the effectiveness of the various management strategies proposed in this CCP and 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 are achieving proposed objectives for improving visitor understanding of Refuge resources, connecting people with nature, and providing a positive visitor experience.

5.4 Adaptive Management

The Service acknowledges that much remains to be learned about the species, habitats, and physical processes that occur on the Refuge 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, increased fire frequency, 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 the CCP proposes to continue this practice.

In designing and implementing the adaptive management strategy for this Refuge, it may be necessary at some point 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.

The adaptive management process will also 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.

5.5 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 in the CCP (Chapter 3), will require various degrees of interaction and support from outside partners. Through ongoing partnerships with other land managers in the region, staff and funding can continue to be leveraged to implement management and monitoring strategies that benefit multiple ownerships. Habitat protection and some restoration efforts will involve partnerships with other Federal, State, and/or local agencies, researchers, and adjacent landowners. Partnering in the management of the resources on the Del Mar Mesa Preserve, which includes the Del Mar Mesa Vernal Pool Unit, is an essential component of the Carmel Mountain and Del Mar Mesa Preserves Resource Management Plan (City of San Diego 2015). Protection of cultural resources will also require partnerships with the region's Native American community on issues such as resource protection, interpretation, and repatriation.

The needs and opportunities for research on the Refuge are vast, and it is only through partnerships that these needs can 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 Refuge, such as Quino checkerspot butterfly, Hermes copper butterfly, and Harbison's dun skipper, while other research could answer questions related to which herbicides can be safely used in areas supporting rare plants or insects.

Bonita Bikers volunteer at trail outreach event (USFWS)

Implementing the Refuge's public use program will require the expansion of existing partnerships and the establishment of new ones. To develop the hunt plan, Refuge staff will work with the hunting community and surrounding land managers. To ensure a quality experience for visitors using the Refuge's designated trail system, as well as to avoid damage to Refuge resources, expanded partnerships with the mountain biking, equestrian, and hiking communities, along with the County of San Diego and other agencies, will be needed. The Refuge will be seeking volunteers to participate in a volunteer trail patrol and in volunteer trail maintenance activities. Other partnerships will be needed to support environmental education and resource interpretation objectives.

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 such as appropriate suppression and/or prescribed fire strategies. The Fire Management Plan (FMP) for the San Diego National Wildlife Refuge Complex addresses fire management strategies for the San Diego Bay, San Diego, Seal Beach, and Tijuana Slough National Wildlife Refuges. With respect to San Diego NWR, the currently approved plan focuses on preparedness, wildland fire operations, prevention, detection, and full suppression of wildfire. Within the currently approved plan, prescribed and wildland fire use are not proposed as a strategy for achieving land management objectives on the San Diego NWR; however, revisions to the Fire Management Plan for the Complex will likely reevaluate this position on prescribed fire use.

Refuge fire crew on 2013 Lyons fire (USFWS)

Values considered in the Fire Management Plan 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. Fire management plans are reviewed periodically to ensure that the fire program is conducted consistent with approved plans and that the program is evolving with the Service mission and the goals and objectives of the Refuges covered by the plans. Revisions to the San Diego NWR Complex Fire Management Plan were nearing completion in August 2016. Once completed, that plan will guide fire management on the Refuge until the Fire Management Plan is once again revised.

5.7 Cultural Resource Management

An objective of this CCP is to implement proactive management of cultural resources that focuses on protecting these resources and, when appropriate, interpreting archaeological and historical resources on the Refuge for the purpose of increasing the public's appreciation of the region's cultural heritage and the need for cultural resource protection. Strategies addressing the protection and interpretation of cultural resources, including partnering with tribes, the Kumeyaay Heritage Preservation Committee, and the Kumeyaay Diegueño Land Conservancy, are presented in Chapter 3 (Objectives 3.3 and 4.5).

To avoid adverse effects to cultural resources during the implementation of Refuge actions, the following procedures will be implemented for all proposals that require subsurface disturbance:

a. Prepare and submit a Request for Cultural Resource Compliance (Appendix J) 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. Initiate tribal consultation per Section 106 of the NHPA;
c. 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 qualified archaeological and Kumeyaay monitors 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;

d. 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

e. 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 continue discussions with interested tribal groups to create a Memorandum of Understanding (MOU) to implement the inadvertent discovery clause of NAGPRA. Development of this MOU involves 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 Step-down Plans

Achieving some of the habitat management objectives and the public use goal for the Refuge will require more in-depth planning than the CCP process is designed to provide. 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. Two step-down plans, an Integrated Pest Management Plan (Appendix D) and a Feral Pig Monitoring and Eradication Plan (Appendix E), were prepared concurrent with the CCP. Several additional step-down plans are proposed for completion following the approval of the CCP. Table 5-1 lists these step-down plans along with target dates for completion.

Table 5-1
Future Step-down Plans Proposed for the San Diego NWR

Plan	Target for Completion
Hunt Plan	FY 2018
Habitat Management Plan	FY 2019
Inventory and Monitoring Plan	FY 2020

5.8.1 Completed Step-down Plans

Integrated Pest Management Plan

The Integrated Pest Management (IPM) Plan for the San Diego NWR was prepared 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 final document is provided as Appendix D.

The IPM Plan provides 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, other non-target organisms, and natural resources, including surface and groundwater resources.


Mechanical invasive weed control (USFWS)

Along with a detailed discussion of IPM techniques, the IPM Plan describes the selective use of pesticides for pest management on the San Diego NWR. It also describes the review and approval process to be followed when pesticides are proposed for use on the Refuge. For any proposed use of a pesticide, a Pesticide Use Proposal (PUP) is submitted for review and approval. The PUP is then reviewed at the Project Leader, Regional Office per guidance in the current year's Western Regions Pesticide Uses Granted Field Station Level Approval, or Washington Office level per the USFWS Headquarters Guidance for Pesticide Use Proposals. Unless an IPM Plan is in place, all PUPs must be submitted for review and approval at the appropriate level on an annual basis. For some pesticides with an approved IPM Plan or IPM strategies in place for the San Diego NWR, a PUP would initially be reviewed and approved at the appropriate level; then, for the next four years, PUPs may only need review and approval at the field level. If, however, the Refuge proposes a substantial change in the use pattern of an approved pesticide, review by the regional or Washington Office would be required before this change could be implemented on the Refuge.

The primary focus of the IPM Plan for the San Diego NWR is on controlling invasive plants. The IPM Plan also addresses the future need to control, to the extent feasible, exotic aquatic wildlife. The IPM Plan will be reviewed and updated as needed to address new information and policy changes.

Feral Pig Monitoring and Eradication Plan

The Feral Pig Monitoring and Eradication Plan addresses the potential future need to control feral pigs on the Refuge, as their presence would pose a substantial threat to the Refuge's sensitive physical, biological, and cultural resources. The final document is provided as Appendix E.

No feral pigs are currently present on the Refuge, but feral pigs and the damage to resources associated with feral pig activity have been identified in the San Diego region. The initial implementation of this plan by the Refuge would therefore involve monitoring for the presence of pigs, with further action on the Refuge becoming necessary only if pigs are identified on Refuge lands. The actions taken to control pigs on the Refuge would be coordinated with the larger regional effort to control feral pigs throughout San Diego County.

This plan, which is consistent with the plan developed by USDA Forest Service, BLM, California Department of Parks and Recreation, and other Federal, State, and local participants on the Inter-Governmental Group on Feral Pig Impacts, draws upon a large body of experience from many successful feral pig elimination and control efforts across the United States (USDA Forest Service 2013). This group has developed Principles of Understanding to work together to address feral pig impacts in San Diego County and to develop an "all-lands" approach to dealing with the feral pig population. We will work with this group to share knowledge and develop strategies for dealing with the feral pig population in the County across jurisdictional boundaries.

5.8.2 Future Step-down Plans

Hunt Plan

Preparation of a hunt plan for the Otay-Sweetwater Unit will begin upon approval of the Final CCP. The plan, which will be prepared in coordination with CDFW and other adjoining property owners (e.g., BLM, City of San Diego, County of San Diego, and City of Chula Vista), is intended to ensure the conservation of wildlife and their habitats, safety of hunters, compliance with applicable State and Federal laws and regulations, and respect for the resource. The process will also involve coordination with partners who have an interest in helping promote a quality hunting program on the Refuge.

The plan and subsequent opening package will be prepared in accordance with 605 FW2 (Hunting) of the Service Manual and Title 50, Part 32 of the Code of Federal Regulations. Topics addressed in the hunt plan will include but are not limited to hunting program goals and objectives, a description of the hunting program (e.g., target species, hunting boundaries, access to the hunting area, harvest limits, permitted equipment, access, methods of control and enforcement, staffing requirements, seasons and/or hours that may differ from CDFW, any other Refuge-specific regulations).

Habitat Management Plan

The development of a Habitat Management Plan (HMP) for the Otay-Sweetwater Unit is expected to begin in FY 2019. To the extent possible, this plan would be developed in partnership with other land managers, particularly those along the Sweetwater River corridor between the Loveland Reservoir to the northeast and the Sweetwater Reservoir to the south, in an effort to ensure a coordinated management effort that addresses issues such as listed and sensitive species, sensitive habitats, invasive species, and water quality and quantity. Plan preparation will also require coordination with other agencies, tribes, and non-governmental land managers to develop management strategies for the habitats and suite of listed and sensitive species that are currently or were historically supported within the Otay-Sweetwater Unit.

Inventory and Monitoring Plan

Following the completion of the HMP, an Inventory and Monitoring Plan (IMP) will be prepared. The IMP will prioritize surveys based on input provided in the HMP and MSCP monitoring strategies and provide guidance for improving the quality, consistency, utility, and long-term storage of monitoring data.

5.9 Compliance Requirements

5.9.1 Federal Regulations, Executive Orders, and Legislative Acts

All projects and step-down plans described in the CCP will be 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 this Refuge are presented in Appendix K, along with a summary of how the CCP will comply with these requirements. With respect to wilderness, the lands within the San Diego 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 San Diego NWR is not analyzed further in the CCP. The results of the wilderness inventory are documented in Appendix L.

5.9.2 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, particularly those actions associated with future step-down plans or individual projects that are to be described in greater detail in the future. Additionally, prior to implementation of the various 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 on the San Diego NWR include:

- **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 J) 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, San Diego Region** - 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.

- **Caltrans** - Coordination and approval of encroachment permits and any associated traffic improvements (e.g., traffic signals, acceleration/deceleration lanes) from Caltrans for proposals that will encroach into the right-of-way of a State highway such as Highway 94.

5.9.3 Conservation Measures to be incorporated into Future Projects

To ensure that the future projects and other actions described in this CCP do not result in significant adverse effects to the environment, conservation measures shall be implemented, as appropriate, in association with the development and/or carrying out of future proposed projects and/or actions. Various conservation measures to be considered are outlined here.

General Conservation Measure for all Project Categories

- 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;
- To the extent feasible, use existing roadways or travel paths for construction and maintenance 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 D for more details);
- Routinely evaluate the results of ongoing 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).

Cultural Resources Protection Measures

- To protect cultural resources, for all projects that propose ground-disturbance follow the steps outlined in Section 5.7 above, including initiation of review with the Regional Cultural Resources Program and consultation with the tribes.

Erosion Prevention Measures

- To minimize the potential for soil and water erosion, sustainable trail practices, such as those developed by the California Department of Parks and Recreation, will be implemented as part of all trail rehabilitation, trail realignment, or new trail construction projects. Such practices would include but are not limited to:
    - Maintaining, to the maximum extent feasible, a linear trail gradient of less than 10 percent (site-specific circumstances may warrant a greater or lesser gradient), while also designing the trail to traverse the natural slope (e.g., aligning the trail along the existing contours to minimize the potential for water to travel down the trail);
    - Creating and maintaining an outsloped (3 to 4 percent cross-slope) trail tread;
    - Using techniques such as grade reversals and rolling contours to prevent water from flowing down the trail;
    - Avoiding the construction of switchbacks, which lead to erosion issues from trail-cutting; and

- Implementing special treatments (e.g., rock retaining walls, turnpikes, puncheons, boardwalks, soil stabilizer) in areas where soils are prone to excessive erosion or soils are known to retain moisture.

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;
- Fence or otherwise delineate the boundaries of the project prior to construction to avoid disturbance to surrounding vegetation;
- 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 on the Refuge:
  - Specify and follow vehicle and equipment fueling procedures and practices that are designed to minimize or eliminate the discharge of fuel spills and leaks into adjacent wetlands or the storm drain system;
  - 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 or runoff, and to contain spills;
  - Inspect construction vehicles and equipment for leaks prior to each day of use and immediately implement repairs if a leak is discovered; 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;
  - 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;
- Revegetate disturbed construction sites with appropriate native plant species within one week of project completion;
- 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 San Diego APCD air quality standards; and
- Carry out the appropriate BMPs, as outlined in the IPM Plan (Appendix D), when applying herbicides.

5.10 Refuge Operations

The CCP serves as the primary management reference document for Refuge operations. The Service will implement the Final CCP with assistance from existing and new partner agencies and organizations and from the public. The timing and achievement of the management strategies proposed in this document is contingent upon a variety of factors, including funding and staffing, completion of step-down plans, accomplishing the compliance requirements, and monitoring outcomes.

Each of these factors is discussed as it applies to the CCP. The CCP provides long-term guidance for management decisions and identifies 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. Accordingly, this plan does not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

5.10.1 Project Funding

For fiscal year (FY) 2011, the general operating costs (excluding staff costs, which are discussed later in this section) for the San Diego NWR were approximately $58,240. Base funding available to refuges varies annually; budgets were reduced in FY 2013 over prior years. 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 2010, $37,900 in additional funding was provided to the San Diego NWR for control of invasive plants. Special funding may also 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 the DOI Financial and Business Management System (FBMS). (FBMS maintains, among other records, the database of record for documented real property.)

The deferred maintenance projects for the San Diego NWR are presented in Table 5-2. The projects are divided between those that have been included in the Region's current "5-Year Plan" for funding, and those projects for which funding have not yet been identified. The deferred maintenance projects included prior to CCP approval total about $454,075, of which $244,000 is needed for projects covered under the "5-Year Plan."

Table 5-2 Current Deferred Maintenance Projects for the San Diego NWR	
Deferred Maintenance Projects (presented in order of priority)	**Estimated Project Cost**
Projects Currently Included in the Deferred Maintenance "5 Year Plan"	
Remove Old Dairy Water Tanks - This asset, acquired with the property, does not support the mission of the Refuge. Removal of the tanks would allow the site to be returned to native habitat.	$16,000
Remove Abandoned Well/Pumphouse (South of Jamacha Road) - This asset, located on donated land, is non-operational and does not support the Refuge mission. Demolition of the pumphouse and closure of the well will eliminate a safety issue and allow the site to be restored to native habitat.	$28,000
Other Refuge Deferred Maintenance Projects	
Repair Saddle Road Dam - Repair dam to eliminate erosion and seepage on the outside of the dam face to maintain wetland habitat in and around the existing pond, and reduce erosion and sedimentation below the dam.	$170,272
Rehabilitate Maintenance Access Road Behind the Otay Pumphouse in south Las Montañas – Repair the existing gate and road for maintenance and law enforcement access into the southern portion of the Las Montañas.	$35,000
Rehabilitate the San Miguel Ranch Access Road – Rehabilitate the deteriorated pavement on this access route that extends from San Miguel Avenue onto the Refuge to facilitate management and maintenance.	$198,827
Remove Existing Metal Storage Building – Demolish structure.	$5,976
Total Estimated Cost	$454,075

The database also includes new constructions projects. Prior to the approval of the CCP, the new construction projects included in the database for the San Diego NWR totaled approximately $2,892,200, with $162,000 allocated for facilities associated with wildlife and habitat management, $435,200 for visitor facilities, and $2,295,000 for Refuge operations. The database will be updated to reflect the proposals included in this Final CCP, as presented in Table 5-3. The projects presented in Table 5-3 are listed in order of priority for completion. Projects related to visitor services have been further prioritized and are identified at the end of the construction project description with a Visitor Services (VS) Priority number.

Table 5-3 Proposed Update to the FBMS Database		
Construction Project (presented in order of priority)	**Corresponding CCP Objective(s)**	**Estimated Project Cost**
Construct a Visitor Staging Area/Temporary Contact Station – Design and construct a facility to accommodate visitor parking, a temporary visitor contact station, and restroom on a 3.5-acre site near Millar Ranch Road and Highway 94. This project (Phase 1 of a larger project) would provide for trail and volunteer staging and make Refuge staff more accessible to the public. In addition to a temporary contact station, the site would include a parking area (with some pull-through sites for equestrian trailers), trailhead, information kiosk, and restrooms. Traffic improvements (e.g., traffic study, traffic control, road widening for ingress and egress) totaling about $1 million would be required to facilitate access to the site. (VS Priority #1)	4.1-4.8	$3,400,000
Construct a Refuge Office/Permanent Visitor Contact Station – Design and construct a Refuge office and visitor contact facility on a portion of the 2.4-acre site near Millar Ranch Road and Highway 94, (Phase 2). Facilities would include a Refuge office, parking area for staff and Refuge vehicles, and a permanent visitor contact station.	4.1-4.9	$4,000,000
Mine Closures on Mother Miguel and McGinty Mountains – Secure two horizontal openings (one on Mother Miguel Mountain and one at the Peg Leg Mine) using bat-compatible gates, and close existing vertical shafts and other openings to eliminate any public safety hazards and to protect wildlife.	2.1-2.6; 4.1-4.8	$25,000
Construct Seasonal Staff and Volunteer Barracks – Purchase and set up a modular, 4-bedroom, 2-bath, "green" residence with photovoltaic panels to provide temporary housing for seasonal firefighters and transient staff/volunteers at Rancho Jamul.	4.2 - 4.8	$700,000
Relocate Storage Building (Rice Barn) - Due to frequent vandalism at its present location on San Miguel Mountain, relocate the existing metal storage building to an appropriate location on the Refuge; install photovoltaic panels on relocated facility.	2.1-2.6	$115,000
Construct Security Fence and Gates Along Refuge Boundary at Jamacha Road and Willow Glen Drive - Construct approximately 1,000 linear feet of 8-foot-high black chain link fencing with gates along the refuge boundary behind existing commercial development to minimize impacts related to trespass and illegal encampments.	2.3	$75,000
Mark Refuge Boundaries– Identify and post Refuge boundaries as parcels are acquired, and install new markers elsewhere as needed.	2.1-2.6	$100,000
Construct Native Plant Nursery - To propagate native plants for use in Refuge restoration and enhancement projects, develop a nursery at Rancho Jamul to include a greenhouse, potting shed, outdoor growing areas, and seed cleaning and storage facilities. To the maximum extent practicable, "green" technology (e.g., solar panels to run lights and equipment) will be utilized at the site.	2.1-2.6	$75,000

Table 5-3 Proposed Update to the FBMS Database		
Construction Project (presented in order of priority)	**Corresponding CCP Objective(s)**	**Estimated Project Cost**
Realigned Trails To Improve Sustainability (Otay-Sweetwater Unit) – Implement the CCP trail recommendations, including closure and rehabilitation of user-created trails and the realignment of other trails to reduce impacts to Refuge trust species, recontour eroded areas, improve trail sustainability, and/or address visitor safety. (VS Priority #2)	2.1-2.6; 3.3; 4.1-4.8	$1,500,000
Enhance Existing Interpretive Elements Along the Sweetwater River – Design, fabricate, and install five new interpretive elements along an existing interpretive trail in the Sweetwater River area of the Otay-Sweetwater Unit to interpret the listed species and native habitats in the immediate area. (VS Priority #3)	2.1-2.6; 3.3; 4.5	$50,000
Construct Interpretive Kiosk at the Barn at the Oaks – Design, fabricate, and install a two-panel visitor contact kiosk with that introduces and interprets the historic Barn at the Oaks and conveys the history of the barn and surrounding lands. (VS Priority #4)	3.3; 4.1-4.8	$30,000
Install Two Trail Bridges – Design, construct, and install two trail bridges (at the confluence of Sweetwater River and Steele Canyon Creek and over the drainage to the east of the Sweetwater River Trail Bridge) to reduce impacts to riparian habitat and ephemeral streams. (VS Priority #5)	2.1-2.6; 3.3; 4.1-4.8	$230,000
Construct a Kiosk near the Convergence of Steele Canyon Creek and Sweetwater River – Design, fabricate, and install a shaded visitor contact kiosk with six interpretative and information panels (e.g., trail map, regulations) near the confluence of Steele Canyon Creek and the Sweetwater River. (VS Priority #6)	2.1-2.6; 3.3; 4.1-4.8	$60,000
Construct Kiosk at Southern McGinty Mountain Trailhead – Design, fabricate, and construct a two-paneled kiosk and associated displays for the McGinty Mountain trailhead parking area at Jamul Drive. In addition to a trail map and facts about hazards and prohibitions, the panels will interpret the unusual biological resources (e.g., plants, butterflies, birds, gabbro soils) on McGinty Mountain. (VS Priority #7)	2.1-2.6; 3.3; 4.1-4.8	$25,000
Construct Kiosk on the Sweetwater River Trail – Design, fabricate, and install a two-panel visitor contact kiosk (including interpretive panels) on the Sweetwater River Trail near the Shinohara parcel to inform users that they are entering the Refuge and to introduce and interpret coastal sage and chaparral scrub, grassland, and vernal pool ecology. (VS Priority #8)	2.1-2.6; 3.3; 4.1-4.8	$20,800
Construct Kiosk at the End of Par Four Drive – Design, fabricate, and install a two-panel visitor contact kiosk (including interpretive panels) at this trailhead to inform users that they are entering the Refuge and to introduce and interpret San Diego ambrosia, Hermes copper butterfly, and California gnatcatcher. (VS Priority #9)	4.2-4.8	$20,800

Table 5-3 Proposed Update to the FBMS Database		
Construction Project (presented in order of priority)	**Corresponding CCP Objective(s)**	**Estimated Project Cost**
Parking Area for the South Las Montañas Area – Design and construct a parking area, restroom, and required street improvements from Highway 94 for the south Las Montañas area to accommodate wildlife-dependent recreational uses at this location. Access from Highway 94 will require a traffic study and Caltrans encroachment permit, improvements to Highway 94 for ingress/egress, and a short vehicular bridge to cross Steele Canyon Creek. (VS Priority #10)	4.1-4.8	$4,000,000
Interpret Rare Vernal Pool Habitat – Design, fabricate, and install two interpretive panels, that will interpret the unique species and habitat requirements of this specialized wetland habitat. (VS Priority #11)	1.4; 4.2-4.8	$60,000
Expand Opportunities for Wildlife Observation – Design, fabricate, and install bird identification signs for the birding trail to be established in the south Las Montañas area to support organized and individual outings to observed the birds supported by the oak woodland, riparian, and scrublands present in this area. (VS Priority #12)	4.2-4.8	$30,000
Improve Accessibility on the Sweetwater River Trail Bridge – Design, construct, and install two new access ramps for the Sweetwater River Trail Bridge to better accommodate individuals in wheelchairs, as well as equestrians. (VS Priority #13)	4.2-4.8	$100,000
Total Estimated Cost	$14,616,600	

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 San Diego NWR Complex, of which the San Diego NWR is a part, are prioritized to identify the most important projects within the Complex. Each year RONS projects are submitted for consideration and compete with similar projects for Refuge funds. The projects included the San Diego NWR CCP are presented in Table 5-4. For each project, the corresponding CCP objective, as described in Chapter 3, is also provided.

The costs presented in Table 5-4 are rough estimates and will be refined as more details are available. The listed projects are presented in order of priority (from highest to lowest). 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.

Table 5-4 Update to the RONS Database Based on the Actions addressed in the Final CCP			
Action	Corresponding CCP Objective	Operating Costs (in thousands)	
		First Year Cost	Recurring Annual Cost
Projects (presented in order of priority)			
Restore Habitat for the Endangered Quino Checkerspot Butterfly – Restore and enhance (through invasive plant control, planting and seeding of native species) about 300 acres of habitat for the Quino checkerspot butterfly in several areas on the Otay-Sweetwater Unit to increase suitable breeding sites.	1.3	$200,000	$44,470
Restore and Enhance Restore Vernal Pool Habitat – Restore the natural hydrology in vernal pool habitat within the Del Mar Mesa Vernal Pool Unit; remove exotic plants and, where appropriate, reintroduce native vernal pool species to vernal pools on the Refuge.	1.4	$50,000	$25,000
Remove Former Dumpsite and Restore Riparian and Upland Habitat - Excavate and remove dumped materials within a small canyon that drains into the Sweetwater River. Properly dispose of the materials, reconstruct and recontour the canyon to mimic the natural drainage pattern, revegetate with native plants.	1.2; 2.3	$600,000	$0
Restore Upland Habitats for the Coastal California Gnatcatcher and the Cactus Wren Restore coastal sage scrub and cactus habitats on up to 500 acres in several areas within the Otay-Sweetwater Unit to recover populations of coastal California gnatcatcher and cactus wren.	1.1; 2.1	$360,000	$75,000
Restore Native Grasslands and Forblands to Benefit Threatened Otay Tarplant and San Diego Thornmint, and Migratory Birds – Implement restoration of native grass and forb lands on the Otay-Sweetwater Unit by removing invasive plants and planting and seeding native species on up to 200 acres of uplands underlain with Diablo clay soils.	1.6; 2.6	$133,333	$35,000
Control Invasive Exotic Plants in Wetlands, Riparian, and Uplands - Control arundo, tamarisk, castor bean, Mediterranean grasses, and other invasive species in wetland, riparian, and upland habitats per the recommendations included in the IPM Plan.	2.1-2.4; 2.8	$100,000	$50,000
Monitor Presence of Feral Pigs and Wild Turkeys on the Otay-Sweetwater Unit - Initiate the monitoring of upland areas within the Otay-Sweetwater Unit for the presence of feral pigs and wild turkeys on the Refuge.	2.8	$10,000	$10,000

Table 5-4 Update to the RONS Database Based on the Actions addressed in the Final CCP			
Action	Corresponding CCP Objective	Operating Costs (in thousands)	
		First Year Cost	Recurring Annual Cost
Conduct Baseline Rare Plant Survey – Conduct a Refuge-wide survey to identify, map, and assess existing populations of listed and sensitive plant species throughout the Refuge to establish baseline data necessary to ensure long-term protection and identify changes in populations or population trends over time.	1.5-1.6	$200,000	$0
Inventory of Terrestrial Invertebrates in Chaparral Habitat – Inventory and sample terrestrial invertebrates present in chaparral vegetation on the Otay-Sweetwater Unit.	2.7	$100,000	$0
Establish and Staff MAPS Stations - To provide monitoring data for listed and sensitive species, and other bird species present within oak woodland and chaparral or coastal sage scrub habitat within the Otay-Sweetwater Unit, develop two MAPS stations (designated bird banding stations operated by Federal and State agencies, private organizations, and individual bird banders), following standardized protocol for constant-effort mist netting per the Institute for Bird Populations.	2.7	$24,000	$20,000
Support the Restoration of Cryptobotic Crust – Provide initial funding to support research related to the restoration of cryptobotic crust, including the preparation and maintenance of test plots on the Refuge to facilitate this research.	1.3	$50,000	$0
Enhance Riparian Habitat Quality to Support Listed Species – Implement riparian restoration/enhancement proposals described in the Habitat Management Step-down Plan to be prepared within five years of CCP approval.	1.2; 2.3	TBD following completion of the Step-down Plan	TBD
Monitoring of Ground/Surface Water – Monitor surface water and groundwater quality and the quantity of groundwater available for riparian and oak woodland areas within the Otay-Sweetwater Unit.	2.7	$5,000	$1,000
Subtotal		$1,832,333	$260,470

Table 5-4 Update to the RONS Database Based on the Actions addressed in the Final CCP			
Action	Corresponding CCP Objective	Operating Costs (in thousands)	
		First Year Cost	Recurring Annual Cost
Additional Staffing Needs (presented in order of priority)			
Implement Biological Activities – Hire a Fish and Wildlife Biological Technician (GS 5/7/9) to assist in the implementation of MSCP-required survey and monitoring efforts, annual surveys of upland game bird and wildlife species, monitoring of invasive species, and monitoring and maintenance of habitat restoration sites.	2.7	$37,500	$37,500
Implement Strategic Habitat Conservation and Science-Based Adaptive Management – Hire a Fish and Wildlife Biologist (GS 11) to implement MSCP requirements not currently implemented on a routine basis; to implement strategic habitat conservation and adaptive management for listed species; and to assess the adequacy of current invasive plant control.	2.7- 2.8	$95,000	$95,000
Enhance Public Interpretation Programs – Hire a Park Ranger (GS 5/7/9) to assist in the development of interpretive trails, visitor kiosks, brochures, and public outreach.	3.3; 4.5	$37,500	$37,500
Maintain Refuge Facilities, Equipment, and other Real Property – Hire a Maintenance Worker (WG 8) to maintain facilities, equipment, and other real property and assist with habitat restoration/enhancement, kiosk installation and upkeep, trail and access road maintenance, and other related activities.	2.1-2.8; 4.1-4.8	$61,655	$61,655
Improve Public Outreach and Expand Current Volunteer Program – Hire a Community Outreach Specialist (GS 11), with half of this position's time devoted to the San Diego NWR and half to the Refuge Complex. Responsibilities would include public outreach about Refuge actions, activities, and special events; implementing an Invasive Species Rapid Response Program; and implementing volunteer programs.	4.8	$47,500 (0.5 FTE)	$47,500
Enhance Environmental Education Programs – Hire an Environmental Education Specialist (GS 11) to implement an expanded environmental education program on the Refuge to reach additional K–12 students, as well as incorporate a program to reach students at nearby community and four-year colleges.	4.4	$95,000	$95,000

Table 5-4 Update to the RONS Database Based on the Actions addressed in the Final CCP			
		Operating Costs (in thousands)	
Action	Corresponding CCP Objective	First Year Cost	Recurring Annual Cost
Provide Geospatial Information and Analysis – Hire a GIS Technician (GS 7/9/11) who would be responsible for maintaining and analyzing data to assist Refuge staff in various matters, including wildlife and habitat management, land acquisition, fire protection, law enforcement, and visitor services.	2.1-2.8; 4.1-4.8	$23,750 (0.25 FTE)	$23,750
Subtotal		$397,905	$397,905
Total Estimated Cost		$2,230,238	$658,375

The estimated cost for implementing the proposals in the FBMS and RONS database (excluding deferred maintenance projects), as outlined in Tables 5-3 and 5-4 is $16,846,838 and the anticipated reoccurring annual cost for these new proposals is estimated at $658,375.

5.10.2 Current and Future Staffing Needs

The San Diego NWR is part of the San Diego NWR Complex, which provides supervisory, administrative, and logistical support for the San Diego NWR. The amount of time that staff within the Complex devote to the operations at San Diego NWR are reflected in Table 5-5, as are the current and future (proposed) on-site staff needs for the Refuge. Based on the actions included in the Final CCP, the need for five additional Refuge staff positions and two Refuge Complex staff positions, which would dedicate a portion of time to the San Diego NWR, is identified. If 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 of the positions are not filled, some aspects of the CCP may not be completed within the timeframes described in the CCP. The estimated cost of providing the staffing needs for maintaining and operating the San Diego NWR is approximately $860,080.

5.10.3 Continued Acquisition of Land per the Approved Acquisition Boundary

As described in Chapter 3, there are lands within the approved Refuge boundary that have not been acquired for inclusion in the San Diego NWR or by other entities for the purpose of habitat and species conservation. The remaining properties may at some point, based on available funding, be considered for acquisition if the following conditions apply: 1) there is a willing seller; 2) the land being considered for acquisition supports “very high” to “moderate” habitat values, high biological diversity/species richness, priority target species, vernal pool habitat, and/or would provide appropriate habitat connections (wildlife corridors) between larger areas of preserved land; and 3) the property meets the general requirements of acquisition by the Service (e.g., no encumbrances on the land, no contaminants issues, no access restrictions). An important factor in the selection of potential future acquisitions is the extent to which the acquisition would improve the contiguity (i.e., eliminating inholdings, reducing edge/area ratio) of the lands already preserved within the Refuge.

The Land Protection Plan for the Vernal Pools Stewardship Project acknowledges that not all of the lands included within the proposed acquisition boundary would become part of the Vernal Pools Unit of the San Diego NWR, and, to date, there are no plans to acquire additional properties within the acquisition boundary of the Stewardship Project. If a new acquisition was to be proposed, the conditions for acquisition described previously would be considered prior to approval.

Table 5-5
Staffing Needs for the San Diego NWR CCP

Position (grade)	Quantity	Unit[1]	Cost[2] (salary + benefits)
San Diego NWR Complex			
Project Leader (GS-14)	.20	FTE	$34,802
Deputy Project Leader (GS-13)	.25	FTE	$32,426
Administrative Officer (GS-7)	.25	FTE	$18,575
Community Outreach (GS-11)	.50[3]	FTE	$47,500
GIS Technician (GS 7/9/11)	.25[3]	FTE	$23,750
Federal Wildlife Officer (GL1801, FPL 9)	1.0	FTE	$72,024
San Diego NWR			
Refuge Manager (GS-12)	1.0	FTE	$126,680
Refuge Operations Specialist (GS-11)	1.0	FTE	$95,000
Wildlife Biologist (GS-11)	2.0[4]	FTE	$190,000
Fish and Wildlife Biological Technician (GS-5/7/9)	1.0[3]	FTE	$37,500
Park Ranger (GS 5/7/9)	1.0[3]	FTE	$37,500
Maintenance Worker (WG 8)	1.0[3]	FTE	$49,323
Environmental Education Specialist (GS-11)	1.0[3]	FTE	$95,000
Total Staffing Costs			$860,080

[1] FTE = Full-Time Equivalency Position
[2] Based on FY 2013 costs
[3] New position proposed in the CCP
[4] One FTE is a new position proposed in the CCP

5.10.4 Potential Funding Sources for Implementing CCP Projects

Many 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., National Fish and Wildlife Foundation, Service Cost Share Grants, Federal Highway Administration Refuge Roads Program, *TransNet* Environmental Mitigation Program). Other potential sources of funding for habitat restoration, listed species conservation and recovery, and research include the Cooperative Endangered Species Conservation Fund, California Landscape Conservation Cooperative funding, and grants that support community-based restoration through partnerships with land management agencies.

5.11 Compatibility and Appropriate Use Determinations

The Improvement Act requires that all uses permitted on a national wildlife refuge must be compatible with Refuge purposes and the mission of the NWRS and 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 (CDs) have been prepared for hunting, fishing, wildlife observation, interpretation, and environmental education, public trail use, and research. Both an appropriate use evaluation and compatibly determination have been prepared for public trail use and for research. The final CDs are provided in Appendix C.

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Appendix A: List of Preparers, Planning Team Members, and Persons/Agencies Consulted

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Caltrans
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SDG&E

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Appendix B: Glossary of Terms and Acronyms

1. Acronyms and Abbreviations

ADT	average daily traffic volumes
APCD	San Diego Air Pollution Control District
APE	Area of Potential Effect
APHIS-PPQ	Animal and Plant Health Inspection Service, Plant Protection and Quarantine unit
ATV	all-terrain vehicle
BCR	Bird Conservation Regions
BLM	Bureau of Land Management, Department of the Interior
BMPs	Best Management Practices
CAAQS	California Ambient Air Quality Standards
Caltrans	California Department of Transportation
CAPCOA	California Air Pollution Officers Association
CARB	California Air Resources Board
CBI	Conservation Biology Institute
CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game (renamed the California Department of Fish and Wildlife in January 2013)
CDFW	California Department of Fish and Wildlife
CEPA	California Environmental Protection Agency
CEQ	President's Council on Environmental Quality
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cm	centimeter
CO	Carbon monoxide
CO_2	carbon dioxide
CH_4	methane
CNDDB	California Natural Diversity Database
Complex	San Diego National Wildlife Refuge Complex
County	County of San Diego
CWA	Clean Water Act
DOI	Department of the Interior
EA	environmental assessment
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	Executive order
ESA	Federal Endangered Species Act
FC	Federal Candidate Species
FE	Federally endangered
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FR	Federal Register
FT	Federally threatened
FTE	full-time equivalent

FY	fiscal year
GHGs	greenhouse gases
GPS	Global Positioning System
GS	General Service
GUS	Groundwater Ubiquity Score
GWP	global warming potential
HUD	U.S. Department of Housing and Urban Development
H_2S	Hydrogen sulfide
IBP	Institute for Bird Populations
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
MAPS	Monitoring Avian Productivity and Survivorship
MBTA	Migratory Bird Treaty Act
MCAS	Marine Corps Air Station
MCLs	maximum contaminant levels
MHPA	Multi-Habitat Planning Area, as defined in the City of San Diego's Multiple Species Conservation Program Subarea Plan
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
mph	miles per hour
MRZ	Mineral Resource Zones
MSCP	Multiple Species Conservation Program
MSDS	Material Safety Data Sheet
MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NCCP	Natural Community Conservation Planning
NGOs	non-government organizations
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	Nitrogen dioxide
NOI	Notice of Intent
NOx	Oxides of nitrogen
N_2O	nitrous oxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NVCS	National Vegetation Classification Standards
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polycyclic aromatic hydrocarbons
PCC-grade aggregate	Aggregate that has been naturally sorted, rounded, and polished in rivers and creeks
PC region	production/consumption region
PCBs	polychlorinated biphenyls

PM_{10}	particulate matter equal to or less than 10 microns in size
$PM_{2.5}$	fine particulate matter equal to or less than 2.5 microns in size
PPE	personal protective equipment
ppm	parts per million
ppt	parts per thousand
PUP	Pesticide Use Proposal
PUPS	Pesticide Use Proposal System
ROD	Record of Decision
RONS	Refuge Operating Needs System
RTC	Resolution Trust Corporation
RWQCB	Regional Water Quality Control Board
SAMMS	Service Asset Maintenance Management System
SANDAG	San Diego Association of Governments
SCIC	California Historical Resources Information System South Coastal Information Center
SDG&E	San Diego Gas & Electric
SDMMP	San Diego Management and Monitoring Program
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
SO_2	Sulfur dioxide
SR	State Rare
SR-125	State Route 125
State	California Department of Fish and Wildlife
SUP	Special Use Permit
SWRCB	California State Water Resources Control Board
SWPPP	Storm Water Pollution Prevention Plan
TBT	tributyltin
TMDLs	Total Maximum Daily Loads
TNC	The Nature Conservancy
TRPH	total recoverable petroleum hydrocarbons
URDS	Urban Runoff Diversion System
USC	United States Code
USDA	U.S. Department of Agriculture
USDA APHIS	U.S. Department of Agriculture, Animal Plant Health Inspection Service
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Department of the Interior, Fish and Wildlife Service (also, Service)
USGS	United States Geological Survey
VOC	volatile organic compounds
WG	wage grade
WMA	San Diego Bay Watershed Management Area
WSA	wilderness study area
WUI	wildland-urban interface
°C	degrees Celsius
°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.

Alluvial. Clay, silt, sand, gravel, or other sedimentary matter transported and deposited in a delta or riverbed by flowing water.

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.

Approved Acquisition Boundary. A project boundary that the Director of the Service approves upon completion of the planning and environmental compliance process. An approved acquisition boundary only designates those lands that the Service has authority to acquire or manage through various agreements. The approval of an acquisition boundary does not grant the Service jurisdiction or control over lands within the boundary, and it does not make lands within the Refuge boundary part of the National Wildlife Refuge System. Lands do not become part of the System until the Service buys them or they are placed under an agreement that provides for their management as part of the Refuge System.

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.

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 (e.g., 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.

Critical Habitat. According to Federal law, the ecosystems upon which endangered and threatened species depend.

Cultural Resource. Sites, buildings, structures, and objects that are the result of human activities and are over 50 years old meet the definition of a cultural resource. Cultural resources include prehistoric, historic, and architectural sites, artifacts, historic records, and traditional cultural properties that may or may not have material evidence. These resources are managed on Refuges in accordance with all applicable Federal laws and Executive Orders (see Appendix K).

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 Overview. 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.

Cultural Landscape. A geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values."[1]

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.

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1 Birnbaum, C.A. 1994. Preservation Brief 36: Protecting Cultural Landscapes: Planning, Treatment and Management of Historic Landscapes. National Park Service. (https://www.nps.gov/tps/how-to-preserve/briefs/36-cultural-landscapes.htm)

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 and alternatives to such action; it 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 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).

Exotic Species. Species that have been intentionally introduced to or have inadvertently infiltrated an area in which they are not naturally found. Exotic species compete with native species for food or habitat.

Feral. Animals living in the wild, but descended from domesticated individuals.

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 that is naturally subjected to flooding.

Fluvial. Pertaining to a river.

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 (e.g., 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. Refer to Exotic Species.

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 that encourages productive and enjoyable harmony between humans and their environment to promote efforts that will prevent or eliminate damage to the environment and atmosphere and 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 Refuge System (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 America 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 the goal of improving joint stewardship of our natural resources.

Overbank Flooding. River flows that exceed the boundaries of the existing river channel and/or levees and that flood adjacent areas.

Passerine Bird. A songbird or other perching bird that is in the order Passeriformes (e.g., blackbirds, crows, warblers, sparrows, and wrens).

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.

Pollutant or Contaminant. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

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; it 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 recreation 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 and strong talons, that 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 System. The National Wildlife Refuge System (NWRS).

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, that have free water at or near the surface; or 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 Area. A transitional area between terrestrial and aquatic ecosystems, distinguished by gradients in biophysical conditions, ecological processes, and biota; areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands.

Riparian Habitat. Gravel bars; sand dunes; non-vegetated riverbanks; herbaceous, scrub, and forested vegetation that 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.

USFWS Trust Resources. These are natural resources that the USFWS has been entrusted with protecting for the benefit of the American people 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.

Understory. Shrubs and herbaceous plants that typically grow beneath larger trees or shrubs.

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 six 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 six 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 year, 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.