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FIGURES

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5.0 CONSERVATION STRATEGY

5.1 OVERVIEW

This chapter outlines the main components of the Solano Habitat Conservation Plan (HCP) Conservation Program for achieving the purpose of the HCP: to promote the conservation of biological diversity and the preservation of Covered Species and their habitats within the Plan Area. This chapter describes the goals and objectives for the Covered Species and their associated Natural Communities and the criteria for the selection and management of the reserves and preserves that will form the Solano HCP Reserve System (Reserve System). These goals and objectives and the establishment of the Reserve System: (a) provide measurable biological standards on which the Resource Agencies will measure the overall success of the HCP Conservation Program; and (b) will be primarily implemented through project-specific avoidance, minimization, and mitigation requirements described in Chapter 6.0 and the monitoring and adaptive management program described in Chapter 7.0.

Implementation of the Solano HCP goals and objectives results in the establishment of a Reserve System[1] that will:

- Preserve and manage 13,000 to 15,000 acres (ac) of Valley Floor Grassland and Vernal Pool habitat that shall include the following elements:
    - 9,900 ac of California tiger salamander upland and movement habitat
    - An estimated 200 ac of restored and 800 to 1,000 ac of preserved vernal pool and associated aquatic habitats for Covered Species
    - Approximately 3 ac of new California tiger salamander breeding habitat
- Preserve and manage approximately 5,9700 ac of agricultural foraging habitat, 1,000 ac of nesting and associated foraging habitat, and 2,240 ac of grassland/oak savanna habitat for Swainson's hawks and burrowing owls, and provide for increased long-term nesting opportunities through the establishment of a tree planting program and installation and maintenance of artificial burrow complexes.
- Preserve and manage approximately 3,300 ac of upland habitat for the California red-legged frog and callippe silverspot butterfly.
- Preserve and manage 50 ac of riparian and 36 ac of freshwater marsh, pond, and seasonal wetland habitat within Priority Watersheds and Drainages.
- Restore and manage 75 to 100 ac of coastal salt and/or brackish marsh habitat.
- Restore and manage an additional 175 ac of aquatic habitat and approximately 120 ac of associated upland habitat for giant garter snakes.

[1] The acreages for the anticipated Reserve System components are based on projected Covered Activities and development described in Chapter 2.0 at build out over the next 30 years. Reductions or alterations in projected build out could affect the anticipated Reserve System acreages.

In addition to establishing a Reserve System, the Solano HCP contributes to broader, regional conservation actions by:

- Providing funding to control invasive species on 5,000 to 8,500 ac of coastal marsh, stream, and riparian habitats within the Plan Area; and
- Providing funding to implement measures to control and treat existing urban and agricultural runoff.

5.2 RESERVE SYSTEM

The Reserve System is the backbone of the HCP conservation program. The extent to which the Reserve System can preserve, support, and maintain viable populations of Covered Species, biological diversity, and ecosystem functions will determine the overall success of the HCP. The Conservation Analysis in Chapter 4.0 addresses basic reserve design principles that shall, to the maximum extent practicable, guide development of the Reserve System. Chapter 4.0 also addresses the broader actions necessary to conserve and recover Covered Species and natural communities within the Plan Area. This chapter addresses the Plan Participant's specific commitments to minimize and mitigate the impacts from Covered Activities and their contribution toward the broader recovery goals described in Chapter 4.0.

5.2.1 Reserve Design Model

The reserve design model for the Solano HCP has been adapted from the Biosphere Reserve Design (UNESCO 1987), in which people are an integral component. Land management objectives range from complete protection to intensive, sustainable production (i.e., working farms and ranches), where production areas also provide habitat value for Covered Species. The Reserve System works within the parameters established by existing County zoning laws and uses existing habitat reserves and preserves to provide a core for building a large, relatively interconnected system of protected habitat lands. Most reserves will be located within Zones 2 and 3 (i.e., non-urban areas; Figure 1-4), where existing and anticipated future land uses, primarily agriculture and livestock grazing, provide suitable habitat for Covered Species. These surrounding lands can act as buffers to core reserve areas to minimize urban impacts, such as edge effects, and maintain connectivity between reserves. Whenever possible, buffer zones and corridors will be incorporated into the reserve design via land acquisitions or conservation easements.

The reserve design model for the Solano HCP must be consistent with the purpose of the HCP: *"…to promote conservation of biological diversity consistent with the recognition of private property rights, providing for a healthy economic environment for the citizens, agriculture, and industries, and ongoing maintenance and operation of public and private facilities in Solano County"* (Section 1.3.1). The reserves will act as core conservation areas with specific biological monitoring, management, and restoration practices conducted to promote ecosystem function and contribute to the recovery of Covered Species. The Reserve System must also incorporate the following assumptions, restrictions, and limitations:

1. Since land for future conservation areas will be acquired from willing sellers only, the HCP generally utilizes "soft line maps" that delineate potential reserve areas based on their relative conservation "value". Specific reserve or potential reserve boundaries are only shown where

they have been specifically proposed or identified for that purpose by private or governmental agency landowners in public documents. Specific acreages will be preserved or restored within each conservation area according to the goals and objectives for each Natural Community and associated Covered Species (Sections 5.3 through 5.10). The "soft line maps" depicting priority areas for protection represent a general guide to locating new reserve lands. The reserve design principles described in Section 4.2 shall be employed, to the maximum extent practicable, when choosing the exact location of a future preserve/reserve. All reserves authorized to fulfill HCP conservation requirements must undergo a review and approval process (see Section 10.5.1).

2. The Reserve System must be self-supportive in perpetuity. This requires a funding source, such as a management endowment, that will provide adequate funding for operation, management, and monitoring of the reserve in perpetuity. Funding requirements shall be based on reserve-specific conditions and management requirements (see Sections 10.5.1 and 10.5.3).

3. The Plan Participants recognize the need to review reserve system acquisition and potentially reprioritize areas for protection in order to maintain the integrity and functionality of the Reserve System as new information becomes available and in light of potential changes in the environment resulting from climate change and changes in land use and agricultural crop patterns. Periodic review of current land use practices (see Chapter 7.0) within the County will allow Plan Participants to modify conservation actions accordingly. Changes to the conservation actions may include the need to shift priorities for land purchase or conservation easements in order to provide habitat linkages and maintain connectivity between established reserves and preserves (see also Section 10.7).

4. Adaptive management is a necessary and ongoing activity for incorporating new information and management practices and confronting uncertainty in natural resources management. An adaptive management approach acknowledges that new and improved forms of management emerge over time as knowledge is gained and different techniques are tried and tested. Adaptive management also acknowledges that surprises are inevitable and that new uncertainties will emerge. Uncertainties do not paralyze management actions nor are they ignored. Instead, uncertainties are dealt with via an active learning approach.

5. As practicable, Plan Participants will incorporate buffer zones into reserve lands through direct purchase or establishment of conservation easements that maintain land uses beneficial to Covered Species and Natural Community conservation. Buffer zones protect natural ecosystems from the direct and indirect impacts associated with urbanization.

6. While a goal of the Solano HCP Conservation Strategy is to avoid establishment of small, isolated habitat areas, smaller reserves will need to be established within planned urban areas to achieve conservation needs for certain Covered Species and to provide linkages between natural communities. These areas, given their close proximity to urban development, will require more extensive management than areas further away from urban development.

5.2.2 Reserve Approval and Implementation

The Reserve System will consist of a combination of commercial and institutional mitigation/ conservation banks, private or project-specific mitigation lands, and lands purchased by the Plan Participants. Long-term management and monitoring is critical to a successful Reserve System. As such, each reserve established under the provisions of the Solano HCP must incorporate basic management and monitoring objectives. Chapter 7.0, Monitoring and Adaptive Management, and

Section 10.5, Plan Implementation, address these specific requirements, criteria, and process for establishing and approving future reserves under the Solano HCP. Reserve design and implementation standards are prescribed for the following in order to provide consistent compliance with HCP management, monitoring, and performance requirements:

- **Mitigation/Conservation Bank Certification and Project-Specific Mitigation Lands Approval (Section 10.5.1):** This section addresses the review and approval process for proposed reserves.
- **Conservation Easement Standards and Requirements (Section 10.5.2):** All reserve lands must be protected in perpetuity, and this section addresses the required standards to be included in conservation easements.
- **Resource Management Plan Preparation, Long-Term Funding Assurances, Implementation, and Monitoring and Reporting Requirements (Sections 7.3 and 10.5.3):** These sections provide the minimum standards for the management, monitoring, and funding for reserves as well as the review and approval process for the management plans. These sections also include any special management objectives for applicable Covered Species and Natural Communities based on the goals and objectives prescribed in Sections 5.3 through 5.11, below.
- **Habitat Restoration and Enhancement Plans (Section 10.5.4):** This section addresses the basic guidelines for restoration and enhancement as well as the format and content necessary for review and approval of such plans.
- **Adaptive Management Requirements (Section 10.5.5):** The ability and need to modify management activities in response to new information (e.g., adaptive management) is critical to the long-term success and viability of individual reserves and the overall Reserve System. This section addresses the requirement to incorporate flexibility and funding for implementing adaptive management strategies into specific reserve plans as well as how the Solano County Water Agency (SCWA) and the Plan Participants will oversee and implement the overall adaptive management hypothesis and testing program for the broader Reserve System (see Section 7.4).
- **Good Neighbor Policy Requirements (Section 10.5.6):** The establishment of the Reserve System may result in the expansion (colonization or increased numbers) of some Covered Species populations on private lands adjacent to preserves, potentially restricting the activities of adjacent landowners. The Solano HCP provides for a "Good Neighbor Policy" for incidental take permit coverage for willing participants on an "opt-in" basis for all agricultural lands adjacent to established reserves. This section addresses the specifics of the policy and the procedures for implementing the policy at each reserve.

5.3 VALLEY FLOOR GRASSLAND AND VERNAL POOL CONSERVATION STRATEGY

The Valley Floor Grassland and Vernal Pool Natural Community goals and objectives are applicable to grassland habitat within the historical alluvial terraces or valley floor portions of Solano County as well as the larger grasslands in the Montezuma Hills and Potrero Hills (Figure 4-8). Significant portions of these grassland areas currently support or historically supported and are reasonably capable of being restored to vernal pool habitats that support Covered Species and Special Management Species (see Table 4.1).

In Section 4.3.2.3, High, Medium, and Low Value Conservation Areas were identified based on specific conservation criteria (Figure 4-8). The High and Medium Value Conservation Areas were further divided into subareas based on geographic areas and species-specific conservation requirements. Conservation goals and objectives were developed for each conservation subarea. The project-specific mitigation requirements in Chapter 6.0 pertain to these conservation areas and subareas, and establish appropriate mitigation for Covered Activities and acceptable levels of development within the Plan Area compatible with the broad regional conservation goals and objectives.

The Valley Floor Grassland and Vernal Pool Natural Community Conservation Strategy establishes and maintains a reserve system that:

- Enhances the functions and values of valley floor grassland and vernal pool ecosystems;
- Maintains populations of Covered Species and common species that co-occur in these habitats; and
- Supports adaptation and genetic diversity of the Covered Species that inhabit the Valley Floor Grassland and Vernal Pool Natural Community.

Primary conservation actions include preservation, restoration, and reintroduction of Covered Species and their habitat, maintaining connectivity between vernal pool regions, and implementing management strategies that enhance populations of Covered Species and Special Management Species.

The Jepson Prairie Region of Solano County (see Figure 1-3) is renowned for its extensive and largely intact vernal pools and associated grasslands. The Jepson Prairie contains several large, existing resource agency and non-profit conservation organization preserves (Figure 3-11). The most well-known preserve is the Jepson Prairie Preserve (1,569 ac), which was originally established by The Nature Conservancy but is currently owned and managed by the Solano Land Trust. Other nearby preserves include the Wilcox Ranch (The Nature Conservancy owns 1,562 ac and the City of Fairfield in Solano County owns 1,858 ac), and the Calhoun Cut Ecological Reserve (934 ac owned by the California Department of Fish and Game [CDFG]).

In addition to these preserves, a number of private and public vernal pool community conservation and mitigation banks have been approved or are under consideration in the State and Federal Mitigation Banking Review process. Once approved, conservation easements and approved management plans for these banks will be implemented. Habitat restoration at commercial banks are typically conducted in advance of impacts because of standard banking agreement conditions that limit the availability and/or value of restoration credits until specific performance criteria are achieved. Currently approved multispecies, vernal pool mitigation and conservation banks within Solano County (Figure 3-11) include:

Campbell Ranch		158 ac
Elsie M. Gridley Preserve		1,800 ac
North Suisun Mitigation Bank		612 ac
Muzzy Ranch		1,390 ac
Burke Ranch		960 ac
Noonan Ranch		200 ac
Goldfield Conservation Bank		155 ac
	Total	**5,275 ac**[1]

All of these existing and proposed banks are located within High Value Vernal Pool Conservation Areas (see Figure 4-8). The combined acreage in these banks, depending on available credits, could provide approximately half of the 10,500 to 11,500 ac needed to fulfill the long-term conservation commitment for this community type and associated Covered Species as specified in the HCP. The establishment of these mitigation and conservation banks will provide substantial vernal pool habitat preservation, restoration, and management before any development or anticipated habitat loss/take of Covered Species occurs. Most of the remaining conservation for this community type is anticipated to occur as specific land dedications for preservation of Contra Costa Goldfield Core Population Areas (see Figure 4-6) and to provide secure corridors between established reserves.

The Solano HCP Conservation Strategy in combination with existing preserves will encompass approximately 16,000 ac of contiguous vernal pool habitat within high-priority conservation areas by the time the HCP is fully implemented. This large system of protected and managed lands will significantly contribute to the conservation target established in Section 4.5.2 and identified in the Vernal Pool Species Recovery Plan (USFWS 2005a). The Solano HCP Conservation Strategy will also provide for preservation of two important landscape corridors in Solano County: Suisun Marsh to Jepson Prairie and Jepson Prairie to Vaca Mountains/Inner Coast Range (See Section 4.3.1 and Figure 4-3).

5.3.1 Valley Floor Grassland and Vernal Pool Natural Community Goals and Objectives

5.3.1.1 Goal VPG 1

Establish and maintain a system of new reserves and existing preserves that enhances essential ecological processes, functions, and values, provides for species movement and dispersal, and Valley Floor Grassland and Vernal Pool ecosystem resiliency.

Objective VPG 1.1. Preserve 13,000 to 15,000 ac[2] of Valley Floor Grassland and Vernal Pool habitat within High Value Vernal Pool Conservation Areas and/or potential preserve and reserve areas identified in Figure 4-8 that provide habitat for Covered Species. More specifically, preserve approximately:

[1] Acreages reported are for the total bank size and do not necessarily reflect the current availability of credits.

[2] Habitat preservation and restoration objectives are based on projected habitat losses described in Chapter 2.0 at build out and the specific mitigation requirements for Covered Species and Natural Communities described in Section 6.4.

- 380 to 400 ac in Subarea 1B,
- 700 to 760 ac in Subarea 1C,
- 60 ac in Subarea 1D,
- 170 ac in Subarea 1E,
- 120 ac in Subarea 1G,
- At least 350 ac in Subarea 1F, and
- 11,140 to 13,220 ac in Subarea 1A or other potential vernal pool preserve and reserve areas.

Objective VPG 1.2. Preserve or establish corridors linking the vernal pool complexes and reserves between the upper Union Creek/northeastern McCoy Creek watersheds (Subareas 1B, 1C, and 1D) and the Jepson Prairie (Subarea 1A), and between the Jepson Prairie (Subarea 1A) and the Potrero Hills (Subarea 2F) (Figure 4-8). Corridor reserves less than 1 mile (mi) in width shall be as long as they are wide, with a minimum width of 1,320 feet (ft).

Rationale. Subarea preservation objectives establish minimum reserves in all High Value Conservation Areas as well as establishing requirements to interconnect these broader landscape areas. The establishment of reserves in Subareas 1B through 1G is particularly important for conserving Contra Costa goldfields. In some of these areas (e.g., Subarea 1E), existing development or unsuitable habitat surrounds the habitat area inhabited by a Covered Species, limiting the amount of habitat (60 to 170 ac) available for designation as reserves. Nonetheless, existing populations of Covered Species in these areas contribute to the total genetic diversity of the species and are therefore targeted for preservation.

Objective VPG 1.3. Restore a minimum of 1 ac of vernal pool habitats within High and Medium Value Vernal Pool Conservation Areas for every acre of seasonal wetland directly impacted by Covered Activities (1:1 ratio, estimated to be approximately 200 ac of restored vernal pools).

Rationale. Historical land use practices have altered much of the remaining vernal pool and associated valley floor grassland habitat (see Figure 4-5). While significant resources still exist, active management and restoration is needed to restore historical levels of productivity and value for native vernal pool as well as associated grassland species. Restoration will be conducted in moderately to highly disturbed habitats within and adjacent to moderate/high-quality vernal pool complexes identified in Figures 4-5 and 4-8. The success of restoration efforts will be measured by the diversity of species (i.e., native versus nonnative) and the distribution and relative abundance of vernal pool Covered Species present in restored habitats (see Chapter 7.0 for specific monitoring criteria). In addition to wetland community restoration, re-establishing the inter-pool and swale-mounded topography may also be necessary in many areas to promote habitat for fossorial rodents.

Objective VPG 1.4. Reserve Management Plans shall include vegetation management strategies that promote establishment of native grasses and that result in a patchwork of lightly to moderately grazed pastures, with occasional patches of ungrazed or taller vegetation.

Rationale. As described in the Valley Floor Grassland and Vernal Pool Natural Community model in Appendix B, dense nonnative annual grass and other invasive plant species can result in a buildup of thatch cover that inhibits the successful germination of many native plants and the movement and foraging behavior of animals such as the California tiger salamander and Delta green ground beetle. Grazing has substantial benefits as a vegetation management tool for offsetting problems with nonnative annual grasses in vernal pool ecosystems. Vernal pool

plants and fairy shrimp may also benefit from livestock grazing by the transport of seeds or cysts from one pool to another in feces, on fur, or on hooves. While many species in this Natural Community benefit from grazing, patches of ungrazed to lightly grazed grasslands are important to a number of other grassland-associated species such as the short-eared owl, northern harrier, and grasshopper sparrow (see Section 5.11). Sections 10.5.3 and 7.3 provide additional information on management requirements for reserves in the Valley Floor Grassland and Vernal Pool Natural Community.

5.3.2 Species Goals and Objectives

5.3.2.1 Goal VPG 2

Maintain and, where possible through restoration, increase population levels and distribution of vernal pool Covered Species.

Objective VPG 2.1. Preserve 90 percent of the occupied habitat of Contra Costa goldfields within the Plan Area.

Objective VPG 2.2. Establish 100 ac of new, self-reproducing Contra Costa goldfield populations[1] within known or potential habitat areas (Figure 4-6).

Objective VPG 2.3. Preserve and/or establish one occurrence[2] of Ferris's milk-vetch within the Plan Area.

Objective VPG 2.4. Preserve and/or establish eight occurrences of alkali milk-vetch within the Plan Area.

Objective VPG 2.5. Preserve and/or establish one occurrence of vernal pool smallscale within the Plan Area.

Objective VPG 2.6. Preserve and/or establish two occurrences of Boggs Lake hedge-hyssop within the Plan Area.

Objective VPG 2.7. Preserve and/or establish three occurrences of legenere within the Plan Area.

Objective VPG 2.8. Preserve and/or establish one occurrence of Colusa grass within the Plan Area.

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1 Self-reproducing population is defined as having plants that re-establish annually for a minimum of 5 years with no human intervention such as supplemental seeding.

2 One occurrence corresponds to an occupied area at least 0.25 mi away from the next occupied area (USFWS 2006). The number of plants making up an occurrence may vary from year to year particularly as annual plant germination and growth may be effected by environmental conditions in a given year. An occurrence must be self-sustaining; therefore, a single Contra Costa goldfield plant would not likely be considered an occurrence. If, however, a small number of plants is repeatedly observed at a location over time, this location could be considered an occurrence provided it is separated from other occurrences by at least 0.25 mi.

Objective VPG 2.9. Preserve and/or establish one occurrence of San Joaquin Valley Orcutt grass within the Plan Area.

Objective VPG 2.10. Establish one new occurrence of Solano grass on preserved lands within the Plan Area.

Objective VPG 2.11. Preserve 2,500 ac of natural vernal pool grassland encompassing known occurrences of Delta green ground beetles in the Jepson Prairie region of the Plan Area.

Objective VPG 2.12. Preserve and/or establish five populations[1] of Conservancy fairy shrimp within the Plan Area.

Objective VPG 2.13. Preserve and/or establish ten populations of vernal pool fairy shrimp within the Plan Area.

Objective VPG 2.14. Preserve and/or establish four populations of vernal pool tadpole shrimp within the Plan Area.

> **Rationale.** The Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005a) establishes recovery criteria that require protection of 100 percent of all species populations with fewer than 20 occurrences and that occur in 3 or fewer vernal pool regions unless new populations are discovered or established (i.e., replacements for current occurrences). The recovery criteria require protection of less than 100 percent of all species with more than 20 known occurrences throughout their geographic and ecological range. The United States Fish and Wildlife Service (USFWS) defines 1 occurrence as an occupied area at least 0.25 mi away from the next occupied area (USFWS 2005a). Implementation of the Solano HCP Conservation Strategy will result in the cumulative protection of approximately 50 percent of the habitat identified in the Recovery Plan. Therefore, species-level objectives for the HCP were also established at 50 percent of the recovery criteria. The objectives identify the number of occurrences to be preserved based on the percentage of known occurrences identified in the Recovery Plan. Preservation of these occurrences will be achieved by preserving known, new, or restored occurrences on reserve lands. Should preservation sites not be available, new populations will be established on existing reserves.

Objective VPG 2.15. Preserve existing and/or restore 9,900 ac of California tiger salamander habitat within the High or Medium Value Vernal Pool Conservation Areas (see Figures 4-8 and 4-26). [Note: This acreage objective may be achieved concurrently with Objective VPG 1.1.] Selected reserves shall meet the following criteria:

- Each reserve shall contain or serve to connect a minimum of two protected breeding sites[1] (ponds or pools) located within contiguous uplands with no more than 0.7 mi separating the breeding sites.

[1] Population is defined in the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005a) as "a group of individuals of the same species that occupy an area small enough to permit interbreeding regularly."

- New reserves, in combination with existing protected areas shall provide a minimum of 350 to 500 ac of contiguous upland habitat that will allow unobstructed movement between breeding sites and upland burrow sites.
- Priority shall be given to establishing reserves that connect existing reserves or that restore habitat between existing reserves in Vernal Pool Conservation Areas 1F and 2F (the Potrero Hills/State Route 12 [SR-12] region), Vernal Pool Conservation Area 1A (the Greater Jepson Prairie region), and Vernal Pool Conservation Areas 1C and 1D (northeast Fairfield region) (see Objective VGP 1.2).
- Preserves shall include measures for restoration of upland mounds, where applicable, in order to provide increased burrowing habitat for fossorial rodents and California tiger salamanders above the shallow, rainy season water table (see Section 10.5.4.1).
- Preserves shall include measures to limit access to and control California tiger salamander larval predators such as fish, crayfish, and bullfrogs in suitable breeding habitat.

Rationale. As shown on Figure 4-7, California tiger salamander distribution in Solano County occurs in four partially isolated population nodes. The largest population node, which forms the core population in Solano County, is on the Jepson Prairie (Conservation Area 1A). The other sub-population nodes are northeastern Fairfield (Conservation Areas 1C, 2C, and 1D), Potrero Hills (Conservation Areas 1F and 2F), and the Montezuma Hills (Conservation Area 2I). The barrier created by the existing high traffic volumes on SR-12 has largely eliminated California tiger salamander movement between the core population on the Jepson Prairie and the sub-populations in the Potrero Hills and the Montezuma Hills. The corridor between the Jepson Prairie and the northeastern Fairfield population has been diminished to a currently very narrow and fragmented corridor because of incompatible land uses (irrigated agriculture and Travis Air Force Base [AFB] runway).

Objective VPG 2.16. Preserve and create new, suitable, California tiger salamander breeding habitat at a 3:1 (mitigation-to-impact) ratio for impacted breeding habitat. Additional breeding habitat shall be provided at a ratio of 0.0035 ac per acre[2] of California tiger salamander upland habitat. All new and preserved breeding habitat shall be within lands acquired for the Solano HCP Reserve System.

Rationale. Habitat preservation, by itself, is an important tool for species recovery; however, additional breeding habitat, as required under Objective VPG 2.16, is necessary to increase California tiger salamander populations above baseline conditions in preserves and offset reduced population levels in impacted lands.

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1 Acceptable breeding sites suitable for meeting this criterion shall have demonstrated an ability for successful recruitment and have suitable hydrology to be capable of successful recruitment during low to normal rainfall years.

2 Trenham and Shaffer (2005) have identified ponds in the range of 0.35 ac as being desirable to maximize potential for retaining a viable population for a 350 ac preserved area. The additional breeding habitat ratio of 0.0035 ac per acre of impacted upland habitat in combination with upland habitat mitigation requirements (see Section 6.4.2.2) is designed to achieve this amount of additional breeding habitat for 350 ac of preserved upland habitat.

5.4 CALIFORNIA RED-LEGGED FROG CONSERVATION STRATEGY

The California red-legged frog goals and objectives apply to all aquatic and upland habitats within the California Red-legged Frog Conservation Area and, to a lesser degree, the remainder of the Inner Coast Range (Figures 3-5 and 4-14). The Recovery Plan for the California Red-Legged Frog (USFWS 2002a) identifies five criteria and seven general actions needed for recovery. The overall recovery strategy involves:

- Protecting existing populations by reducing threats;
- Restoring and creating habitat that will be protected and managed in perpetuity;
- Surveying and monitoring populations and conducting research on the biology and threats of the subspecies; and
- Re-establishing populations of the subspecies within its historic range.

Several existing reserves owned by the Solano Land Trust, which is supported by funding from the City of Fairfield and other sources, are present in the California Red-legged Frog and Callippe Silverspot Butterfly Conservation Areas. The City of Vallejo also owns and manages two additional open space reserves in this area. These reserves cover approximately 4,450 ac and include Lynch Canyon (a City of Fairfield purchase donated to Solano Land Trust), King and Swett Ranches (owned by the Solano Land Trust), and the Sky Valley and Gateway Open Space Reserves (owned by the City of Vallejo).

The Solano HCP Conservation Strategy for California red-legged frog encompasses the elements of the Recovery Plan identified above and works to expand the protected lands within the conservation area. Protecting existing populations will be accomplished primarily through the preservation and/or active management of an estimated 3,300 ac of additional Inner Coast Range upland, riparian, and aquatic habitats within the California Red-Legged Frog Conservation Area. Implementation of the Conservation Strategy will result in the construction and restoration of additional breeding habitat within the Conservation Area that will be managed for the benefit of California red-legged frogs. The control of invasive species includes measures to prevent the creation of new permanent water features and the "perennialization" of intermittent creeks and to implement control programs established as part of the resource management plans for the reserves.

Re-establishing or augmenting existing populations will occur through salvage of individuals from impacted sites (see Section 6.3.3, Avoidance and Minimization) and their release at recently constructed or existing aquatic breeding habitats or other reserves with applicable management requirements. The relocation of California red-legged frogs is also considered important for maintaining the metapopulation structure of California red-legged frogs in this region. The California Red-Legged Frog Conservation Area is divided into three discrete and largely isolated units by I-80 between Vallejo and Fairfield and by SR-12 between Fairfield and Napa County. The barriers formed by these highways severely restrict or eliminate the natural dispersal and migratory movements of individuals between these three blocks of habitat, thereby reducing the resiliency of populations and limiting genetic diversity.

Chapter 7.0, Monitoring and Adaptive Management, provides information on monitoring and research for the goals and objectives for this species.

Section 4.5.4 identifies a conservation target of 20 percent of the historic range within Solano County or roughly 31,160 ac for this species, which equates to 97 percent of the Solano HCP California Red-Legged Frog Conservation Area. A large network of reserves is currently being developed by the Tri-City County Open Space Joint Powers Authority (JPA) in conjunction with the Solano Land Trust. This reserve network preserves approximately 8,500 ac and provides an excellent foundation upon which to build a reserve system and achieve the overall conservation target (see Section 4.5.4 for details). The California Red-Legged Frog Conservation Strategy will contribute to this reserve system through the protection and management of additional habitat (up to 3,300 ac) and funding for the management of California red-legged frog and associated species on existing open space lands.

While the primary emphasis of the Solano HCP Conservation Strategy for the California red-legged frog is within the Conservation Area, currently unknown populations of California red-legged frog may be present in other locations in western hills of the County. Approximately 4,150 ac of intermixed upland grassland and oak woodland are located in established open space reserves in the western hills of Solano County in Fairfield and Vacaville. The City of Fairfield currently owns and manages approximately 1,400 ac of land (Rockville Hills Park, Rolling Hills, Serpas Ranch, and others), and approximately 800 ac of oak woodland/grassland has been set aside as private open space as part of the Rancho Solano development in northeastern Fairfield. The City of Vacaville owns approximately 1,950 ac (Lagoon Valley, Butcher Road, Lyon Road, Glen Eagle, and others).

A major objective of the Conservation Strategy for California red-legged frog in the Conservation Area as well as in the remainder of the Inner Coast Range Natural Community is to limit the expansion of introduced predators (e.g., bullfrogs and warm water fish). This objective requires limiting the creation of new habitats for these species as an indirect effect of planned development and other HCP Covered Activities.

5.4.1 California Red-Legged Frog Goals and Objectives

Goal RLF 1. Re-establish or increase California red-legged frog populations through preservation and management of interconnected blocks of upland and aquatic habitats that support natural movement patterns, breeding, and metapopulation dynamics within the California Red-Legged Frog Conservation Area and Inner Coast Range Natural Community.

Objective RLF 1.1. Preserve and/or actively manage 3,300 ac of upland, riparian, and aquatic habitats within the California Red-Legged Frog Conservation Area in perpetuity for the benefit of California red-legged frogs.

Objective RLF 1.2. Preserve existing California red-legged frog breeding habitat at a 2:1 (mitigation-to-impact) ratio and create new breeding habitat at a 2:1 ratio in approved reserves within the California Red-Legged Frog Conservation Area for unavoidable direct impacts to suitable breeding habitat from Covered Activities.

Rationale. Increasing California red-legged frog populations primarily requires expanding the acreage and distribution of suitable breeding habitat and by controlling nonnative predators in new and existing breeding habitat.

Objective RLF 1.3. Reserve Management Plans shall include vegetation management strategies that promote the establishment of native grasses and that result in a patchwork of lightly to moderately grazed pastures with occasional patches of ungrazed or taller vegetation.

Rationale. Reserve management objectives in this Conservation Area are similar to the Valley Floor Grassland and Vernal Pool Natural Community. Tall, dense grass thatch may inhibit California red-legged frog dispersal and movement through upland areas. Grazing or other techniques will be used to reduce annual grass, invasive weed, and thatch cover, and to create a patchwork of residual light to moderate grassland cover.

Objective RLF 1.4. Maintain connectivity between existing habitat areas and translocate frogs between the three disjunct blocks of the California Red-Legged Frog Conservation Area at least once every 10 years during the effective time frame of the HCP.

Rationale. The California Red-Legged Frog Conservation Area has been artificially divided into three discrete blocks of habitat by two major highways (I-80 and SR-12). While frog dispersal/movement within each block is relatively unobstructed (each area has few roads or natural barriers), I-80 and SR-12 severely restrict frog movement between blocks. This inability for natural dispersal can severely reduce the resiliency and genetic diversity of frog populations within the Conservation Area. Since re-establishing natural corridors between the blocks is impracticable, transplanting California red-legged frogs collected from reserves or salvaged from habitats impacted by Covered Activities is necessary to achieve Goal RLF 1. Therefore, SCWA shall coordinate with the USFWS, CDFG, and managers of preserves and open space lands to translocate California red-legged frogs between the three disjunct blocks of the California Red-Legged Frog Conservation Area.

Objective RLF 1.5. Prohibit activities that would increase or create new aquatic habitat for introduced predators and competitors of California red-legged frogs and other native amphibians (e.g., bullfrog, crayfish, and warm water fish) within the entire Inner Coast Range Natural Community, with an emphasis in the California Red-legged Frog Conservation Area.

Rationale. California red-legged frogs are currently only known to be present in the hills east of Green Valley and in the Tri-City/County Planning Area (i.e., the California Red-Legged Frog Conservation Area). Although there are currently no extant records of frogs from the Vaca Mountains/Blue Ridge, relict populations could still be present. There are historical records near Lake Berryessa, and much of the Inner Coast Range region of Solano County (excluding the California Red-Legged Frog Conservation Area) has not been extensively surveyed. Objective RLF 1.5 and its implementing measures (see Section 6.3.3) are intended to incorporate design practices for new development that would minimize potential for creating suitable habitat and expanding populations of bullfrogs and fish into the western edge of the County. These measures also contribute to protecting habitat for and expanding populations of other Special Management Species such as the pond turtle and foothill yellow-legged frog.

5.5 CALLIPPE SILVERSPOT BUTTERFLY CONSERVATION STRATEGY

The callippe silverspot butterfly goals and objectives are designed to protect and enhance callippe silverspot butterfly habitat and populations throughout the Callippe Silverspot Butterfly Conservation Area (Figure 4-13). These goals and objectives are, in large part, intended to be implemented concurrently with the California red-legged frog goals and objectives described in Section 5.4.

The overall conservation goal for callippe silverspot butterfly is to preserve multiple populations in secure core areas and to provide connectivity between these preserved core areas. The Callippe Silverspot Butterfly Conservation Strategy is largely based on avoiding habitat impacts and maintaining connectivity between existing stands of Johnny jump-up (the larval host plant) within the Conservation Area (see Avoidance Measures in Section 6.3.4); however, some direct and indirect impacts are anticipated. Mitigation for these impacts will provide additional protection for core breeding habitat within the Conservation Area as well as additional habitat restoration to expand breeding habitat and adult nectar plants.

Reserve management objectives are similar to those for California red-legged frog and the Valley Floor Grassland and Vernal Pool Natural Community Reserves. Light to moderate livestock grazing will be used to maintain low annual grass cover and residual thatch buildup (see Callippe Silverspot Butterfly Conceptual Model, Appendix B). Johnny jump-up typically grows best in areas where the grasses are short during the beginning of spring and thatch is low.

5.5.1 Callippe Silverspot Butterfly Goals and Objectives

Goal CSB 1. Maintain or increase callippe silverspot butterfly populations through preservation and management of interconnected blocks of upland habitat that support natural movement patterns, breeding, and metapopulation dynamics within the Callippe Silverspot Butterfly Conservation Area.

Objective CSB 1.1. Preserve and manage suitable callippe silverspot butterfly breeding habitat at a 3:1 (mitigation-to-impact) ratio for direct unavoidable impacts to suitable breeding habitat and a minimum of a 1.5:1 ratio for indirect impacts to suitable breeding habitat. Breeding habitat preservation and management shall be accomplished in combination with the 3,300 ac of Inner Coast Range habitats to be acquired under Objective RLF 1.1 (Section 5.4.1).

Objective CSB 1.2. Increase the quantity and quality of breeding habitat and adult nectar sources for callippe silverspot butterfly within the Callippe Silverspot Butterfly Conservation Area.

Objective CSB1.3. Reserve Management Plans shall include vegetation management strategies that promote establishment of native grasses and low residual cover of introduced annual grasses (700 to 1,000 pounds [lbs] or less residual dry matter) in core breeding areas.

Objective CSB 1.4. Maintain connectivity between core breeding sites and existing subpopulations within the Callippe Silverspot Butterfly Conservation Area by preserving corridors with a minimum width of 300 ft oriented along hilltops and ridgelines.

Rationale. The matrix of the reserve system within the Callippe Silverspot Butterfly Conservation Area will overlap with the reserve acquisition for the California red-legged frog in these two overlapping conservation areas. The callippe silverspot butterfly objectives are intended to: (1) preserve and protect existing larval/breeding habitat and movement corridors on the periphery of planned urban development areas; and (2) to incorporate requirements for the reserves in this broader conservation area to include necessary elements for the callippe silverspot butterfly (breeding habitat/larval host plant, dispersal corridors, and adult nectar sources).

Low to moderate levels of thatch or residual grass mulch (700 to 1,000 lbs or less residual dry matter for typical California annual grassland range sites) favor low-growing wildflowers such as Johnny jump-up, the host plant for the callippe silverspot butterfly. Populations of other California grassland-associated butterflies such as the Bay checkerspot (*Euphydryas editha bayensis*) have been found to positively respond to low residual levels of introduced annual grasses (Guenther and Hayes 2008).

5.6 RIPARIAN, STREAM, AND FRESHWATER MARSH CONSERVATION STRATEGY

The Riparian, Stream, and Freshwater Marsh Natural Community goals and objectives apply to all freshwater, aquatic, marsh, and riparian habitats within the Plan Area, excluding vernal pools and seasonal wetlands associated with the Valley Floor Grassland and Vernal Pool Natural Community (Figure 3-5). The Riparian, Stream, and Freshwater Marsh Natural Community Conservation Strategy is designed to preserve and enhance remaining stream and riparian habitats and limit significant future alterations of hydrogeomorphic functions while recognizing historical changes in these communities and the current need to protect life and property from flooding. Primary conservation actions include preservation, habitat restoration, invasive species control, and maintenance of water quality and hydrogeomorphic processes in order to contribute to the conservation and recovery of associated Covered Species and promote habitat connectivity.

In Section 4.3.6.3, Priority Drainages and Watersheds were identified based on specific conservation criteria (Figure 4-10). Priority Drainages were further subdivided into specific conservation areas based on site-specific conservation actions (Section 4.3.6.3). The designated actions for each conservation area outline the overall conservation approach for the Riparian, Stream, and Freshwater Marsh Natural Community (see Section 4.6.5 for a detailed discussion of the reserve design and conservation approach). The implementing measures (Chapter 6.0) establish appropriate mitigation for Covered Activities and acceptable levels of development within the Plan Area compatible with the regional conservation goals and objectives.

The goals and objectives in the HCP are designed to fully mitigate impacts resulting from Covered Activities to riparian, stream, and freshwater marsh ecosystems within the Plan Area commensurate with the anticipated level of impact. The following sections detail the goals and objectives for the Riparian, Stream, and Freshwater Marsh Natural Community.

5.6.1 Riparian, Stream, and Freshwater Marsh Natural Community Goals and Objectives

Goal RSM 1. Provide for no net loss of natural hydrogeomorphic processes; essential ecological processes, functions, and values; species diversity; and habitat heterogeneity of riparian, stream, and freshwater marsh habitats within the Plan Area.

Objective RSM 1.1. Preserve, restore, and enhance 50 ac of riparian and 36 ac of freshwater marsh, pond, and seasonal wetland habitat within Priority Watersheds and Drainages.

Objective RSM 1.2. Plan Participants shall develop and adopt invasive species control programs as part of ongoing operational and maintenance activities associated with public facilities (e.g., maintained stream channels, flood control channels, parks, bike paths, and linear parks). Invasive species control programs are subject to review and approval by SCWA in consultation with the Regulatory Agencies and shall be in place within 5 years of adopting the Solano HCP.

Objective RSM 1.3. Restore and expand riparian and floodplain habitat within at least 2.5 mi of existing channelized stream and flood channels of old Alamo Creek, old Ulatis Creek, upper Union Creek, other streams identified for restoration efforts, and future development along Priority Drainages (Figure 4-10). Channel design standards shall include, but not be limited to, establishing a two-stage floodplain corridor that allows natural channel meander patterns to develop while still providing for riparian habitat restoration and protection, and an adequate capacity to handle predicted storm flows.

Objective RSM 1.4. Maintain peak flows from storm water discharge and natural hydrological processes in order to protect stream channels from degradation through the implementation of storm water management practices.

Objective RSM 1.5. Maintain and increase water quality for Covered Species inhabiting receiving waters within and downstream of the Plan Area by minimizing non-point source pollution derived from storm water runoff.

Rationale. The above objectives promote protection of and opportunities for riparian restoration and enhancement within existing public rights-of-way where it would not conflict with flood control or safety considerations. Riparian habitats are one of the natural communities most affected by invasive exotic species. Objective RSM 1.2 is designed to increase Plan Participant and public awareness of invasive species and to incorporate control measures into the routine vegetation management programs conducted by Plan Participants.

5.6.2 Covered Species Goals and Objectives

Goal RSM 2. Contribute to the recovery of Covered Species associated with the Riparian, Stream, and Freshwater Marsh Natural Community in the Plan Area through the preservation and expansion of existing populations, and future population expansion and re-colonization in restored areas.

Objective RSM 2.1. Remove existing in-stream barriers, to the maximum extent practicable, in Plan Participant rights-of-way and on participating private lands along important steelhead

streams: Jameson Canyon, Lynch Canyon (a.k.a. American Canyon), Ledgewood, Suisun Valley, and Green Valley Creeks and their tributaries that contain suitable breeding and rearing habitat for steelhead and salmon.

Objective RSM 2.2. Prevent the creation of in-stream barriers associated with new development and increase suitable breeding and rearing habitat for steelhead along Jameson Canyon, Lynch Canyon, Ledgewood, Suisun Valley, and Green Valley Creeks and their tributaries.

Objective RSM 2.3. Increase available habitat for the valley elderberry longhorn beetle within the riparian areas of Alamo, Ulatis, Green Valley, Suisun Valley, Ledgewood, and Putah Creeks and other creeks supporting extant valley elderberry longhorn beetle populations by replacing impacted elderberry plants at a minimum ratio of 2:1 (mitigation-to-impact).

Objective RSM 2.4. Establish at least 70 ac of new, suitable nesting habitat[1] for tricolored blackbirds in agricultural reserves established as Swainson's hawk foraging and nesting habitat mitigation.

Objective RSM 2.5. Preserve one known tricolored breeding site with a similar sized breeding population for each known breeding colony affected by development. SCWA, in consultation with the Resource Agencies (see Section 10.2.6), will implement interim measures to protect active and known colonies until such time as the HCP reserve system supports a number of breeding colonies equal to or greater than the number lost as a result of development activities.

> **Rationale.** Several existing barriers limit steelhead access into and out of suitable steelhead breeding/rearing habitat on several streams in western Solano County. These barriers include: existing tide gates on several streams that discharge to Suisun Marsh; long culverts under existing freeways; and, in a few instances, beaver dams (LSA 2008b). Removal or modification of these barriers should improve reproduction and populations of steelhead using these streams. Objective RSM 2.3 focuses on providing additional obligate larval habitat and filling in gaps in elderberry distribution along riparian habitat along streams with known populations of valley elderberry longhorn beetle. Tricolored blackbirds occur sporadically around the County. Providing requirements to establish dense thickets of suitable nesting cover into reserves established for Swainson's hawk will provide additional long-term opportunities for expanding nesting colonies within the Plan Area.

5.7 GIANT GARTER SNAKE CONSERVATION STRATEGY

The status of the giant garter snake in Solano County is unknown. Trapping studies in 2004 and 2005 by the United States Geological Survey (USGS) in Solano County failed to document giant garter snakes. However, a major population is present in the Yolo Bypass and Lower Putah Creek Basin area just northeast of the Plan Area. Overtime, giant garter snake populations may re-establish or expand in the Plan Area, especially if substantial marsh habitat restoration occurs as has been proposed by a number of entities for recovery actions for the Delta smelt (CALFED

[1] Nesting habitat established to meet this objective shall not consist of nonnative invasive weed species.

2000). The Solano HCP Giant Garter Snake Conservation Strategy focuses on the Delta Region of the Plan Area, in the likely historic and probable current range of the species (Figure 4-18). Suitable habitat for this species, with the exception of Rio Vista, falls outside of Covered Activity Zone 1 (City Urban Growth Boundaries [UGBs]). Therefore, the primary concerns for this species are the indirect effects of increased urban runoff in downstream receiving waters and flood control channels, and direct impacts from operational and maintenance activities within Plan Participant facilities.

Existing lands owned or managed by conservation organizations containing suitable giant garter snake habitat are limited to portions of Liberty Island (approximately 4,760 ac), which is owned by the Trust for Public Lands; Calhoun Cut, which is owned by the CDFG and Solano Land Trust; and Barker Slough, which is owned by the Elsie Gridley Mitigation Bank and Solano Land Trust. However, long-term restoration of suitable giant garter snake habitat within the Plan Area could be substantial. The CALFED Ecosystem Restoration Program Plan (July 2000) objectives proposed establishing "a large, contiguous habitat corridor connecting the mosaic of tidal marsh, seasonal floodplain, riparian and perennial grassland habitats in the Yolo Bypass, Cache Slough Complex, Jepson Prairie Preserve, Prospect Island, Little Holland Tract, Liberty Island, and Steamboat Slough. The sloughs would drain into extensive marsh-slough complexes developed in shallow islands (i.e., Liberty, Little Holland, and Prospect) at the lower end of the bypass." While this restoration has largely been focused on Delta smelt and other fish species, this habitat restoration would also benefit the giant garter snake. Various drafts of the Bay-Delta HCP have expanded on this identified restoration and have identified 5,000 to 11,000 ac of aquatic habitat restoration in the Cache Sough/Yolo Bypass region.

The Solano HCP Giant Garter Snake Conservation Strategy will contribute to this broader overall ecosystem restoration objective and will result in the conservation and restoration of approximately 175 ac of aquatic habitat and 121 ac of associated upland habitat within the Giant Garter Snake Conservation Area (Figure 4-18). The following sections describe the goals and objectives designed to promote the potential recovery of giant garter snakes within the Plan Area.

5.7.1 Giant Garter Snake Goals and Objectives

Goal GGS 1. Promote actions to re-establish or expand giant garter snake populations and habitat in the Plan Area and contribute to their recovery through protection, management, restoration, and enhancement of suitable habitat within the Yolo Basin-Liberty Farms population area.

> **Objective GGS 1.1.** Increase the quality of Delta waterways and tributaries in the Plan Area by implementing programs to control invasive exotic plants and animals and improve water quality. Funding for these programs shall be sufficient to control invasive species on 100 to 170 ac of coastal marsh habitat annually (or 5,000 to 8,500 ac in Delta waterways and Suisun and Napa River Marshes over the life of the HCP) and to fund cost-sharing of water quality improvement measures for discharges from municipal and agricultural sources. This objective shall be implemented in conjunction with Objective CM 1.1.
>
> **Objective GGS 1.2.** Acquire, enhance, and manage 85 ac of aquatic and 22 ac of associated upland habitat for giant garter snake as mitigation for unavoidable impacts from routine operational and maintenance activities.

Objective GGS 1.3. Acquire, enhance, and manage up to 90 ac of aquatic and 95 ac of associated upland habitat for giant garter snake.

Rationale. Minimizing the cumulative adverse effects of urban storm water runoff and improving the quality of water discharged from urban areas and agricultural operations is important for maintaining and improving habitat for giant garter snake and other species dependent on downstream receiving waters in the region. Objective GGS 1.2 provides for a one-time mitigation for temporary impacts associated with Operational and Maintenance activities within core habitat areas. An estimated 170 ac of perennial marsh and aquatic habitat and 220 ac of associated uplands are present within Plan Participant facilities in the Giant Garter Snake Conservation Area. Operational and maintenance activities within these areas involve periodic clearing of vegetation and sediment. Typically, clearing of these waterways cannot be practicably accomplished during the desired periods for avoidance and minimization (see Section 6.3.6). Clearing schedules vary by feature, but only limited areas of channel are cleared in any given year, and clearing cycles range from once every few years in smaller channels to more than once every 10 years in larger channels. The effects of channel vegetation removal tend to be of limited duration, typically lasting only 1 to 2 years.

5.8 COASTAL MARSH CONSERVATION STRATEGY

The Coastal Marsh Natural Community goals and objectives apply to all marsh habitats within the historic influence of tidal action, including areas that are currently influenced by tidal action or are diked and no longer affected by tides. These marshes exhibit a broad range of characteristics and include the current and historic estuarine-influenced marshes of San Pablo Bay/Lower Napa River, Southampton Marsh in the Carquinez Straits, Suisun Marsh, and tidally influenced freshwater marshes in the upper regions of the sloughs and creeks in the Delta region of Solano County (Figures 1-3 and 3-5). As described in Section 3.5, over 95 percent of the coastal marsh habitats in Solano County are protected from conversion to other land uses (Figure 3-9).

Impacts to coastal marsh from Covered Activities result more from indirect or secondary consequences such as changes in hydrology and water quality associated with development adjacent to marsh habitats or in the watershed rather than direct take of habitat. Coastal marsh habitats do not often occur within urban boundaries; when they do, the marshes are managed or incorporated into open space areas that have been established to protect and enhance existing values (e.g., White Slough, River Park, and Mare Island). In addition, all of the California Fully Protected Species—salt marsh harvest mouse, California black rail and California clapper rail—occur in the Coastal Marsh Natural Community and direct take is prohibited. The presence of fully protected species in coastal marsh habitat within Suisun Marsh and Napa River Marshes largely precludes large-scale development within these areas. Some minor direct impacts are anticipated because of road projects (e.g., the widening of Cordelia Road in Fairfield), utility crossings, high-flow flood control, bypass channels and storm water outfalls, shoreline/flood wall maintenance, flood control channel maintenance, and potential development-related projects at Mare Island in Vallejo and in Rio Vista.

The Solano HCP Coastal Marsh Conservation Strategy is designed to address water and sediment quality standards, hydrology, and ecological functions of the Natural Community. Primary

conservation actions include preservation (primarily through avoidance, Section 6.3.7), restoration, invasive species control, and improvement of water quality.

In addition to mitigating impacts, the Coastal Marsh Conservation Strategy contains additional commitments to be undertaken by the Plan Participants to conserve marsh habitat through invasive species control and water quality improvement programs. Plan Participants intend to work with State, Federal, and private agencies and organizations to obtain additional funding and/or land to contribute to the restoration goals set by the CALFED Bay-Delta Program and the Suisun Marsh Conservation Plan.

The following sections detail the goals and objectives for the Coastal Marsh Natural Community.

5.8.1 Coastal Marsh Natural Community Goals and Objectives

Goal CM 1. Contribute to enhancing essential ecological processes, functions, and values; species diversity; and habitat heterogeneity of coastal marsh habitat within the Plan Area.

Objective CM 1.1. Increase the quality of coastal marsh habitat in the Plan Area by implementing programs to control invasive exotic plants and animals and improve water quality. Funding for these programs shall be sufficient to control invasive species on 170 to 280 ac of coastal marsh habitat annually (or 5,000 to 8,500 ac over the life of the HCP) and to fund cost-sharing of water quality improvement measures for municipal and agricultural water discharges.

Objective CM 1.2. Plan Participants shall prevent increases over baseline conditions (HCP Adoption) in dry season (May 1 through October 15) discharge from storm water systems into tributaries that drain into Suisun Marsh, Southampton Marsh, and the marshes bordering the Napa River and San Pablo Bay.

Rationale. Two of the major threats or stressors to coastal marsh Covered Species (see Coastal Marsh Community Model, Appendix B) are invasive species and changes in natural hydrology. The alteration of the hydrology of coastal marshes due to freshwater input occurs during both the dry and wet seasons. This input originates from wastewater treatment plants, increased storm water runoff from urban development, and agricultural irrigation runoff. In general, urbanization results in increases of the peak discharge of runoff, reduction in infiltration, increases in annual volume of runoff, and increases in the length of the runoff season (Noss et al. 2002). While some species such as the Delta smelt, longfin smelt, and Sacramento splittail may benefit from increased freshwater flows, increases in dry season runoff, often referred to as nuisance flows, have significant adverse effects on most native plants and animals. In brackish to saline marsh communities, additional freshwater inflow, especially during the summer dry season, can substantially alter the natural species composition and result in the loss of important native species in the localized area near the outflow. Many native marsh plant species also rely on high salinity periods to maintain a competitive advantage with other plant species. These reductions in salinity also tend to promote invasive species establishment.

5.8.2 Species Goals and Objectives

Goal CM 2. Plan Participants shall maintain and, where possible, increase population levels and distribution of coastal marsh Covered Species in order to contribute to their recovery.

Objective CM 2.1. Preserve, manage, and restore 80 ac of coastal brackish marsh habitats. Restored marsh habitats shall include a matrix of mid- to high-elevation tidal marsh interspersed with tidal channels targeted to provide habitat for California black rail, California clapper rail, salt marsh harvest mouse, Delta smelt, and Mason's lilaeopsis.

Objective CM 2.2. Plan Participants shall restore and manage 175 ac of shallow water aquatic habitat suitable for Delta smelt and Sacramento splittail in the lower Delta area of Solano County. This objective shall be implemented in conjunction with Objective GGS 1.2 for the giant garter snake.

Objective CM 2.3. Plan Participants shall establish at least one new self-reproducing occurrence of Suisun thistle and soft bird's-beak.

Objective CM 2.4. Contribute to increasing food production and habitat quality for longfin smelt and green sturgeon through restoration of tidal marsh habitat (Objectives CM 2.1 and 2.2) and improvements to water quality discharge from urban and agricultural sources (Objective CM 1.1).

Rationale. The longfin smelt and green sturgeon are pelagic (i.e., lives primarily in open water) estuarine fish. While these two species may occasionally occur in the upper reaches of tidal marsh and Delta sloughs, they are not tied directly to or expected to use restored marsh habitats in the Delta area or Suisun Marsh. However, the Draft Bay-Delta Habitat Conservation Plan has identified anticipated benefits to these two species from increased food production and turbidity associated with marsh restoration in Suisun Marsh and the Delta region as well as improved water quality through additional treatment of urban and agricultural runoff (The Essex Partnership 2009). The primary actions for these two species focus on avoiding and minimizing impacts associated with new construction and operational and maintenance activities (see Section 6.3.7).

5.9 SWAINSON'S HAWK CONSERVATION STRATEGY

The Swainson's Hawk Conservation Strategy is designed to maintain suitable nesting habitat in proximity to suitable foraging habitat to support Swainson's hawk populations within the Plan Area. Primary conservation actions include preservation of suitable foraging habitat and planting of new nest trees.

Current mitigation sites for preservation of agricultural foraging habitats for Swainson's hawk and burrowing owl are being or have been established in the region (Figure 3-11):

Jenny Farms Mitigation Bank (approved)	430 ac
Beelard Trust (Southtown/Southtown Commons Mitigation)	290 ac
Muzzy Ranch/Dixon SW Developers (approved)	360 ac
Total	**1,080 ac**

Although not directly intended to conserve Swainson's hawk, the Solano Land Trust has an active farmland conservation easement program, with about 6,000 ac of agricultural lands currently under conservation easement or fee title ownership. The Land Trust's long-term goal is to establish conservation easements on 20,000 to 40,000 ac of agricultural land over the next 20 years (1,000 to 2,000 ac per year). In general, the Solano Land Trust reserves do not have the restrictions on crops and agricultural uses that are required to preserve Swainson's hawk foraging habitat; however, they do have a few properties that have been acquired for Swainson's hawk habitat mitigation that contain the applicable restrictions (e.g., Beelard Trust and Muzzy Ranch). Preservation of agricultural lands under the Solano Land Trust's program, with or without crop/land use restrictions, will ultimately contribute to Swainson's hawk conservation; however, preserved lands without the necessary restrictions and management activities are not suitable for mitigating Swainson's hawk impacts.

Section 4.3.9.3 identifies Swainson's Hawk Conservation Areas based on the distribution of Swainson's hawk records and foraging habitat quality (Figure 4-21). Not all potential habitats within the Plan Area contribute equally to the conservation of Swainson's hawks; therefore, specific conservation areas were defined to direct conservation efforts. Based on the value of different foraging habitats and the distribution of Swainson's hawk records within the Plan Area, three Swainson's Hawk Conservation Areas were identified: the Irrigated Agriculture Conservation Area, Valley Floor Grassland Conservation Area, and the Inner Coast Range Conservation Area. Section 4.6.8 further refines these conservation areas to identify potential areas in which reserves could be established as compensatory mitigation for impacts to foraging habitat. The Irrigated Agriculture, Valley Floor Grassland, and Inner Coast Range Potential Reserve Areas are depicted on Figure 4-27. The Irrigated Agriculture Potential Reserve Area is further subdivided into three subareas: (a) Subarea A, north of I-80; (b) Subarea B, west of State Route 113 (SR-113); and (c) Subarea C, east of SR-113 (Figure 4-27).

The potential reserve areas are designed to avoid establishing reserves in areas that may be indirectly affected by future development or are in line with conservation areas for other Covered Species or Natural Communities. The Irrigated Agriculture Potential Reserve Area includes all irrigated agricultural land beyond the Plan Participants' urban limit lines, which are areas zoned under the Solano County General Plan (Solano County 2008) for rural residential, commercial, and industrial uses, and land above sea level. The Valley Floor Grassland Potential Reserve Area encompasses portions of the Valley Floor Grassland Conservation Area (Figure 4-27), minus the wind resource area in the Montezuma Hills. The Inner Coast Range Potential Reserve Area encompasses key corridors between the valley floor and the Inner Coast Range, the North Vacaville Corridor and the Vacaville-Fairfield Green Belt (see Section 4.3.1.1), and grassland habitat within the California Red-Legged Frog and Callippe Silverspot Butterfly Conservation Areas (Figure 4-14). The Inner Coast Range Potential Reserve Area captures the higher value and higher risk habitats within this region of the Plan Area.

Implementation of the Solano HCP Conservation Strategy will result in the preservation of approximately 21,210 ac of Swainson's hawk foraging habitat: 5,970 ac within the Irrigated Agriculture Potential Reserve Area, 13,000 to 15,000 ac within the Valley Floor Grassland Potential Reserve Area, and up to 3,300 ac of oak savannah/grassland within the Inner Coast Range Conservation Area. Additional foraging habitat (approximately 2,120 ac) will also be protected or enhanced through implementation of the California Red-Legged Frog and Callippe Silverspot Butterfly Conservation Strategies. The following sections detail the goals and objectives for Swainson's hawk.

5.9.1 Swainson's Hawk Goals and Objectives

Goal SH 1. Contribute to the maintenance of the existing population of Swainson's hawk (estimated to be between 120 and 130 pairs) by preserving 21,210 ac of Swainson's hawk habitat in Swainson's Hawk Potential Reserve Areas.

Objective SH 1.1. Preserve and manage in perpetuity a minimum of 5,970 ac of agricultural foraging habitat in the Swainson's Hawk Irrigated Agriculture Potential Reserve Area. Approximately 25 percent of the reserves will be established in Subarea A (the area north of I-80), approximately 20 percent of the reserves will be established in Subarea B (the area west of SR-113), and approximately 55 percent of the reserves will be established in Subarea C (the area east of SR-113) (Figure 4-27).

Rationale. Currently, Swainson's hawk nest sites and foraging habitat are distributed throughout the Irrigated Agriculture Potential Reserve Area. This measure requires the reserves to be distributed in a manner that is roughly proportional to the three-subarea coverage in the overall Potential Reserve Area. By requiring the reserves to be distributed throughout the Potential Reserve Area, the plan will maintain nesting opportunities and foraging habitat throughout the area currently occupied by Swainson's hawk and avoid a clustering of reserves in one area where land may be most available or least expensive.

Objective SH 1.2. Manage reserves established for Swainson's hawk mitigation within the Irrigated Agriculture Potential Reserve Area (Figure 4-27) to achieve the following:

1. At least 50 percent of cultivated lands in the reserve system, measured on a system-wide basis, shall be planted and managed in any given year for alfalfa or other irrigated crops with similar structural characteristics, prey availability and abundance, and management requirements (e.g., regular irrigation and harvesting throughout the Swainson's hawk nesting season). The remaining 50 percent of cultivated lands may be planted in any annual or biennial crop type that provides suitable foraging habitat for Swainson's hawk and is an acceptable rotation crop typical of or suitable for alfalfa production in this region (see Figure 5-1).
2. Five (5) percent of the Irrigated Agriculture Reserve system, measured on a system-wide basis, shall be set aside and established in permanent, naturalized herbaceous and woody/shrub cover. The locations of these areas shall be determined on a reserve-specific basis to maximize distribution throughout the reserve, minimize interference to agricultural operations, and make best use of the naturalized vegetation areas to provide habitat for a variety of Covered Species and Special Management Species in addition to Swainson's hawk. These areas may be used for preserving or planting nest trees (Objective SH 2.1); establishing burrowing owl artificial nest burrows[1] (Objectives BO 1.1, BO 2.2, and BO 2.3), tricolored blackbird nesting habitat (Objective RSM 2.4), nesting habitat for other Special Management Species (Section 5.11); and providing vegetated filter strips for water quality enhancement (see Figure 5-1 for a reserve design example).

[1] Artificial nest burrows for burrowing owls will be located at least 650 ft (0.12 mi) from existing or planted Swainson's hawk nest trees.

Rationale. This objective requires that at least 50 percent of the Irrigated Agriculture Reserve acreage be managed for high-value foraging crop types in perpetuity while allowing for crop rotations necessary to maintain soil and crop productivity. Set-asides for other habitats provide benefits for Swainson's hawk through the establishment of nesting habitat as well as increasing the abundance of potential prey species within the agricultural fields.

Objective SH 1.3. Preserve and manage 13,000 to 15,000 ac of Valley Floor Grassland habitat to promote Swainson's hawk foraging and nesting opportunities within Swainson's Hawk Valley Floor Grassland Potential Reserve Areas. This measure may be addressed concurrently with Objective VPG 1.1 in Section 5.3.1.

Objective SH 1.4. Preserve and manage 3,300 ac of grassland and oak savanna to promote Swainson's hawk foraging and nesting opportunities within the Inner Coast Range Potential Reserve Areas.

Rationale. While irrigated agricultural habitats provide the primary foraging habitat for Swainson's hawk, grasslands within and around the edges of the valley floor also provide foraging opportunities for Swainson's hawk. Objectives SH 1.3 and SH 1.4 will be accomplished concurrently with Objectives VPG 1.1 and RLF 1.1, respectively.

Goal SH 2. Provide sufficient nesting habitat in proximity to suitable foraging habitat to support the current Swainson's hawk population within the Plan Area.

Objective SH 2.1. Provide a minimum average density of suitable nest tree or grove of trees[1] in perpetuity at the following densities within each Natural Community Reserve Type:

- One suitable nest tree or grove of trees per 40 ac of reserve (minimum of 143 trees/groves) in perpetuity in the Swainson's Hawk Irrigated Agriculture Potential Reserve Area.
- One suitable nest tree/grove per 320 ac of reserve (estimated to be 32 to 36 trees/groves) in the Valley Floor Grassland and Vernal Pool Natural Community Reserve Area by preserving and replacing suitable nest trees within current and historic homesteads and restoring riparian habitats.
- Ten suitable nest trees/groves per 320 ac of reserve (estimated to be 3 trees/groves) in the Inner Coast Range Natural Community Reserve Area.

Objective SH 2.2. Preserve and manage one active Swainson's hawk nest for each known Swainson's hawk nest affected by Covered Activities. SCWA, in consultation with the Resource Agencies (see Section 10.2.6), will implement interim measures to protect active and known Swainson's hawk nest sites until such time as the Reserve System supports a number of nests equal to or greater than the number of nests lost for both species as a result of HCP Covered Activities. The Nest Protection Program consists of two actions:

[1] Nest tree sites ideally will include a small grove or row of native trees, with fewer than 10 individuals per site. Each grove should include several species and age groups of mature and young replacement trees. This objective shall be achieved at each reserve.

1. SCWA will preserve 1,000 ac encompassing active and known nest sites and associated foraging habitat for Swainson's hawk in perpetuity. The location of the preserved nesting habitat will be based on land availability and long-term suitability of nesting habitat as determined by SCWA and the Resource Agencies. Lands will be preserved through direct acquisition and/or conservation easements from public and private landowners. All acquired lands will be preserved and managed consistent with the reserve management requirements in Section 10.5.

2. SCWA, in consultation with the Resource Agencies, will implement an interim program to protect active nest sites. SCWA will identify acceptable active nest sites and then work with landowners to establish defined term contracts or agreements (3 to 5 years) to protect and manage the nest sites. Contracts or agreements to preserve known nest trees will remain in place until: (1) the term of the contract expires; (2) the tree dies of natural causes and becomes a hazard to people or property; or (3) the tree is abandoned by nesting Swainson's hawks for at least 3 consecutive years. Upon termination of a defined term contract to protect a known nest tree, another contract shall be obtained. Nest impact assessment funds (see Section 11.1.2) may also be used to purchase "established nest" credits at HCP-certified mitigation banks or acquire and manage occupied nesting habitat per action 1, above.

   Rationale. The Swainson's hawk goals and objectives provide conservation actions for the Swainson's Hawk Conservation Areas (Figure 4-21) and the Swainson's Hawk Potential Reserve Areas (Figure 4-27). The goals and objectives focus on maximizing Swainson's hawk foraging habitat values while providing necessary flexibility for ongoing agricultural production and preserving near-term and long-term suitable nesting habitat. Each Swainson's Hawk Reserve shall plant and preserve native tree species[1] known to be used for nesting by Swainson's hawk to provide the minimum nest tree density specified in Objective SH 2.1. Species selection shall be based on site-specific conditions and location (e.g., willows will not be planted in nonriparian habitats) and large trees (i.e., valley oaks, sycamore, and walnut) shall be planted to the maximum extent practicable. The exact quantity and location of nest trees or groves shall be determined on a reserve-specific basis as part of the reserve Resource Management Plan approval process described in Section 10.5.3.

5.10 BURROWING OWL CONSERVATION STRATEGY

No extensive systematic surveys for burrowing owls have been conducted in Solano County. Broader statewide population studies by the Institute for Bird Populations (IBP) statewide surveys in 2006–2007 (Wilkerson and Siegel 2010), 66 burrowing owl pairs were estimated to occur in 27 5 km x 5 km survey blocks that were assigned to the Middle Central Valley Region, which includes Solano County. In 20 of these blocks that were surveyed in this region in both the 1991–1993 and 2006–2007 survey efforts, 107 pairs were estimated to occur in 1991–1993 and 57 were estimated to occur in 2006–2007 (Wilkerson and Siegel 2010). Although statewide population levels were

[1] Suitable native tree species for Swainson's hawk nesting habitat include species such as Fremont cottonwood (*Populus fremontii*), various oaks (*Quercus lobata*, *Q. agrifolia*, *Q. douglasii*), box elder (*Acer negundo*), black willow (*Salix gooddingii*), red willow (*S. laevigata*), arroyo willow (*S. lasiolepis*), California sycamore (*Platanus racemosa*), and California black walnut (*Juglans californica*).

not statistically different between the two surveys (Wilkerson and Siegel 2010), these results suggest a sharp decline in the burrowing owl population in Solano County and the overall Middle Central Valley Region.

The Burrowing Owl Conservation Strategy is designed to preserve and manage suitable foraging and improve nesting habitat availability for the burrowing owl wintering and nesting population within the Plan Area. Primary conservation actions include preservation of large tracts of suitable habitat, protection of important nesting and wintering areas, and expansion of nesting habitat (e.g., increased burrow densities/availability).

Burrowing owls are an open-country species that naturally inhabits grasslands, open shrublands, and open woodlands and has also adapted well to human-modified landscapes (e.g., using agricultural lands, disturbed fields, roadsides, and railroad rights-of-way). This pattern is evident in the distribution of existing burrowing owl records in Solano County. Most records are from agricultural areas or vacant, disturbed areas within or adjacent to urban development (see Section 4.3.10 and Figure 4-22 for more details). As a result, the Burrowing Owl Conservation Strategy, particularly the reserve system, is intricately tied to the Swainson's Hawk Conservation Strategy, the Valley Floor Grassland and Vernal Pool Conservation Strategy, and to a lesser degree the California Red-Legged Frog and Callippe Silverspot Butterfly Conservation Strategies. Reserves and preserves established for these Covered Species and Natural Communities will also be managed to support and promote expansion of the burrowing owl population throughout the Plan Area.

5.10.1 Burrowing Owl Goals and Objectives

Goal BO 1. Preserve and manage suitable foraging in order to mitigate for lost foraging habitat in the Plan Area.

Objective BO 1.1. Preserve and manage in perpetuity 5,970 ac of agricultural lands and annual grassland within the Swainson's Hawk Irrigated Agriculture Potential Reserve Areas. In order to promote foraging and nesting opportunities for burrowing owl, a minimum of 140 ac of grassland habitat within the Swainson's Hawk Irrigated Agriculture Reserve system (target 2 percent per reserve) shall be established to provide nesting opportunities and suitable cover for burrowing owls. This objective will be implemented concurrently with Objective SH 1.1.

Objective BO 1.2. Preserve and manage 13,000 to 15,000 ac of valley floor grassland habitat to promote foraging and nesting opportunities within the Swainson's Hawk Valley Floor Grassland Potential Reserve Areas. This objective will be implemented concurrently with Objective VPG 1.1.

Objective BO 1.3. Preserve and manage 3,300 ac of foraging habitat to promote burrowing owl habitat within the Inner Coast Range Potential Reserve Area. This objective will be implemented concurrently with Objective RLF 1.1.

Rationale. Burrowing owls inhabit open grasslands and agricultural lands throughout the Plan Area. Their basic habitat needs are similar to other Covered Species; therefore, preservation of burrowing owl habitat can be achieved through the protection and management of associated Covered Species and Natural Communities. To expand burrowing owl populations, conservation actions focus on increasing the number of nesting

burrows and suitable short grass landscapes because limits on these resources appear to be limiting the burrowing owl population in the Plan Area (see Appendix B).

Goal BO 2. Preserve the existing nesting areas outside the developed urban areas and promote the expansion of nesting habitat/burrows in the grassland and agricultural regions of the Plan Area.

Objective BO 2.1. Preserve and manage one active burrowing owl nest for each known burrowing owl nest affected by Covered Activities. This will be accomplished through the two-stage process described under Objective SH 2.2, through targeted acquisition, defined term contracts or agreements, and conservation easements of known active nesting habitat.

Objective BO 2.2. Install, monitor, and maintain at least 70 burrow complexes (minimum 3 burrows per complex) within the 140 ac of unplanted grassland preserved in the Swainson's Hawk Irrigated Agriculture Reserve system (Objective SH 1.2) to provide suitable burrowing owl nesting habitat[1]. For each burrow complex installed, at least 5 additional burrows within 250 ft of the nest burrow complex will also be installed and maintained for use as escape burrows by owlets. These burrowing owl habitat reserve areas shall also be provided on a system-wide basis under the following additional criteria:

1. **Suitable Burrow and Cover Habitat:** At least 2 ac[2] of reserve land shall be permanently taken out of production to provide suitable nesting habitat and cover for burrowing owls on each 80 ac reserve that is used for burrowing owl mitigation. These 2 ac shall consist of one continuous block of habitat and shall not be located adjacent to a County road, highway, or within 650 ft of Swainson's hawk nesting trees (see Figure 5-1 for an example).
2. **Artificial Burrows:** At least two burrow complexes (three burrows per complex) shall be installed and maintained in perpetuity where natural burrows do not occur in sufficient density within the 2 ac of habitat set aside for burrowing owls. Artificial burrows will be monitored annually for effectiveness. Biological monitors will report on the colonization of the nest burrows by owls and the number of owls fledged per nest.
3. **Vegetation Height:** Within the 2 ac of habitat set aside for burrowing owls, management measures shall be implemented and adequately funded to maintain an average effective vegetation height less than or equal to 6 inches from February 1 to April 15, when owls typically select mates and nest burrows (see Section 10.5.3.2). In addition, the 2 ac of habitat must be kept free of tree and shrub canopy cover in perpetuity.

Objective BO 2.3. Provide 28 suitable burrows per 280 ac of valley floor grassland and vernal pool preserves by expanding ground squirrel populations in grassland reserves and, if necessary, installing and maintaining artificial burrows where natural burrows do not occur in

[1] Not every reserve will have burrowing owl artificial nest burrows established within the unplanted areas, but the reserve system will have the equivalent of 1 burrow complex installed for every 80 ac reserve established.

[2] This preservation requirement equates to approximately 50 percent of the unplanted areas required in agricultural reserves (5 percent of reserves left unplanted = 285 ac, half of which is approximately 140 ac); the other 50 percent (approximately 140 ac) can be used for tree plantings, taller grass, or shrub cover (e.g., nesting habitat for tricolored blackbird and northern harrier).

sufficient density. Reserves established for burrowing owls shall be at least 80 ac in size, provide suitable foraging habitat, and meet the basic reserve management standards identified in Sections 7.3 and 10.5.3 and the following additional management requirements:

1. **Vegetation Height:** Management measures shall be implemented and adequately funded to maintain an average effective vegetation height[1] less than or equal to 6 inches over 80 percent of the reserve. This average effective vegetation height shall be sustained from February 1 to April 15, when owls typically select mates and nest burrows. To achieve this standard, the average effective height of residual vegetation on February 1 each year shall not exceed 4 inches. In addition, no more than 20 percent of the reserve may support tree and shrub canopy or tall dense grass cover.
2. **Restrictions on Rodent Control:** Reserves in grassland habitats shall allow ground squirrel control only within existing irrigation canals/drains easements. Ground squirrel control on the perimeter of the reserves will be accomplished on adjacent properties, not on the reserve itself (see Sections 7.3 and 10.5.3).
3. **Burrow Density:** Valley Floor Grassland Reserves shall provide at least 28 suitable burrows per 280 ac of Valley Floor Grassland and Vernal Pool Preserves. Where natural burrows do not occur in sufficient density, at least 3 artificial burrow complexes per 280 ac of reserves shall be installed, monitored, and maintained until sufficient burrow density is achieved. Artificial burrow complexes shall be provided at a rate of 3 multi-entrance nest burrow/chambers and 9 temporary burrows per 280 ac of reserves until suitable, natural burrow densities reach a minimum of 28 burrows per 280 ac.

Objective BO 2.4. Provide 28 suitable burrows per 280 ac of reserves established within the Inner Coast Range Potential Reserve Area. Reserves for burrowing owls shall be at least 80 ac in size, provide suitable foraging habitat, and meet the basic reserve management standards identified in Objective BO 2.3 and Section 10.5.3.

Objective BO 2.5. Provide suitable burrowing owl burrows and manage foraging habitat in proximity to impacted habitat when burrowing or foraging habitat is subject to temporary impacts (one breeding season or less). Where natural burrows do not occur in sufficient density, artificial burrows shall be provided.

Rationale. Suitable subterranean burrowing owl nesting habitat is limited in the Plan Area. The California ground squirrel, the primary natural burrow excavator for burrowing owl, is classified as an agricultural pest species. As such, populations of California ground squirrel are intensively controlled by poison and trapping programs in irrigated agricultural areas and grasslands. Sparse populations of ground squirrels remain but are primarily limited to roadsides, utility corridors, urban edges/vacant lots, and railroad rights-of-way. Increasing nesting opportunities is necessary for expanding burrowing owl populations in the Plan Area and requires increasing the number of burrows, either artificial or natural.

Expansion of ground squirrel populations in managed agricultural areas is not practical for maintaining economically viable agriculture nor is it desirable as a Good Neighbor. In these

[1] Effective vegetation height is the height at which 90 percent of a white board is obscured by vegetation when viewed 3 ft from the ground at a distance of 33 ft (Green and Anthony 1989).

intensively managed agricultural areas, artificial burrow complexes provide the only realistic opportunities for providing long-term nest burrows. Whenever artificial burrows are installed, additional satellite burrows will be provided within 250 ft of nest complexes in order to provide escape burrows for owlets or alternate burrows as the nest burrows become crowded with growing owlets. Note that Objectives BO 2.1 through 2.3 will be accomplished in conjunction with Objective BO 1.1.

In Valley Floor Grassland and Inner Coast Range Reserves, ground squirrel management will be limited to properties adjacent to the reserves, but no poisoning or trapping will occur on the reserves themselves except along levees or drainage canals that might be compromised by burrowing. Ground squirrels colonize new areas relatively slowly, but over time and with proper management (i.e., installation of rock piles or brush piles, restoration of mounds) ground squirrels are expected to expand onto the reserves where there is an existing source population of squirrels. On reserves where ground squirrels have been extirpated, artificial burrows and relocation of ground squirrels may be used to establish the burrows necessary to create conditions under which burrowing owl populations may inhabit the reserve and become self-sustaining. Even with the installation of artificial burrows and relocation of ground squirrels, burrow distribution will be patchy. However, a minimum of 28 burrows (natural or artificial) per 280 ac will provide a suitable nest site for burrowing owls within Valley Floor Grassland and Vernal Pool Preserves.

5.11 SPECIAL MANAGEMENT SPECIES MANAGEMENT REQUIREMENTS

Special Management Species (Table 1.2 and Appendix C) will receive substantial conservation benefit from implementation of the habitat preservation and restoration, water quality protection, invasive species control, and reserve management associated with the Conservation Strategies for Covered Species and Natural Communities described above. However, several Special Management Species require additional reserve management to maximize conservation benefits. Reserve Managers shall evaluate the management actions described below for inclusion into the required Reserve Management Plans (Sections 7.3 and 10.5.3). Special management actions shall be implemented on each reserve, as appropriate, and to the extent they do not conflict with Covered Species management.

5.11.1 Northern Harrier and Short-Eared Owl Special Management Requirements

Both the northern harrier and short-eared owl are widespread in Solano County and are associated with several natural communities, including the Valley Floor Grassland and Vernal Pool, Agriculture, Coastal Marsh, and Inner Coast Range Natural Communities (Table 4-1). Both species benefit from a habitat mosaic that includes agricultural crops with suitable prey species, lush ungrazed to lightly grazed grasslands, and weedy fields (Shuford and Gardali eds. 2008). Both species are ground nesters, typically nesting in fairly tall and dense grass, weeds, marshy vegetation, or shrubs. Meadow voles (*Microtus* sp.), which are a primary food source for these two raptors as well as Swainson's hawk, also thrive in wet, ungrazed to lightly grazed grasslands (Fehmi and Bartolome 2002). The establishment of 50 percent of the Swainson's hawk reserve system in alfalfa or a similar crop (see Objective SH 1.2) will greatly benefit northern harrier and short-eared owl. Management requirements for Covered Species associated with the Valley Floor Grassland and Vernal Pool Natural Community focus on maintaining moderate grazing levels to reduce the abundance of annual grasses and promote native vegetation growth (see Appendix B).

In grassland and agricultural communities, the lack of available nesting cover is likely the primary factor limiting the populations of both species.

The following special management actions shall be incorporated into required Reserve Management Plans (see Sections 7.3 and 10.5.3) to increase habitat values for northern harrier and short-eared owl:

- **Establish Patches of Tall and Dense Nesting Cover:** Typical nest cover includes fairly tall (2 to 4 ft) and dense grass, weeds, marshy vegetation, or shrubs.
    - In Valley Floor Grassland and Vernal Pool, California Red-legged Frog, and Callippe Silverspot Butterfly Reserves, nesting cover will be allowed to establish in suitable areas. Suitable areas include: old homesteads, corrals, or barn areas; ditches, streams, stock ponds, or marshy areas; and other waste areas separated from high-value vernal pools, callippe silverspot butterfly larval host plant stands, or native grassland habitats. Potential nesting habitat should be fenced to exclude regular livestock access, but may be periodically grazed to promote new vegetation growth and control invasive exotic vegetation.
    - In Irrigated Agriculture Reserves for Swainson's hawk, dense nesting cover should be allowed to establish in 2.5 percent of the reserve lands specified in Objective SH 1.2. Dense shrubby cover established as tricolored blackbird nesting habitat (see Objective RSM 2.4) may also satisfy this requirement (see Figure 5-1 for an example).
- **Implement Grazing Schemes That Result in a Patchwork of Ungrazed, Lightly to Moderately Grazed Pastures:** In most Valley Floor Grassland and Vernal Pool and California Red-Legged Frog/Callippe Silverspot Butterfly Reserves, moderate grazing levels are desired to maximize habitat values for Covered Species. On larger reserves, periodically ungrazed or lightly grazed pastures may be appropriate to promote vole populations where multiple pastures are present and where limited grazing would not degrade habitat conditions for Covered Species associated with vernal pools or callippe silverspot butterfly breeding and larval habitat. Areas where reduced grazing could be implemented include riparian pastures, vernal pool and seasonal wetland restoration areas where Covered Species have not yet established, wet or alkali meadows, or pastures that lack or have minimal vernal pools. In general, no more than 20 percent of a reserve shall be ungrazed or lightly grazed in any given year.

The above requirements have been incorporated into Objectives VPG 1.4 and RLF 1.2, addressing reserve management within the Valley Floor Grassland and Vernal Pool Natural Community and California Red-Legged Frog Conservation Area, respectively.

5.11.2 Loggerhead Shrike Special Management Requirements

Loggerhead shrike may use grasslands and agricultural areas for foraging and breeding, but prefer microhabitats such as the edges of riparian corridors and other areas with trees and shrubs (i.e., along roads or fence lines in agricultural areas). In addition to breeding, loggerhead shrikes also travel between habitat patches via these sheltered corridors. Areas of open agriculture or grassland habitat without trees and shrubs have experienced reduced shrike use and dispersal (Haas 1995). The following special management requirement shall be implemented to establish shrubby nesting cover for loggerhead shrike:

- **Establish Shrub Nest Cover:** Typical nest cover includes small trees and shrubs.
    - In Valley Floor Grassland and Vernal Pool, California Red-Legged Frog, and Callippe Silverspot Butterfly Reserves, nesting cover for loggerhead shrikes will be established in suitable areas. Suitable areas for establishing nesting cover include: old homesteads, corrals, or barn areas; edges of ditches, streams, stock ponds, or marshy areas; or other waste areas.
    - In Irrigated Agriculture Reserves for Swainson's hawk, shrubs should be established in association with tree and shrub plantings in portions of the reserve lands specified in Objective SH 1.2 (see Figure 5-1 for an example). Shrub plantings shall not occur in areas reserved for burrowing owl habitat (Objective BO 2.2). Dense shrubby cover established as tricolored blackbird nesting habitat (see Objective RSM 2.4) would also provide suitable nesting habitat for loggerhead shrike.

5.11.3 Grasshopper Sparrow Special Management Requirements

Grasshopper sparrows prefer breeding habitat comprised of open, native bunch-grass grasslands (versus sod type); however, nonnative annual grasslands and fallow agricultural fields throughout California are used for breeding in the absence of native bunch-grass ecosystems. Open grasslands allow the birds to forage and move freely, whereas sod-type grasses hinder these activities (Whitmore 1981). A negative correlation has been identified between proximity to woodland areas and grasshopper sparrow use. This is likely due to an increase in predation and nest parasitism by brown-headed cowbirds (Thogmartin 2006). Grasshopper sparrows are also considered area-sensitive, meaning they prefer interior habitat areas with a high interior-to-edge ratio (Renfrew 2005, Davis 2004).

Primary habitat for grasshopper sparrows occurs in the larger tracts of grassland within the Valley Floor Grassland and Vernal Pool and Inner Coast Range Natural Communities. Specific information on optimal grazing regimes is limited (Shuford and Gardali 2008); however, life history data suggest that light grazing resulting in a patchy environment that includes bare ground, scattered shrubs, and dense residual grass cover is desirable.

- **Implement Grazing Schemes That Result in a Patchwork of Ungrazed, Lightly to Moderately Grazed Pastures:** Grazing management that results in a patchwork of ungrazed, lightly, and moderately grazed pastures as recommended for northern harrier and short-eared owl would also apply to the grasshopper sparrow. The above requirements have been incorporated into Objectives VPG 1.4 and RLF 1.2, addressing reserve management within the Valley Floor Grassland and Vernal Pool Natural Community and California Red-Legged Frog Conservation Area, respectively.

5.11.4 Native Perennial Grassland Special Management Requirements

Native perennial grassland is limited to small stands of relict native perennial grasses. Generally, researchers have classified an area with 10 percent relative cover of native grasses as a sensitive natural community. Stands of native grasses are threatened by habitat loss, fragmentation, and invasion by nonnative annual plants caused by urbanization, crop cultivation, disking and tilling, improper livestock grazing, rodent control, and climate change. Moderate grazing can be used to

control nonnative annual grasses. In Valley Floor Grassland and Vernal Pool, California Red-Legged Frog, and Callippe Silverspot Butterfly Reserves, locations where native grasses and associated native forbs comprise at least 10 percent of the cover shall be identified. As part of the required Reserve Management Plan, realistic management objectives shall be established and management actions implemented to preserve and expand native grass and forb stands. Actions to promote native grasses have been incorporated into Objectives VPG 1.4 and RLF 1.2.

Figure 5-1: Alternative Configurations for Achieving Habitat Set-asides on Agricultural Reserves

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