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## 4.0 CONSERVATION ANALYSIS

### 4.1 OVERVIEW

This section presents the results of the Conservation Analysis conducted for the Solano HCP. The intent of this analysis is to assess the status of biological resources within the Plan Area and identify biologically-based measures to conserve Covered Species, irrespective of the Plan Participants' conservation commitments under the Solano HCP (i.e., establishment of reserves/preserves). This section also takes into consideration the location and needs of the Special Management Species described in Appendix C. The Conservation Analysis reflects the State NCCPA standards, requiring a commitment by Plan Participants to conserve Covered Species and communities within the Plan Area at the level of recovery. It also provides a basis for evaluating the Solano HCP Conservation Strategy (Chapter 6.0) against the standards for issuance of incidental take permits under FESA and CESA. The Conservation Analysis presented in this section outlines the recovery standards for Covered Species and Natural Communities in the Plan Area and estimates the acreage of each community type needed to achieve recovery. The biological goals, objectives, and conservation measures detailed in the Conservation Strategy are based, in part, on the results of the Conservation Analysis. Figure 4-1 provides a graphical representation of the relationships between the Conservation Analysis described in this section and the other elements of the Solano HCP.

The Conservation Analysis evaluates four broad natural communities, encompassing a wide range of habitat types. These natural communities are Valley Floor Grassland and Vernal Pools; Inner Coast Range; Riparian, Stream, and Freshwater Marsh; and Coastal Marsh (Figure 4-2). Northeastern Solano County consists primarily of irrigated agriculture that provides important habitat for several Covered Species (e.g., Swainson's hawk and burrowing owl) and Special Management Species (e.g., tri-colored blackbirds, loggerhead shrike and northern harrier). The Conservation Analysis does not define agriculture as a Natural Community, but the conservation and management of agricultural lands have been considered in the analysis for Swainson's hawk and burrowing owl.

The Conservation Analysis synthesizes biological information at three levels (species, Natural Community and landscape) and combines it with information on current and projected land use practices, Solano County General Plan and Zoning restrictions, and environmental constraints (see Section 3.6, Risk Analysis) to identify priority areas for future protection (see Section 4.4). Sections 3.1 through 3.3 provide a review of Solano County's biodiversity and an analysis of the key geographic, geologic, and hydrologic factors that influence the habitats, physical processes, and biota of the region. Appendix B includes detailed biological information for each Natural Community and associated Covered Species; Appendix C includes similar information for each Special Management Species.

The Natural Community accounts in Appendix B contain a background and distribution section and a narrative conceptual model. The preliminary narrative conceptual model outlines the essential ecological processes, habitat variables, and significant pressures affecting the Natural Community. These models make assumptions about the effects of land use practices on the Natural Community based on the current understanding of the ecological processes and habitat variables within that

system. The data gaps, uncertainties, and assumptions inherent in these narrative conceptual models are also discussed in the natural community account.

The Conservation Analysis for each Natural Community (Section 4.3) is organized into three sections: 1) Covered Species and Special Management Species; 2) Key Conservation Elements; and 3) Conservation Areas. Table 4-1 summarizes the Covered Species and Special Management Species associated with each Natural Community. The Natural Community accounts (see Appendix B) form the basis for identifying the key conservation elements (Figure 4-1). A key conservation element is a habitat feature or environmental characteristic that can be physically mapped that corresponds to, or is a surrogate measure of, the relative relative conservation value and/or overall habitat quality of the Natural Community. Conservation areas are identified based on key conservation elements and the reserve design principles outlined in Section 4.2. The conservation areas are used to develop a conservation approach for each Natural Community, outline compensation/mitigation levels (see Section 6.0) for Covered Activities, and determine the level of development compatible with regional conservation goals and objectives.

Section 4.4 describes the Conservation Analysis for the entire Plan Area. It combines all of the key conservation elements identified in Section 4.3 to identify priority areas for acquisition and define an overall vision for developing reserves in the Plan Area. This Plan-wide Conservation Analysis represents the synthesis of biological information at the species, Natural Community, and landscape levels.

In Section 4.5, various methods, including the species-area relationship model, recovery plans, and expert opinion, are employed to develop conservation targets for each Natural Community. These conservation targets address the question of ‘how much is enough,’ namely, what proportion of an ecosystem must be conserved to ensure that ecological processes continue to function and the composition and structure of native species remain intact.

When combined, the results of the Conservation Analysis (Sections 4.3 and 4.4), the Risk Analysis (Section 3.6), Conservation Targets (Section 4.5) and the Reserve Design Principles (Section 4.2) form the basis for developing an overall vision for the design of reserves in the Plan Area and specific reserve design criteria for each Natural Community.

## **4.2 RESERVE DESIGN PRINCIPLES**

Designing a reserve system draws upon all aspects of conservation biology and must take into consideration all ecological scales from species to the landscape scale. Reserve design encompasses the size, shape, connectivity, orientation, and juxtaposition of conservation areas. All of these factors influence the ability of a reserve to sustain viable populations of Covered Species, minimize edge effects, maintain natural disturbance regimes and movement patterns, and support evolutionary processes (Cowling and Pressey 2001).

Reserve design is critical to the conservation and recovery of Covered Species. Each individual reserve should support a viable population of species for which it was designed and the reserve network, as a whole, should preserve natural movement patterns and metapopulation dynamics. The size, spatial distribution and connectivity of reserves can significantly alter the structure of metapopulations, a collection of sub-populations that exchange genetic information through

individual dispersal events. The classic metapopulation model assumes that sub-populations inhabiting individual patches come into and out of existence with colonization rates dependent upon the spatial arrangement of these patches. Certain design assumptions need to be considered when using a metapopulation model. First, empty patches can be just as valuable for species conservation as occupied patches. Second, protection of dispersal routes is critical because dispersal between patches dictates colonization rates. Finally, reservoir populations and sink areas must be identified, protected and/or enhanced (e.g., removal of invasive species) to increase their productivity. In short, all potential habitat, occupied or unoccupied, has value. Connectivity between reserves and preserves must be maintained in order to preserve genetic diversity and buffer local extinction events. Restoration of lower quality (i.e., sink) areas could increase overall population numbers, even populations within high quality areas.

Well-designed reserve networks should preserve functional landscapes, minimize risk from invasive species, conserve Natural Community conditions, and provide for or increase resilience to natural and anthropogenic (human-caused) disturbances. Functional landscapes support a number of ecological processes, natural communities and species at various scales (coarse, intermediate, and local), are ecologically intact and retain (or can have restored) most or all of their key components, patterns, and processes (TNC 2000). Reserve design should facilitate the preservation and/or restoration of functional landscapes.

The reserve system is the backbone of any HCP. The extent to which the reserve system can protect and support viable populations of Covered Species and maintain biological diversity and ecosystem function will determine the overall success of the HCP. The Conservation Analysis (Sections 4.3 and 4.4) and Conservation Strategy (Section 6.0) refer to the reserve design principles that shall, to the maximum extent practicable, guide development of the Solano HCP reserve system. The reserve design principles include:

- 1. Preserve Large Blocks of Habitat.** Preservation of large blocks of habitat supporting large populations of target species is superior to preservation of smaller blocks of habitat (Groves 2003). Large blocks of habitat are necessary for maintaining ecosystem processes and buffering against anthropogenic pressures. Large blocks typically provide a variety of habitat conditions and have greater ecosystem resilience. However, smaller reserves may be necessary to preserve isolated populations of extremely rare or range-limited species (particularly rare plant species).
- 2. Conserve Target Species Throughout the Plan Area.** Species distributed across their native ranges are less susceptible to extinction, than those species confined to small portions of their native ranges. Therefore, the design of the reserve system shall attempt to conserve target species throughout the entire Plan Area, rather than in limited habitat segments.
- 3. Prioritize Habitat with High Conservation Value at High Risk of Development.** Habitat with the highest conservation value and at most risk of development shall be given the highest priority for acquisition. Parameters that define the conservation value of an area vary by community type. Areas of high conservation value typically support an abundance of native species and contain few roads, trails or other human disturbances. However, degraded habitats may also have high conservation value if they link preserve areas together, contain unique habitat features, support key populations of Covered Species, or have high potential for restoration and enhancement.
- 4. Incorporate a Range of Environmental Gradients.** Reserves/preserves shall encompass a representative range of environmental gradients including moisture, soil, slope, elevation, aspect,

climate, and habitat diversity in order to accommodate shifts in species distribution due to changing weather patterns and other circumstances.

5. **Protect Regional Water Quality.** Regional water quality affects all Covered Species. The best way to protect regional water quality is to preserve entire watersheds or subwatersheds (particularly within headwater reaches), maintain sufficient riparian buffer zones, and sustain the ecological processes needed to efficiently catch, filter, and cycle water through the environment.
6. **Maintain Connectivity.** Interconnected blocks of habitat sustain effective movement and interchange of organisms and serve conservation purposes better than isolated blocks. Corridors or linkages between reserves function best when they resemble preserve habitats.
7. **Preserve Blocks of Habitat Close Together.** The juxtaposition of conservation areas is an important factor in reserve design: preserving blocks of habitat close together is better than preserving blocks further apart.
8. **Incorporate Buffer Zones.** Where possible, reserves shall incorporate land specifically designed to buffer the natural ecosystems from direct and indirect impacts associated with urbanization. The size and characteristics of the buffer zone will depend on site-specific conditions such as topography, local land practices, intensity of adjacent urban development, and needs of the Natural Community and Covered Species. Buffer zones may result from direct land acquisition or conservation easements with adjacent landowners. Conservation easements would maintain existing land uses (i.e., working farms and ranches) compatible with Covered Species and Natural Community conservation or designate areas near urban development as parks with hiking, biking and walking trails.
9. **Minimize Edge Habitat.** The design of preserves and reserves shall maximize area-to-perimeter ratio, thereby decreasing the amount of edge habitat, particularly within urban development and along buffer zones, to minimize indirect effects of adjacent land use on the Natural Community. Maximizing the area-to-edge ratio of future development projects will also minimize edge habitat.
10. **Provide Diverse Environmental Conditions.** Species that distributed across a range of environmental conditions exhibit greater genetic diversity, promoting the continuation of evolutionary processes. Species are also not distributed randomly across available habitat, rather they are drawn to specific environmental characteristics. Thus, preserve and reserve shall include a diverse range of physical and environmental conditions including the preservation of unique or uncommon habitat features (such as large playa pools or lakes, alkali flats, and unique soil types) that reflect the ecological diversity of the Plan Area.
11. **Consider Ecotone and Transition Areas.** Ecotone or transition areas, especially those between wetlands and uplands, are important habitat components and shall be given special consideration in the development of priority conservation areas.
12. **Target 'Hot Spots' of Diversity.** Areas with unique habitat features, concentrations of target species, and/or high biological diversity shall be targeted for preservation.
13. **Minimize Human Disturbance.** Blocks of habitats with limited accessibility to humans conserve target species better than accessible blocks. However, parks with hiking, biking and walking trails may buffer adjacent preserve lands from the indirect effects of urban development.

- 14. Consider Management Needs.** Once reserves/preserves are established, long-term management and/or stewardship is required to maintain the biological values for which the lands are preserved. Introduced species have significantly altered and overtaken California's natural communities, such that in many communities, non-native species are more prevalent than native species. Long-term management is critical for addressing the altered ecology of these lands, protecting new and existing reserve lands from surrounding land uses (and vice versa), controlling invasions of exotic pests (animal and plants) prevalent in the region, and maintaining infrastructure. Reserves, preserves and other sites established to fulfill the Solano HCP conservation objectives will need to address these issues.
- 15. Incorporate Restoration Activities.** While significant resources exist throughout the Plan Area, current and historic land use practices have altered many of these resources. For these areas, restoration and active management are needed to reestablish historic productivity and value. Therefore, restoration will be an important component of the Solano HCP reserve system. In addition, restoration activities should be conducted on lands adjacent to existing high quality preserves in order to increase the potential for successful restoration.

#### 4.2.1 Reserve Design Model

The reserve design model for the Solano HCP has been adapted from the Biosphere Reserve Design, 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 HCP Reserve System works within the parameters established by existing County zoning laws. The preserves themselves, will act as core conservation areas with specific ecological monitoring and management practices conducted to maintain ecosystem function and contribute to the recovery of Covered Species. Most reserves will be located within non-urban areas (i.e., Zones 2 and 3; Figure 1-4), where existing and anticipated future land use patterns provide suitable habitat for Covered Species. Current and anticipated future land use practices in Zone 2 and 3 areas are generally compatible with the conservation of Covered Species. These surrounding lands can act as buffers to core reserve areas to minimize urban impacts/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 on-going maintenance and operation of public and private facilities in Solano County"* (Section 1.3.1). It must also incorporate the following assumptions, restrictions, and limitations:

1. Since land for mitigation banks and future conservation areas will be acquired only from willing sellers, the HCP must utilize "soft line maps" that delineate potential reserve areas based on their relative conservation 'value.' Specific acreages will be preserved or restored within each conservation area according to the goals and objectives for each Natural Community (Section 6.0). The 'soft line maps' depicting priority areas for protection represent a general guide to locating new reserve lands. The reserve design principles described above shall be employed, to the maximum extent practicable, when choosing the exact location of a future preserve/reserve.

2. Given current County zoning restrictions and regional topography, certain lands between, and adjacent to, established and future reserves are at low risk for development and can contribute to the value of the reserve network, by allowing for wildlife movement and dispersal between reserves. As circumstances change, Plan Participants recognize the need to adjust the reserve design model and reprioritize areas for protection in order to maintain the integrity and functionality of the reserve system. Periodic review of current land use practices (see Section 7.0) within the County will allow Plan Participants to adapt the Conservation Strategy accordingly. Changes to the Conservation Strategy may include the purchase of land, or the establishment of conservation easements needed to provide habitat linkages and maintain connectivity between established reserves and preserves (see also Section 10.7.3, Changed Circumstances).
3. 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.
4. Smaller reserves will be established within planned urban areas to protect existing populations of extremely rare and range-limited species and uncommon habitats or associations and/or 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.

### **4.3 CONSERVATION ANALYSIS BY NATURAL COMMUNITY**

The Conservation Analysis for each Natural Community is organized into three sections: 1) Associated Covered Species and Special Management Species; 2) Key Conservation Elements; and 3) Conservation Areas. Table 4-1 summarizes the Covered Species and Special Management Species associated with each Natural Community. Key conservation elements for each Natural Community have been determined based on the Natural Community accounts presented in Appendix B (Figure 4-1). A key conservation element is a habitat feature or environmental characteristic that can be physically mapped within the Plan Area that and reflects the conservation value and/or habitat quality of the Natural Community. Conservation areas are identified based on key conservation elements and the reserve design principles outlined in Section 4.2. The conservation areas are used to develop a conservation approach for each Natural Community, outline compensation or mitigation levels (see Section 6.0) for Covered Activities, and determine the level of development compatible with the regional conservation goals and objectives.

#### **4.3.1 Landscape Level Key Conservation Elements**

Certain conservation issues cannot be adequately addressed under a single Covered Species or Natural Community. Landscape-level issues simultaneously affect multiple Natural Community assemblages and are best addressed from a broad perspective that ties all of the Natural Community assemblages together. For the Solano HCP, landscape-level issues primarily concern dispersal corridors, habitat connectivity across Natural Community boundaries, and species diversity.

**4.3.1.1 Corridors.** An analysis of major and minor barriers and patterns of habitat fragmentation revealed seven major corridors within the Plan Area. These corridors are, the area north of Vacaville, the Vacaville-Fairfield Green Belt, the Suisun Valley agricultural area (represented as the Suisun Creek Riparian Corridor), the small patch of natural vegetation between the West Hills and the Vaca Mountains (i.e., West Hills-Vaca Mountains Corridor), Vallejo Lakes, Rockville Hills, and Jepson Prairie-Suisun Marsh Corridor (Figure 4-3).

**North Vacaville.** The North Vacaville Corridor represents the portion of the English Hills north of the rural residential areas in northern Vacaville. This area provides an important transition between the Vaca Mountains, Pleasants Valley, and the Vacaville Vernal Pool High Value Conservation Area (Figure 4-3).

**Vacaville-Fairfield Green Belt.** Despite the presence of Interstate 80, the Vacaville-Fairfield Green Belt provides connectivity between the lowlands of the Jepson Prairie and the Vaca Mountains (Figure 4-3).

**Suisun Creek Riparian Corridor.** The Suisun Valley agricultural area, dominated by vineyards and orchards, provides a 'greenbelt' connecting the West Hills to Suisun Marsh (Figure 4-3).

**West Hills – Vaca Mountains Corridor.** Intensive agricultural in Suisun Valley separates the West Hills from the Vaca Mountains, but a small area of natural vegetation north of Suisun Valley provides a corridor between these two areas (Figure 4-3).

**Vallejo Lakes and Rockville Hills.** Rural residential development has expanded northwest from Cordelia into the West Hills, separating them from the Tri City/County Planning Area. However, two corridors maintain connectivity between these two areas: Vallejo Lakes west of the rural residential development and Rockville Hills between the rural residential development and Cordelia (Figure 4-3).

**Jepson Prairie-Suisun Marsh Corridor.** The region surrounding the Potrero Hills represents important transition habitat between Suisun Marsh and Jepson Prairie (Figure 4-3).

**4.3.1.2 Rarity-Weighted Richness Index.** Areas containing, potentially supporting or with high richness of Covered Species and Special Management Species were identified throughout the Plan Area. Areas of high richness were identified by calculating a rarity-weighted richness index (RWRI) using methods developed by Chaplin et al. (2000) and CDFG (2003a) for the CDFG *Atlas of the Biodiversity of California*. An RWRI measures the irreplaceability of certain areas based on species occurrence records. The methods and biases inherent in this approach are described in Hunting (2003). One significant bias in the analysis conducted for the HCP is the lack of survey data available for the majority of the County. With more data collection, the resulting diversity patterns may change. The analysis and its results are described in further detail below..

For the RWRI, a grid of equal-area hexagonal cells with sides ¼ mile long and approximately 2,286 ft. (0.433 miles) between centers was overlaid onto the Plan Area (see Figure 4-4). Species occurrence information was then used to determine rarity values for each cell. The RWRI assigns a weight to each species based on the inverse of the number of hexagons in which it occurs. For

example, a species found in only one hexagon receives the maximum possible score of 1/1, or 1.0. The score for a species occurring in 20 hexagons would be 1/20, or 0.05. The rarity-weighted index for the cell is the sum of the individual scores for all species in the hexagon (Chaplin et al. 2000).

Two sources of rare species occurrence data were used for this analysis: (1) CNDDDB polygon records and (2) additional species occurrences, collected by LSA that do not appear in the CNDDDB. Following the methods outlined in the *Atlas of the Biodiversity of California*, data was "filtered" to exclude extirpated or low precision occurrence records. CNDDDB records identified as "extirpated" or "likely extirpated" or with an accuracy class of 10 (indicating the record had been created by placing a 5-mile radius around very non-specific locality information) were removed. Non-CNDDDB records considered extirpated based upon evaluation of available habitat via field surveys or aerial imagery were also removed.

Figure 4-4 presents the results of the RWRI for Covered Species and Special Management Species within the Plan Area. Dark green and blue hexagons represent irreplaceable conservation areas based on species occurrence records; however, this map must be used with caution because the results are highly affected by insufficient survey information.

Figure 4-4 depicts Jepson Prairie as a hotspot of diversity within the Plan Area. Jepson Prairie is known for its diversity of vernal pool species and would be recognized as a biological diversity hotspot even with additional survey data. The RWRI also identified Suisun Marsh as an area of high biological diversity within the Plan Area. Suisun Marsh is also known to host a suite of rare and threatened species. However, limited data is available for privately owned areas of Suisun Marsh; more records from these areas may change the results of the RWRI analysis. Other hotspots within the Plan Area include the area northeast of Vallejo where callippe silverspot butterfly records occur.

Figure 4-4 depicts the Inner Coast Range as predominantly low richness with isolated "hotspots" of biological diversity, reflecting the limited availability of data for that region. The isolated high value hexagons represent the small number of Covered Species and Special Management Species associated with this Natural Community and the limited availability of records for some of the Special Management Species, such as the yellow-breasted chat (*Icteria virens*), foothill yellow-legged frog (*Rana boylei*), and Western pond turtle (*Actinemys marmorata*). More data would likely alter the pattern observed for this region from low to moderate richness with occasional areas of high richness (i.e., light to dark green with occasional blue hexagons). The depiction of the Inner Coast Range does not accurately reflect its biodiversity because only Covered Species and Special Management Species were included in the RWRI analysis. An analysis of all species in the region would indicate high biodiversity in the Inner Coast Range. Approximately 331 species depend on oak woodlands throughout their lifecycle (Verner 1980; Barrett 1980; Block and Morrison 1998) and riparian or streamside vegetation provides important habitat for over 225 species of fish, amphibians, reptiles, birds, and mammals in California (RHJV 2000).

Another region with surprisingly low values for species diversity and rarity is the Vacaville Vernal Pool High Value Conservation Area due to the lack of biodiversity data. This area likely contains a diverse range of claypan vernal pool species, similar to the Jepson Prairie and may even contain a slightly different composition of species. Regardless, with more data, this area would likely rank higher for species richness.

The patchwork of light to moderately dark hexagons in the northeastern portion of Solano County corresponds to an area dominated by irrigated agriculture and predominantly represents records of Swainson's hawk and burrowing owl. Both species occur throughout this area and the pattern observed from this analysis likely results from greater public accessibility to some areas (e.g., more public access increases the likelihood of species being observed and recorded), particularly the southern part of the Main Prairie (Figure 1-3).

### **4.3.2 Valley Floor Grassland and Vernal Pools**

Valley Floor Grassland and Vernal Pools are dominated by two typically intermixed associations: vernal pool system grasslands and grasslands associated with low hills, such as the Montezuma Hills, Potrero Hills, and upper terraces along the Valley Floor/Inner Coast Range Foothills. Vernal pool ecosystems in Solano County consist of seasonally inundated pool basins and swales embedded in a matrix of undulating grasslands.

The Valley Floor Grassland and Vernal Pools Conservation Analysis applies to all areas on historical alluvial terraces on the valley floor that currently support or likely historically supported vernal pool habitats. Areas that likely historically supported vernal pools are encompassed within the Conservation Analysis because they are reasonably capable of being restored. This Natural Community encompasses both the wetland component, including vernal pool and other seasonal to semi-permanent wetlands, and associated uplands within their immediate watersheds that provide habitat for vernal pool associated species.

This section presents the conservation analysis for the Valley Floor Grassland and Vernal Pool Natural Community including identification of key conservation elements and conservation areas. The conservation analysis is based on information for this Natural Community provided in Appendix B.

**4.3.2.1 Associated Covered Species and Special Management Species.** Vernal pools and their associated plant communities provide the primary habitat for 15 (40%) Covered Species and 25 (69%) Special Management Species (Table 4-1). Four additional species will receive secondary benefits from vernal pool conservation in the Plan Area. Covered Species and Special Management Species have been divided into four groups based on specific habitat associations (Table 4-2).

**Group 1 – Vernal Pool/Grassland Complex Species.** This group includes species capable of tolerating a broad range of water quality/alkalinity, depth, and duration. These species are expected to occur in almost any vernal pool community complex within their respective range or distribution in the Plan Area. However, several of these species are quite uncommon and have a very limited range or occurrence.

**Group 2 – Alkali Playa, Flats, and Meadow Species.** This group includes a number of plant species typically associated with highly alkaline plant communities such as alkali playas, flats, and meadows. These species may also occur in higher salinity zones around the drying edges of vernal pool communities.

**Group 3 – Long Duration Hydro-period/Playa Pool/Vernal Lake Species.** This group includes a number of species that are extremely rare or range-limited within the Plan Area and are closely tied to the larger playa pools/vernal lakes. These pools are characterized by turbid water and an extended hydro-period and are typically associated with Pescadero Series soils.

**Group 4 – Upland Species.** This group is composed of species (or life stages) primarily associated with upland grasslands (or vernal pools and swales during the dry season) as opposed to the aquatic-oriented species described above.

**4.3.2.2 Key Conservation Elements.** As described above, key conservation elements reflect the conservation value and/or habitat quality of the Natural Community. The following key conservation elements were assessed to determine the relative conservation value of areas within the Valley Floor Grassland and Vernal Pools Natural Community:

- Disturbance Levels
- Distribution of Covered Species and Special Management Species
- Unique or Uncommon Habitat Features
- Proximity to Existing and Proposed Preserves/Reserves
- Barriers
- Core Recovery Areas and Designated Critical Habitat
- Corridors and Linkage Areas

**Disturbance Levels.** All potential vernal pool habitat (Figure 4-6) was ranked into five disturbance categories based on 1999 aerial photographs (at a scale of 1" equals 2,000 ft.) and limited ground-truthing/verification. These disturbance levels establish a metric for assessing the degree to which anthropogenic pressures have degraded or altered the ecological processes, functions and overall habitat value of the Natural Community. The five disturbance categories are as follows:

**Converted.** This category includes areas on historic vernal pool soils (Figure 3-6) that have been converted to agriculture, urban development, or other uses, essentially eliminating the natural communities.

**Very High Disturbance Levels.** This category includes areas supporting grassland cover, but in which historic vernal pool features have been largely erased (i.e., current land use was incompatible with vernal pools or there was clear evidence of plowing and/or leveling). Severe disturbance within these areas occur when the underlying claypan/hardpan no longer exists or has been covered by development. These areas have very little, if any, potential for restoration due to the significant alteration of essential habitat and ecological processes.

**High Disturbance Levels.** This category includes areas containing evidence of current or historic farming (i.e., plow lines) as well as some evidence of topographic variation, pools, swales, or native vegetation despite being extensively graded. Restoration within these areas, while possible, would likely require hydrologic changes and extensive revegetation.

**Moderate Disturbance Levels.** This category includes areas containing evidence of historic disturbance, vehicle tracks, or bare ground from an unknown source, but no visible plow lines or apparent leveling. These areas also exhibited topographic variation, clearly defined pools or swales, or natural vegetation. Restoration/revegetation and changes in land management would be needed to establish or maintain vernal pool habitat in these areas.

**Low Disturbance Levels.** This category includes areas where the landform and vegetation appeared to be in relatively “pristine” condition. In these areas, natural topographic variation, including mima mound topography, ponds and/or swales and natural vegetation was evident, with little or no evidence of historic farming (furrows or leveling) or other serious disturbance. These areas would require little or no restoration to establish or maintain vernal pool habitat for the purpose of conservation.

A large, essentially contiguous block of native topography/low disturbance vernal pool habitat occupies much of the greater Jepson Prairie in Solano County (Figure 4-6). This large block extends approximately 18 square miles, from Travis Air Force Base on the west, Highway 113 on the east, Hay Road on the north, and Creed Road on the south. Additional scattered blocks occur east of Highway 113 in the Gridley Ranch Mitigation Bank along Alamo Creek, and in an area north of Robinson Road south of Calhoun Cut (Figure 4-6). Disturbance in this block relates primarily to historical and ongoing agricultural operations. Additional, smaller blocks of moderately disturbed habitats occur in northeastern Fairfield and north of Vacaville (Figure 4-6).

**Distribution of Covered Species and Special Management Species.** Three types of data were used to evaluate the distribution of Covered Species and Special Management Species in the Valley Floor Grassland and Vernal Pool Natural Community: 1) the distribution of all Covered Species and Special Management Species according to the RWRI; 2) the distribution of Contra Costa goldfield occurrences and the known and potential range of the species (Figure 4-7); and 3) the known and potential range of the California tiger salamander.

**Rarity-Weighted Richness Index (RWRI).** Areas containing or potentially supporting and areas with high richness of Covered Species and Special Management Species were identified throughout the Plan Area by calculating the RWRI (see Section 4.3.1.2). This analysis identified Jepson Prairie, known for its diversity of vernal pool species, as a hotspot of biological diversity within the Valley Floor Grassland and Vernal Pools Natural Community (Figure 4-4).

**Contra Costa Goldfields.** Contra Costa goldfields have been designated into seven Core Population Areas to address potential genetic variations between various locations in the County (see Appendix B). These seven Core Population Areas are shown on Figure 4-7. Most of these Core Areas are located around the periphery of, or within, existing and proposed development within the cities of Fairfield and Suisun. Core Population Areas containing large contiguous blocks of habitat, unfortunately, lack large populations of Contra Costa goldfields. However, these areas may be valuable for re-establishment efforts. Adjacent areas lacking populations may provide important corridors for dispersal or occur within watersheds that support these Core Population Areas.

**California Tiger Salamander.** Within Solano County, California tiger salamanders are known from multiple records in an area stretching from the Potrero Hills northeast through the Jepson Prairie/Dozier region and into northeast Fairfield. There is also a historic record east of Dixon (Figure 4-8). No records of California tiger salamanders occur north of I-80 on the west side of the Central Valley except for the one area in the Dunnigan Hills in Yolo County. Figure 4-8 represents the known and potential range of California tiger salamanders within the Plan Area.

**Unique or Uncommon Habitat Features.** In order to meet the reserve design criteria for preserving a diverse range of physical and environmental conditions, unique or uncommon habitat features (such as large playa pools) and potential outlier or edge populations were identified for vernal pool species within the Plan Area. These two features include the distribution of playa pools and hardpan soils. Within the Plan Area, playa pools occur from the northern edge of the Potrero Hills northeast to the Jepson Prairie (Figure 4-5). North of Vacaville a small remnant vernal pool region is characterized by hardpan soils. Whether this region supports a different fauna than the claypan pools of the Jepson Prairie is unknown; until that is determined, this region is highlighted as a unique environmental feature.

**Proximity to Existing and Proposed Preserves/Reserves.** Areas adjacent to existing preserves and reserves have high conservation value because land acquired adjacent to existing conservation areas will effectively increase preserve size and establish additional connectivity between preserve lands. Figure 3-9 shows the distribution of existing preserves/reserves and proposed mitigation banks within the Valley Floor Grassland and Vernal Pool Natural Community. The majority of these existing and potential reserves/preserves encompass the higher quality/low disturbance vernal pools of the greater Jepson Prairie.

**Barriers.** Barriers, such as roads and development, which significantly hinder wildlife movement and hydrology, were identified within the Plan Area and were classified as either major or minor barriers. Major barriers include high volume roads such as Interstates 80, 680 and 505; State Highways 12 and 113; and local roads such as Vanden Road and Peabody Road where traffic volumes are high and the ability for small animals to cross the road successfully is unlikely. These roads also form significant barriers to the natural flow of water. Minor barriers include lower traffic volume roads that would not represent a significant barrier to terrestrial animal movement, but would affect hydrology and drainage patterns and serve as corridors for invasive species expansion. Delineation of potential barriers reveals patterns of habitat fragmentation and helps to identify where linkages should be established. The largest area of uninterrupted habitat within the Valley Floor Grassland and Vernal Pools Natural Community is an essentially roadless area within the Jepson Prairie (Figure 4-6). No public roads occur within this large block of habitat and access is limited to a few minor ranch roads/trails.

**Corridors.** Three corridors have been identified within the Valley Floor Grassland and Vernal Pools Natural Community: the North Vacaville Corridor, the Vacaville-Fairfield Green Belt, and the Jepson Prairie-Suisun Marsh Corridor (Figure 4-3). Section 4.3.1.1 provides a description of all three corridors. The North Vacaville corridor primarily contains Inner Coast Range habitat, but also supports a small remnant of hardpan vernal pool habitat.

**Core Recovery Areas and Designated Critical Habitat.** The Draft Vernal Pool Ecosystem Recovery Plan (USFWS 2004a) designated five Core Recovery Areas in Solano County: Jepson Prairie, Suisun Marsh, Collinsville, Montezuma Hills, and Vacaville. In addition to these Core Recovery Areas, designated critical habitat for the Delta green ground beetle, California tiger salamander and vernal pool critical habitat is present within the Plan. The locations of these areas are shown on Figure 4-5.

**4.3.2.3 Conservation Areas.** The Valley Floor Grassland and Vernal Pool Natural Community, as depicted in Figure 4-1, has been divided into three conservation areas (low, medium and high) based on the key conservation elements described in section 4.3.2.2. These conservation areas are shown on Figure 4.9 and further detailed below.

**High Value Conservation Areas.** Based on the key conservation elements described in Section 4.3.2.2, high value conservation areas were delineated using the following criteria:

- Large blocks (greater than 500 acres, regardless of ownership) of vernal pool complexes and associated habitats with low to moderate levels of disturbance and containing or potentially supporting populations of target species;
- Unique or uncommon habitat features (such as large playa pools or lakes, alkali flats, and unique soil types) and areas with high concentrations of target species and biological diversity;
- Moderately to highly disturbed habitats within and adjacent to moderate to high quality vernal pool complexes that have a high potential for restoration and enhancement of vernal pools and associated habitats;
- Complexes that support isolated populations of extremely rare or range-limited species and/or core populations of Contra Costa goldfields regardless of size (less than 500 acres, regardless of ownership), level of disturbance or existence of barriers;
- Areas that may serve as corridors or linkages between other high value lands;
- Vernal pool complex ecotone or transition areas, especially areas between estuarine, lacustrine, palustrine, and riverine systems; and
- Areas representing separate evolutionarily significant units.

Based on the above criteria, the high value conservation areas (39,555 acres in total) are further subdivided into 11 subareas to facilitate conservation activities (Figure 4-9). These subareas are:

- Subarea 1A - Jepson Prairie (26,860 acres): High Value Conservation Criteria 1, 2, 3, 4, 5, 6, and 7
- Subarea 1B - McCoy Creek Basin Contra Costa goldfields core population (610 acres): High Value Conservation Criteria 3, 4, and 7
- Subarea 1C - Upper Union Creek Contra Costa goldfields core population (1,380 acres): High Value Conservation Criteria 1, 3, 4, 5 and 7
- Subarea 1D - Vanden Contra Costa goldfields core population (100 acres): High Value Conservation Criteria 3, 4, and 7

- Subarea 1E – Walters/Air Base Parkway Contra Costa goldfields core population (170 acres): High Value Conservation Criteria 3, 4, and 7
- Subarea 1F - Potrero Hills/Lower Union Creek/Denverton Creek Contra Costa goldfields core population (4,990 acres): High Value Conservation Criteria 1, 2, 3, 4, 5, 6, and 7
- Subarea 1G - Ledgewood Creek Contra Costa goldfields core population (280 acres): High Value Conservation Criteria 2, 3, 4, 6, and 7
- Subarea 1H - Cordelia Contra Costa goldfields core population (15 acre): High Value Conservation Criteria 4, 6 and 7
- Subarea 1I – Montezuma Hills Core Recovery Area (140 acres): High Value Conservation Criteria 4 and 7
- Subarea 1J – Collinsville Core Recovery Area (880 acres): High Value Conservation Criteria 4, 5, 6, and 7
- Subarea 1K - Hardpan Pools (Corning series soils - northwest area; 3,530 acres): High Value Conservation Criteria 1, 2, 3, 5, 6 and 7
- Subarea 1L – Davis Communications Annex (600 acres): High Value Conservation Criteria 4 and 7

**Medium Value Conservation Areas.** Medium value conservation areas include highly to very highly disturbed lands located on historic vernal pool soils and adjacent Valley Floor Grassland habitat located on non-vernal pool soils. These disturbed lands on historic vernal pool soils have been previously leveled and/or cultivated such that the natural soil profile has been altered, but the underlying impermeable layers remain intact. Other lands in this category include moderate to highly altered lands that are isolated or surrounded by existing urban development, or other land uses that have substantially altered the hydrological integrity of the site. Typically, medium value conservation areas lie on the periphery of or adjacent to, high value conservation areas but are hydrologically and ecologically separated from these areas by roads, canals, ditches, and/or other development. Although medium value conservation areas may contain suitable habitat, they typically do not support target species (as documented through surveys of an appropriate timing and intensity), or are inhabited by more common and widespread target species<sup>1</sup>.

Medium value conservation areas were delineated based on the following criteria:

- Watershed and buffer lands to High Value Conservation Areas;
- Areas that support (or may support) populations of more common and widespread species;
- Areas that serve as corridors, linkages, or transition zones to other terrestrial habitats;
- Areas that contain fringe or edge populations that represent separate, evolutionarily significant units; and

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<sup>1</sup> Medium and low value conservation areas may include highly altered lands supporting small, isolated populations of Contra Costa goldfields that occur within existing urbanized areas

- Sites of limited size that are isolated and/or subject to significant anthropogenic pressures and the potential for restoration is limited.

The medium value conservation areas (90,780 acres in total) are further subdivided into 14 subareas based on geographical location and species-specific conservation requirements:

- Subarea 2A – Maine Prairie/Valley Floor region (5,880 acres): Medium Value Conservation Criteria 1, 2, 3, 4, and 5
- Subarea 2B – McCoy Creek Contra Costa Goldfield Buffer/Watershed Lands (70 acres): Medium Value Conservation Criteria 1, 2, 3, 4, and 5 (comprised mostly pre-approved projects, minor remnant areas remain)
- Subarea 2C - Upper Union Creek Contra Costa Goldfield Buffer/Watershed Lands (2,020 acres): Medium Value Conservation Criteria 1, 2, 3, 4, and 5
- Subarea 2D – East Vacaville (870 acres): Medium Value Conservation Criteria 2, 4 and 5
- Subarea 2E – Walters/Air Base Parkway Contra Costa goldfields Buffer/Watershed lands and corridor area (380 acres): Medium Value Conservation Criteria 1, 2, 3, 4 and 5
- Subarea 2F – Potrero Hills (5,990 acres): Medium Value Conservation Criteria 1, 2, 3 and 4
- Subarea 2G – Ledgewood Creek Contra Costa Goldfield Buffer/Watershed Lands (100 acres): Medium Value Conservation Criteria 1, 2, and 5
- Subarea 2H – Cordelia Contra Costa goldfields watershed and corridor area (2,040 acres): Medium Value Conservation Criteria 1, 2, 3, 4 and 5
- Subarea 2I – Montezuma Hills (69,750 acres): Medium Value Conservation Criteria 1, 2, 3, and 4.
- Subarea 2J – Cordelia/Western Fairfield (530 acres): Medium Value Conservation Criteria 1, 2, 3, 4, and 5
- Subarea 2K – Vacaville area Corning Series Soils (1,970 acres): Medium Value Conservation Criteria 1, 2, 3, 4, and 5
- Subarea 2L – Yolo County (560 acres): Medium Value Conservation Criteria 2, 4 and 5
- Subarea 2M–Vallejo (300 acres): Medium Value Conservation Criteria 1, 2, 3, 4 and 5
- Subarea 2N – Lagoon Valley (320 acres): Medium Value Conservation Criteria 1, 2, 3, 4 and 5

**Low Value Conservation Areas.** Low Value Conservation areas (approximately 6,450 acres in total) primarily include small, in-fill parcels that are surrounded by existing development, have limited or no connectivity to other natural habitats, and do not support isolated populations of extremely rare or range-limited species<sup>2</sup> (Figure 4-9).

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<sup>2</sup> For the purposes of the Solano HCP, the following covered species are considered to be Extremely Rare or Range-limited Species: Colusa grass, Solano grass, San Joaquin Valley orcutt grass (*Orcuttia inaequalis*), Ferris's milkvetch (*Astragalus tener var. ferrisiae*), Conservancy fairy shrimp, Ricksecker's water scavenger beetle (*Hydrochara ricksecker*), and Delta green ground beetle.

**Exceptions.** The conservation areas outlined above guide the Natural Community Conservation Measures outlined in Section 6.0. However, future biological surveys may identify small, isolated populations of Contra Costa goldfields or other rare or range-limited species in medium and low value conservation areas. As a result, the categorization of vernal habitat and the associated conservation measures would need to be revised. As data gaps are filled and more detailed information becomes available, the conservation area boundaries outlined above will be adjusted appropriately.

### 4.3.3 Inner Coast Range

The Inner Coast Range lies in the western margin of Solano County, and includes the Sky Valley/Sulphur Springs Mountain area (Tri-City/County Planning Area), the area west of Green Valley (e.g., West Hills), the Rockville Hills, and the Vaca Mountains/Blue Ridge area (Figure 4-1). Its geographic location, elevation and soils distinguish this Natural Community from the low-lying, Valley Floor Grassland and Vernal Pools. Consisting of ridges and valleys that trend northwest, the Inner Coast Range is better characterized as a geographical region because it encompasses a number of vegetation communities, including grassland, oak woodland, oak savanna, and mixed chaparral/scrub that form a mosaic over the entire Inner Coast Range (see Figure 4-2 and Figure 3-4). This mosaic of vegetation communities at various successional stages provides a diverse array of habitat types for plants and wildlife. Conserving, maintaining and managing for the continued existence of this mosaic is critical for preserving the highest levels of biodiversity within the region.

This section presents the conservation analysis for the Inner Coast Range Natural Community including identification of key conservation elements and conservation areas. The conservation analysis is based on information for this Natural Community provided in Appendix B.

**4.3.3.1 Associated Covered and Special Management Species.** Two Covered Species are primarily associated with the Inner Coast Range Natural Community: California red-legged frog and callippe silverspot butterfly (Table 4-1). Three additional Covered Species and three Special Management Species are secondarily associated with the Inner Coast Range Natural Community, including Valley elderberry longhorn beetle, burrowing owl, Swainson's hawk, foothill yellow-legged frog, Western pond turtle, and yellow-breasted chat, respectively.

**4.3.3.2 Key Conservation Elements.** To assess the overall conservation value of habitats within the Inner Coast Range, key conservation elements were identified that could be assessed spatially using GIS. For the Inner Coast Range Natural Community, the following key conservation elements were assessed to determine areas of high conservation value:

- Habitat Diversity
- Priority Watershed Areas
- Proximity to Existing and Proposed Preserves/Reserves
- Barriers and Patterns of Habitat Fragmentation
- Corridors and Linkage Areas

- Edge Effects
- Distribution of Covered Species and Special Management Species
- Core Recovery Areas and Designated Critical Habitat

**Habitat Diversity.** As (Appendix B), the Inner Coast Range Natural Community comprises several plant communities and habitats. The mix of woodland, chaparral, and grassland creates a landscape mosaic that provides important habitat for wildlife. Multi-source vegetation data, compiled by the California Department of Forestry and Fire Protection (CalFire) as part of their Fire and Resource Assessment Program (FRAP; Figure 4-10), was used to assess areas with high diversity of native vegetation. From this data, two major areas within the Inner Coast Range contain unique vegetation mosaics: the West Hills above Green Valley, and the northwest corner of Solano County encompassing the Vaca Mountains, Pleasants Valley, and the English Hills (Figure 1-3).

The English Hills consist primarily of grassland mixed with agriculture, bordered by oak savanna on the west and denser oak woodland on the north (Figure 3-4). According to the FRAP data, this area contains the highest density of Valley oaks within the County (Figure 4-10). Low density populations of Valley oaks, which prefer deep alluvial soils, occur in small pockets above Suisun Valley, east of the West Hills (at the southern tip of the Vaca Mountains); west of Interstate 505 (Figure 4-10); and in the southern tip of the Tri City/County Planning Area, at the northern tip of Sulphur Springs Reservoir. Maintaining a high diversity of oak species within the Plan Area may help stabilize acorn productivity between years (acorn productivity varies by species) and provide an important resource for several wildlife species (Koenig et al. 1999).

In addition, maintaining a diversity of tree species, as well as a mixture of age classes and large snags, may enhance wildlife diversity. For example, as described in Appendix B, cavities are an important resource for wildlife, particularly cavity nesting birds (Wilson et al. 1991). Recent research on cavity nesters has focused on the concept of “nest webs” that require the interaction of multiple species such as keystone excavators and keystone tree species in order to be sustained (Martin et al. 2004). Based on these studies, maintaining high tree diversity within the Plan Area is recommended to support the highest diversity of wildlife. The FRAP data highlights areas within the Plan Area with high species diversity (Figure 4-10).

**Priority Watershed Areas.** Priority watershed areas have been identified in the Riparian, Stream, and Freshwater Marsh conceptual models included in Appendix B. Maintaining the integrity of watershed lands is critical for preserving the ecological integrity of streams. Removal of vegetation from watershed lands, particularly on steep hillsides, creates soil erosion and compaction leading to increased sedimentation in downstream watercourses. Therefore, protecting watershed areas associated with priority drainages (see Figure 4-11) should be a high conservation priority.

Uplands within a watershed strongly influence riparian and aquatic ecosystems. The flux of water and sediment from the upper portions of the watershed determine the form of channels and floodplains and many associated attributes of riparian ecosystems (Naiman et al. 2005, Scott et al. 2004). Urbanization and intensive agriculture are the primary land uses within the Plan Area that negatively affect watershed integrity; therefore, the percentage of each watershed under

development or intensive agriculture was calculated (Figures 4-11 and 4-12). Several of the upper watershed areas within the Inner Coast Range are relatively 'pristine,' with little agriculture or urban development. These watersheds include Miller Canyon, Cold Canyon, Putah #1, and to a lesser degree, the Jameson Canyon, American Canyon, and Lagoon watersheds (Figures 4-11 and 4-12).

**Proximity to Existing and Proposed Preserves/Reserves.** Several existing preserves are located within the Inner Coast Range, comprising 13,374 acres or 13.6 percent of the total land area for this Natural Community (Figure 3-8). After ranking the quality of protected lands within Solano County, the majority of preserves in this Natural Community fall within Group 3, "moderate" quality preserves (see Section 3.5; Figure 3-9). Because the existing preserves within this Natural Community are of moderate quality, resources should be devoted to enhancing existing preserves through restoration and adaptive management.

**Barriers and Patterns of Habitat Fragmentation.** The location of potential barriers to dispersal and migration were assessed to determine the extent of habitat fragmentation and identify key corridors and linkages within the Inner Coast Range (Figure 4-3). Possible barriers were classified as either major or minor barriers based on their potential to hinder movement and dispersal. Major barriers such as large roads and developments significantly hinder the movement of animals. Major barriers within the Plan Area include Interstates 80, 680, and 505; State Highways 12 and 113; and local roads such as Vanden Road and Peabody Road where traffic volumes are high and ability for small animals to cross successfully cross is low. Minor barriers include agricultural areas and local roads with light traffic. Agricultural areas are not considered major barriers because they often provide transition habitat that shares some of the habitat values of the adjacent natural communities.

Three natural areas within the Inner Coast Range remain relatively intact and unfragmented. These areas are the Vaca Mountain/Pleasants Valley area (and to some extent, the English Hills), the West Hills south to Interstate 80, and the Tri City/County Planning Area (located between Interstate 80 to the north, 680 to the east, and the cities of Vallejo and Benicia to the south and west (Figures 1-3 and 4-3).

**Corridors.** Based on the analysis of barriers and patterns of fragmentation within the Inner Coast Range, important corridor areas were identified (Figure 4-3). The main corridors within the Inner Coast Range include: North Vacaville, Vacaville-Fairfield Green Belt, Suisun Creek Riparian Corridor, West Hills-Vaca Mountains Corridor, Vallejo Lakes, and Rockville Hills. These corridors are described in Section 4.3.1.1 and illustrated in Figure 4-3.

**Edge Effects.** Habitat loss and fragmentation are not the only impacts that development and intensive agriculture have on wildlife and their habitat. The negative impacts of human occupancy (i.e., increased road density, introduced species, unauthorized access) extend beyond the parcel boundary and can compromise habitat quality for some distance from development. Over 190 miles of urban/wildland edge and over 90 miles of intensive agriculture/wildland edge occur within the Inner Coast Range as a result of irregular development patterns creating "fingers" of development that encroach into natural communities. This pattern of growth exponentially increases the amount of edge habitat compared to a uniform wave of development. Areas most affected by threatened by these edge effects are the West Hills, the region west of

Green Valley, the English Hills in the Vacaville area, the southern tip of the Vaca Mountains near Fairfield, and the Tri City/County Planning Area near Vallejo and Cordelia (Figures 1-3 and 3-4).

**Distribution of Covered Species and Special Management Species.** Two types of data were used to evaluate the distribution of Covered Species and Special Management Species in the Inner Coast Range Natural Community: 1) the distribution of all Covered Species and Special Management Species according to the RWRI; and 2) the distribution of Covered Species and Special Management Species associated with the Inner Coast Range and/or dependent on watershed lands within the Inner Coast Range.

**Rarity-Weighted Richness Index (RWRI).** As described in Section 4.3.1.2, the results of the RWRI (Figure 4-4) indicate that the Inner Coast Range has low richness with isolated “hotspots” of biological diversity, reflecting the limited data available for this region and the small number of Covered Species associated with the Inner Coast Range (as compared to the Valley Floor Grassland and Vernal Pools). Isolated high value areas represent occurrence records for yellow-breasted chat, foothill yellow-legged frog, Western pond turtle, and Valley elderberry longhorn beetle. Hotspots in the Tri-City/County Planning Area represent records for callippe silverspot butterfly and California red-legged frog. More data for this region would likely alter the pattern observed for this region, from low to moderate richness with occasional areas of high richness (e.g., generally light to dark green with occasional blue hexagons). The pattern observed does not reflect the biodiversity of the Inner Coast Range as a whole, because only Covered Species and Special Management Species were included in this analysis. If the analysis accounted for all species, the pattern of biodiversity for this region would likely be reversed. As described above, the Inner Coast Range supports a wide array of vegetation communities including grassland, oak woodland, and oak savanna that provide important habitat for wildlife. As described in Section 4.3.1.2, approximately 331 species depend on oak woodlands throughout their life cycle (Verner 1980; Barrett 1980; Block and Morrison 1998), and riparian or streamside vegetation provides important habitat for an additional 225 species of fish, amphibians, reptiles, birds, and mammals (RHJV 2000).

**Callippe Silverspot Butterfly.** The status, distribution, and population levels of the callippe silverspot in Solano County are unknown. Several unverified reports of the callippe silverspot butterfly or closely related hybrids occur from a number of areas in the Tri-City/County Planning Area. Additional potential areas of concern include Nelson Hill in Cordelia, and the Rockville Hills area (Figure 4-14).

**Core Recovery Areas and Designated Critical Habitat.** Critical habitat designated by the USFWS (2004b) for the California red-legged frog is located in the Tri-City/County Planning Area. This area occupies 9,245 acres of the Jameson Canyon-Lower Napa River Core Recovery Area (USFWS 2002a; Figures 4-14 and 4-15), named the Sky Valley (SOL-1) unit (USFWS 2005b).

**4.3.3.3 Conservation Areas.** Based on specific ecological values, threats, and conservation needs derived from the above analyses, the entire Inner Coast Range is considered to have high conservation value. However, the reasons for this designation vary, making it difficult to divide the Inner Coast Range into areas of high, medium and low conservation value as was done for the Valley

Floor Grassland and Vernal Pools Natural Community. Instead, three areas have been designated based on geography and existing patterns of habitat fragmentation. As mentioned above, three areas within the Inner Coast Range remain relatively intact and unfragmented. These areas are the Vaca Mountain/Pleasants Valley/English Hills Area, the West Hills/Green Valley Area, and the Tri City/County Planning Area (Figure 1-3). Each area has unique ecological value, experiences varying anthropogenic pressures, and possesses different conservation needs, as described below.

**Vaca Mountain/Pleasants Valley/English Hills Conservation Area.**

**Ecological Value.** This area contains large blocks (greater than 500 acres) of Inner Coast Range habitat with diverse vegetation types potentially supporting a high diversity of native species. It contains three important corridors, two linking the Inner Coast Range to the Valley Floor Grassland and Vernal Pools Natural Community (North Vacaville Corridor and Vacaville-Fairfield Greenbelt; Figure 4-3), and one linking the Vaca Mountains with the West Hills. This last corridor contains seven key watershed drainages, Brewer’s western flax, foothill yellow-legged frog, Valley elderberry longhorn beetle, and is part of the Lake Berryessa Tributaries Core Recovery Area for California red-legged frog.

**Potential Risk.** Potential risk was assessed for the Vaca Mountain/Pleasants Valley/English Hills Conservation Area using current County zoning (see Section 3.6 and Figure 3-10). Table 4-3 summarizes the total acres and overall percent of land within the Conservation Area in each zoning category.

**Table 4-3: Summary of Protected Lands and County Zoning within the Vaca Mountain/Pleasants Valley/English Hills Conservation Area of the Inner Coast Range**

County Zoning	Minimum Parcel Size	Total Acres within Conservation Area	Percent of Conservation Area
Protected	NA	4,785 acres	8.5%
Watershed	160 acres	22,892 acres	40.8%
Agriculture	160 acres	648 acres	1.2%
Agriculture	40 acres	3,263 acres	5.8%
Agriculture	20 acres	14,880 acres	26.5%
Rural Residential	5 acres	1,474 acres	2.6%

Lands designated as “watershed” are under relatively little threat of development. However, the remainder of this conservation area is under threat of conversion to agriculture or low density rural residential development, particularly those areas zoned for rural residential or agriculture (20 acre minimum). The English Hills are perhaps most at risk due to the expansion of rural residential development and isolation from the Vaca Mountains by agricultural expansion in Pleasants Valley.

**Conservation Needs.** The primary conservation need for this area is the protection of additional land through land acquisition (i.e., conservation easements, fee title) or rezoning (i.e., from agriculture to open space). Conservation efforts should focus on the

Vacaville/Fairfield greenbelt and land acquisitions within the Northern Rancho Solano Master Plan Area. These areas are under the most threat from Plan Participant-related impacts and provide an important linkage between the Inner Coast Range, the Valley Floor Grassland and Vernal Pool Natural Community, the Vaca Mountains and the West Hills. This corridor also helps to maintain connectivity between the Jameson Canyon-Lower Napa River and the Lake Berryessa Tributaries Core Recovery Areas for California red-legged frog. In addition, conservation activities will promote the restoration and restocking of degraded oak stands, particularly those areas containing oaks of limited distribution such as Valley oak. These activities will increase the extent and quality of oak woodland habitat on public lands and promote oak woodland conservation and enhancement on private lands.

**West Hills/Green Valley Conservation Area.**

**Ecological Value.** This area contains large blocks (greater than 500 acres) of Inner Coast Range habitat with diverse vegetation types potentially supporting a high diversity of native species. It contains two key watershed drainages (Figure 3-5) and four important corridors. One corridor connects the Inner Coast Range and Suisun Marsh, one connects the Vaca Mountain/Pleasants Valley/English Hills Area to the West Hills, and two connect the Tri City/County Planning Area to the West Hills (Suisun Creek Riparian Corridor, West Hills-Vaca Mountains Corridor, Vallejo Lakes, and Rockville Hills; Figure 4-3). These corridors maintain connectivity between the Jameson Canyon-Lower Napa River and the Lake Berryessa Tributaries Core Recovery Areas for California red-legged frog.

**Potential Risk.** Potential risk was assessed for the West Hills/Green Valley Conservation Area of the Inner Coast Range using current County zoning (see Section 3.6 and Figure 3-10). Table 4-4 summarizes the total acres and overall percent of land within the Conservation Area in each zoning category.

**Table 4-4: Summary of Protected Lands and County Zoning within the West Hills/Green Valley Conservation Area of the Inner Coast Range**

County Zoning	Minimum Parcel Size	Total Acres within Conservation Area	Percent of Conservation Area
Protected	NA	3,224 acres	16.6%
Watershed	160 acres	5,619 acres	28.9%
Agriculture	40 acres	2,302 acres	11.8%
Agriculture	20 acres	6,263 acres	32.2%
Rural Residential	5 acres	287 acres	1.5%
Estate Residential	1 acre	65 acres	0.3%

All of the areas zoned as either rural residential or agriculture (20 acre minimum) are under threat of development. The small corridor of natural vegetation north of Suisun Valley is at high risk for conversion to agriculture. This area provides an important connection between the West Hills and the Vaca Mountains.

**Conservation Needs.** Within this area, 3,224 acres (16.6%) are currently protected in preserves, and 5,619 acres (28.9%) are zoned as watershed land. Preserved areas include two

important corridors, Rockville Hills Park and Vallejo Lakes that provide connectivity to the Tri City/County Planning Area. Conservation activities in this area should focus on the enhancement of existing preserves through restoration and adaptive management, as well as the protection of additional land.

### **Tri City/County Conservation Area.**

**Ecological Value.** This area contains primary habitat for the callippe silverspot butterfly and the majority of the Jameson Canyon-Lower Napa River Core Recovery Area for California red-legged frog (Figures 4-13 and 4-14). It also contains three key watersheds and habitat for burrowing owl and other sensitive species.

**Potential Risk.** Within the Tri City/County Planning Area (Figure 1-3), 23.5 percent (6,911 acres) is protected within existing preserves/ reserves and 37.5 percent (11,000 acres) is zoned as agriculture (20 acre minimum). The threat of development or agricultural conversion is small in this conservation area due to limited water availability. In addition, in 2003, Benicia voters approved Measure K, an urban growth boundary initiative to prevent development in the hills northeast of Benicia known as Sky Valley (see Section 3.6.2). Urban development is not allowed beyond the Urban Growth Boundary. The major threat to this area comes from the secondary pressures associated with development (habitat degradation, invasive exotic species, etc.) as it is surrounded on three sides by major urban areas (Vallejo, Benicia, and Cordelia).

**Conservation Needs.** Because a large portion of this area (6,911 acres, 23.5%) is currently protected in moderate quality preserves, conservation efforts for this area shall focus on enhancing existing preserves through restoration and adaptive management; avoiding and minimizing impacts to sensitive areas (particularly core habitat for the California red-legged frog and the callippe silverspot butterfly), and maintaining connectivity between preserves through additional land acquisitions, conservation easements, and fee titles. Conservation efforts in this area are largely driven by the conservation needs of the California red-legged frog and the callippe silverspot butterfly and are further detailed in Sections 4.3.4 and 4.3.5. The primary threat to these species is the invasion of exotic species including bullfrogs and annual grasses. Management and restoration of existing preserves could substantially enhance their overall quality and value thereby increasing populations of sensitive species. The main conservation approach for this area is to convert the 6,911 acres of moderate quality reserves into high quality reserves.

#### **4.3.4 California Red-Legged Frog**

California red-legged frog was listed as a federally threatened species on May 23, 1996 and is a CDFG Species of Special Concern. In 2002, the USFWS published a recovery plan for the frog in 2002 and designated critical habitat on designated April 13, 2004 (USFWS 2002a, 2004b).

According to Hayes and Jennings (1988), California red-legged frogs have been extirpated or nearly extirpated from over 70 percent of their former range. Historically, California red-legged frogs were common in coastal and inland habitats from Point Reyes National Seashore in Marin County, Redding in Shasta County, and south to northwestern Baja California (Hayes and Jennings 1988;

Jennings and Hayes 1985). Today only a few isolated localities in the Sierra Nevada, northern coast, and northern Transverse Ranges are known and California red-legged frogs are believed to be nearly extirpated from the southern Transverse and Peninsular ranges (USFWS 2002a). It is still common in the San Francisco Bay area (including Marin County) and along the central coast (CDFG 2004a). Monterey, San Luis Obispo, and Santa Barbara Counties support the largest extent of currently occupied habitat (USFWS 2002a).

California red-legged frogs occupy extremely diverse habitat types and uses different habitats during various life stages. They have been observed using various aquatic, riparian, and upland habitats, including but not limited to ephemeral ponds, intermittent streams, seasonal wetlands, springs, seeps, permanent ponds, perennial creeks, manmade aquatic features, marshes, dune ponds, lagoons, riparian corridors, blackberry (*Rubus* spp.) thickets, nonnative annual grasslands, and oak savannas (USFWS 2002a). They are found in both natural and manmade aquatic habitats, and inhabit areas of diverse vegetation cover. The most secure aggregations of frogs are found in aquatic sites that support substantial riparian and aquatic vegetation and lack non-native predators, especially bullfrogs (USFWS 2002a).

Habitat loss and alteration, over-exploitation for food, and the introduction of exotic predators contributed significantly to the species' decline in the early-to mid-1900s (Jennings and Hayes 1985). Reservoir construction, predator expansion, grazing, and prolonged drought fragmented and eliminated many of the Sierra Nevada Foothill populations (USFWS 2002a). Currently, only a few drainages in the Sierra Nevada foothills are known to support California red-legged frogs, compared to more than 60 historical records. Several researchers have attributed the decline of California red-legged frogs to predation and competition from introduced species including bullfrogs (*Rana catesbeiana*) and predatory fishes (Hayes and Jennings 1986).

California red-legged frogs are currently threatened by human activities and natural disturbances such as droughts and floods (USFWS 2002a). Degradation and loss of habitat through agriculture, urbanization, mining, overgrazing, recreation, timber harvesting, invasion of nonnative plants, impoundments, water diversions, degraded water quality, and introduced predators contribute to declining populations of California red-legged frogs (Jennings 1988).

These factors have resulted in the isolation and fragmentation of habitats within many watersheds, precluding dispersal between sub-populations and jeopardizing the viability of metapopulations. The fragmentation of existing habitat and continued colonization of this habitat by nonnative species represent the most significant threat to California red-legged frogs.

In Solano County, urban development and invasion of nonnative predators are the greatest concerns for conservation of the species. The Recovery Plan for the Jameson Canyon-Lower Napa River Recovery Area identifies the following conservation needs: “*Protect existing populations from current and future urbanization, create and manage alternative breeding habitats, and protect dispersal corridors,*” (Table 6, Recovery Task 1.15, USFWS 2002a). A secondary concern is to maintain habitat connectivity between the two Core Recovery Areas in the County, Jameson Canyon-Lower Napa River and the Lake Berryessa Tributaries Core Recovery Areas (USFWS 2002a).

This section presents the conservation analysis for California red-legged frog including identification of key conservation elements and conservation areas. The conservation analysis is based on

background information for this species including habitat types, natural community associations, distribution, ecological processes, habitat variables, and threats provided in Appendix B.

**4.3.4.1 Associated Natural Communities, Covered Species and Special Management Species.** In Solano County, the California red-legged frog is associated with the Inner Coast Range and Riparian, Stream, and Freshwater Marsh Natural Communities (Figure 4-1). Covered Species and Special Management Species that will also benefit from this conservation strategy are the callippe silverspot butterfly, Valley elderberry longhorn beetle, foothill yellow-legged frog, Western pond turtle, and other species associated with these two Natural Communities (Table 4-1).

**4.3.4.2 Key Conservation Elements.** The following key conservation elements were assessed to determine the relative conservation values of habitat areas for red-legged frogs within the Plan Area:

- Core Recovery Areas and Designated Critical Habitat
- Watershed Area
- Location of Potential Breeding and Essential Hydration Habitat
- Species Occurrence Data
- Introduced Predators
- Proximity to Existing Preserves and Reserves

**Core Recovery Areas and Designated Critical Habitat.** The Recovery Plan for California red-legged frog (USFWS 2002a) designated core recovery areas throughout its range. Solano County contains portions of two core recovery areas the Jameson Canyon-Lower Napa River Core Recovery Area and the Lake Berryessa Tributaries Core Recovery Area. The Jameson Canyon-Lower Napa River Core Recovery Area encompasses 27,270 acres located in the hills west of Green Valley and into the Tri-City/County Planning Area. The Lake Berryessa Tributaries Core Recovery Area encompasses 4,253 acres located in the extreme northwestern corner of the County, near the University of California Stebbins Cold Canyon Preserve (USFWS 2002a; Figure 4-14).

In addition to Core Recovery Areas, the Plan Area has long supported critical habitat for this species. The most recent revision to proposed critical habitat occurred on September 16, 2008 and encompasses approximately 1,804,865 acres in 28 California counties, an increase of approximately 1,354,577 acres from the 2005 proposal (USFWS 2008b). Three revised critical habitat units are located within the Plan Area (SOL-1, SOL-2 and SOL-3; Figure 4-15). The Sky Valley unit (SOL-1) encompasses approximately 11,971 acres and is located in southwestern Solano County south of Interstate 80 and west of Interstate 680. The Jameson Canyon unit (SOL-2) encompasses approximately 3,360 acres and is located north of Highway 12. The American Canyon unit (SOL-3) encompasses approximately 4,597 acres and is located north of Interstate 80 and south of Highway 12.

**Watersheds (Percent of Watershed Area Developed).** As described in Appendix B, the percent of developed land within a watershed likely has a significant adverse affect on amphibian populations (Richter and Azous 1995). Within Solano County, the Lake Berryessa Tributaries Core Recovery Area falls almost entirely within the Cold Canyon watershed, except for the northwest corner of Putah Creek. Less than 0.01 percent of the Cold Canyon watershed within Solano County is developed, and less than 0.5 percent is currently farmed (Figures 4-11 and 4-12). Table 4-5 lists the percentage of watershed lands in the core recovery area under development (Figure 4-12) and agriculture (Figure 4-13).

**Table 4-5: Percent Development and Agriculture in Watersheds within the California Red-legged Frog Jameson Canyon Core Recovery Area.**

Watershed within Jameson Canyon Core Recovery Area	Total Area within Watershed (acres)	Percent of Recovery Area	Percent of Watershed Developed	Percent of Watershed in Agriculture
Jameson	2,464	9%	6%	<1%
American Canyon	4,375	16%	2%	0%
Marsh #1	6,150	23%	12%	8%
Lake Herman	9,532	35%	17%	<1%
Chabot	2,171	8%	69%	<1%
Green Valley	2,218	8%	20%	7%
Vallejo #2	172	1%	92%	0%
Vallejo #10	156	1%	61%	0%
Benicia #4	24	0%	47%	0%

**Location of Potential Breeding and Hydration Habitat (Pond, Open Water, Marsh, Springs, Seeps, and Channel Habitats).** The locations of suitable breeding and hydration habitats (i.e., pond, open water, marsh, springs, seeps, and channel habitats) were identified in the Core Recovery Areas (Figure 4-16) using multiple data sources. These sources include the USGS high-resolution National Hydrography Dataset; the vegetation and cover type data for Solano County (CH2MHill’s digitized Vegetation Habitat Delineations of Solano County [CH2MHill 2002] and SFEI’s Modern Baylands data); 2004 aerial photographs of Solano County and USGS 7.5’Quads. Based on this data, the southern portion of the Inner Coast Range, within the Jameson Canyon-Lower Napa River Core Recovery Area contains the highest density of potential breeding and hydration habitat for this species (Figure 4-16).

**Species Occurrence Data.** Species occurrence data for Solano County is limited to a small number of CNDDDB records and other observations from the Jameson Canyon-Lower Napa River Core Recovery Area. Although California red-legged frogs have also been reported in the extreme northwestern corner of the County, in the University of California Stebbins Cold Canyon Preserve, no records currently exist to support these reports. Based on species occurrence data, watersheds occupied by California red-legged frogs within the Plan Area include Lake Herman, Chabot, Marsh #1, American Canyon, and Jameson Canyon (Figures 3-5 and 4-15; USFWS 2001). Because California red-legged frogs can be found in a range of habitats within a watershed (e.g., stock ponds, creeks), and may occur in a single location or numerous locations throughout a watershed, an occupied watershed refers to a network of habitat areas, populations, and site-specific localities. Occupied drainages or watersheds include the bodies of water that support frogs (i.e., streams, creeks, tributaries, associated natural and artificial ponds, and adjacent

drainages), and the habitats through which frogs can move (i.e., riparian vegetation, uplands) (USFWS 2001).

The first CNDDDB record for Solano County was recorded in 1993 when LSA Associates found three adults and 20 juveniles at the northern end of Sky Valley in the Page Flat area of the Lake Herman watershed. California red-legged frogs were observed in artificial golf course ponds, stormwater detention ponds, and one spring-fed pool. California red-legged frogs were likely present in the natural springs and seeps in the upper watershed of Sulphur Springs Creek prior to the development of the artificial ponds within Sky Valley. The earliest records for California red-legged frogs occur in the upper portions of Sky Valley, so frogs likely moved down from these springs and seeps following the creation of perennial water sources. After 1993, California red-legged frogs were observed throughout Sky Valley in various created wetlands, stormwater detention ponds, golf course ponds, and spring boxes (CDFG 2004a). Frogs continued to thrive in this area until predators were introduced and their populations expanded (see synergisms section of the Narrative Conceptual Model in Appendix B).

Only one CNDDDB record currently exists from the Chabot watershed. Duffield observed tadpoles, juveniles and an adult in Rindler creek on the north side of Columbus parkway, east of Vallejo. Three CNDDDB records occur within the Marsh #1 watershed: 1) Laabs and Allaback observed three individuals in a pool along Old Paseo Creek (April 1997); 2) Jennings collected a juvenile frog from an old quarry area adjacent to an unnamed tributary (April 1999); and 3) Guinon observed an adult frog in a created pond north of Garibaldi Creek (April 2000). The first record of red-legged frogs from the American Canyon Watershed is from Foreman (LSA Associates) in the Spring of 1997 on Lynch Canyon in Windmill pond. In July of 2000, Muth and Dearn (LSA Associates) observed adult red-legged frogs in three plunge pools along American Canyon Creek. In the Jameson Canyon Watershed, Thomas and Kingma (Monk and Associates) observed one adult in a drainage containing small plunge pools surrounded by open grassland. All of these populations are presumed to be extant and these watersheds are considered by the USFWS to be currently occupied by California red-legged frogs. This assumption is uncertain and additional information about the location and status of California red-legged frog populations within the Plan Area, particularly within the Jameson Canyon-Lower Napa River Core Recovery Area must be determined.

**Introduced Predators.** As mentioned in the Recovery Plan (USFWS 2002a), the primary threats to California red-legged frogs within the Jameson Canyon-Lower Napa River Core Recovery Area are urban development, and predation and competition from exotic species, especially bullfrogs. Very little data on the distribution of introduced predators within the County currently exists. However, several bullfrog records occur within the Jameson Canyon-Lower Napa River Core Recovery Area, particularly within the Lake Herman Watershed. Figure 4-16 illustrates the known distribution of bullfrogs within water bodies of this area. Bullfrog records within the County are highly biased toward the Lake Herman Watershed due to monitoring requirements for Sky Valley development. Bullfrogs, introduced fish, and crayfish are likely to occur in perennial watercourses throughout the Inner Coast Range, although no data is currently available to confirm this information (i.e., represents a data gap for the HCP).

**Proximity to Existing and Proposed Preserves and Reserves.** A large portion of the Inner Coast Range is currently protected within existing preserves and reserves (see Section 4.3.3.5).

Important areas for California red-legged frog conservation include the Jameson Canyon-Lower Napa River and Lake Berryessa Tributaries Core Recovery Areas. Within these areas, 7,716 acres (28.3%) and 1,596 acres (37.53%), respectively are currently protected within existing preserves and reserves. The remainder of the Inner Coast Range provides habitat connectivity between the two core recovery areas; 15,035 acres (14%) of this remaining habitat is currently protected within existing preserves and reserves (Figure 3-8).

**4.3.4.3 Conservation Areas.** Based on the key conservation elements described above, the California red-legged Frog Conservation Strategy covers two areas: 1) the California Red-legged Frog Conservation Area and 2) the remainder of the Inner Coast Range, including Riparian, Stream, and Freshwater Marsh habitat (Figure 4-16). The California Red-legged Frog Conservation Area encompasses most of the Jameson Canyon-Lower Napa River Core Recovery Area within Solano County; however, this core recovery area extends all the way down to the South Hampton Marsh and includes developed portions of Vallejo. Although it largely follows the boundary of the Jameson Canyon-Lower Napa River Core Recovery Area, the boundary of the California Red-legged Frog Conservation Area has been modified slightly to follow the boundary of existing development along Vallejo and Benicia (Figure 4-16).

### **4.3.5 Callippe Silverspot Butterfly**

The callippe silverspot butterfly was listed as a federally endangered species on December 5, 1997 (62 FR 64306). A member of the brush foot family (Nymphalidae), this species was described and named in 1852 by J.A. Boisduval from specimens collected by Pierre Lorquin in San Francisco, California (dos Passos and Grey 1947; Anonymous 1980).

The callippe silverspot is a relatively large butterfly with a wingspan of approximately 2.0 to 2.5 inches (Anonymous 1980; Black and Vaughan 2005). The upper wings are a dull yellowish-brown with a sooty coloration at their base and extensive black spots and lines. The undersides of the wings are brown, orange-brown, and tan with black lines and distinctive black and silver spots (Black and Vaughan 2005).

The callippe silverspot was only known from 14 populations in the San Francisco Bay region, of which only three are still extant. Their historic range encompassed the Inner Coast Range on the eastern shore of San Francisco Bay from northwestern Contra Costa County to the Castro Valley in Alameda County. On the west side of San Francisco Bay, it ranged from San Francisco south to La Honda in San Mateo County. Currently, extant colonies are known only from San Bruno Mountain in San Mateo County, a city park in the Oakland Hills of Alameda County, and the hills between Vallejo and Cordelia in Solano County.

The Callippe silverspot butterfly is one of 16 recognized subspecies within the wider ranging *Speyeria callippe*. Like other species in the genus *Speyeria*, *S. callippe* exhibits considerable phenotypic variability throughout its range (western North America), hence the recognition of 16 subspecies (dos Passos 1964; Miller and Brown 1981). Several researchers have speculated that morphological variation between subspecies is clinal, a gradient of continuous variation in phenotypic or genetic characters (Hovanitz 1941, Hovanitz 1943, Howe 1975, Moeck 1957, Sette 1962, Arnold 1985). A cline can result when natural selection favors certain genotypes in different environments

and gene flow (migration) occurs between them. For the subspecies *callippe callippe*, the darker coloration, a distinguishing characteristic, may be an adaptation to living in foggy areas (such as San Francisco and southwestern Solano County) enabling them to warm up more quickly on foggy days. Like environmental changes, character changes that distinguish the subspecies occur gradually, making exact geographic divides between the subspecies arbitrary (Anonymous 1980).

Western Solano County is an area of overlap and intergradation of the characters that distinguish three subspecies: *callippe callippe*, *callippe comstocki*, and *callippe liliana* (Noss et al. 2002). The darker color morph, representative of *callippe callippe*, occurs less frequently among populations from southwestern Solano County than those from San Bruno Mountain (San Mateo County), and more frequently than it occurs among populations of other subspecies (*callippe comstocki* and *callippe liliana*). Because most populations in Solano County exhibit the higher frequency of the darker color morph, the USFWS treats these populations as the listed subspecies *callippe callippe* at least until additional taxonomic work proves otherwise (USFWS 1997).

This section presents the conservation analysis for the callippe silverspot butterfly including identification key conservation elements and conservation areas. The conservation analysis is based on background information for this species including habitat types, associated natural communities, ecological processes, habitat variables, and threats provided in Appendix B.

#### **4.3.5.1 Associated Natural Communities, Covered Species and Special Management Species.**

The primary species that will benefit from the Callippe Silverspot Butterfly Conservation Strategy is the California red-legged frog. However, other species associated with the Inner Coast Range Natural Community will also benefit from the Callippe Silverspot Butterfly Conservation Strategy (Table 4-1).

**4.3.5.2 Key Conservation Elements.** The following key conservation elements were assessed to determine the relative suitability and/or conservation value of habitat areas for the callippe silverspot within the Plan Area:

- Population Occurrence Data
- Distribution of Johnny Jump-up
- Availability of Adult Nectar Plants
- Topography

**Population Occurrence Data.** All four records for the callippe silverspot in Solano County occur within the Tri-City/County Planning Area, in the hills between Vallejo and Cordelia (i.e., vicinity of Lake Herman, Columbus Parkway, and Sky Valley) and northward into Jameson Canyon (CDFG 2004, Buggy Data Base as cited in Noss et al. 2002: Figure 4-14).

**Distribution of Johnny Jump-up (*Viola pedunculata*).** The distribution of the larval host plant, Johnny jump-up, within the Plan Area is largely unknown. Although it grows in various grassland types throughout California, it must occur at relatively high densities in order to support callippe

silverspot butterflies. Areas known to support butterflies typically contain multiple stands of Johnny jump-up, ranging from a few acres to approximately 40 acres in size. Johnny-jump-up density in these stands range from less than one percent to more than 25 percent cover. In Solano County, the densest stands of Johnny jump-up occur on shallow, rocky or thin soils where annual introduced grasses are less dense. A few dense stands of *Viola pedunculata* have been recorded from field observations conducted by LSA Associates and others, primarily in the Hunter Hill, Lake Herman and Chabot watersheds. Figure 4-14 shows the locations of these field observations.

**Availability of Adult Nectar Plants.** Adults have flexible nectaring requirements and adapt to different flowers depending on availability. In addition, they use a wide variety of plants for nectaring, including native and exotic species that occur throughout the Plan Area.

**Topography.** Adults employ a behavior called hilltopping in order to find mates; thus, the presence of ridgelines and hilltops is critical for reproduction and perpetuation of this species. In addition, the flowering period for Johnny jump-up appears to be longer on eastern facing slopes, extending the growing period for larvae and increasing rates of survival from larvae to adults. Conservation efforts should target ridgelines and hilltops, linking existing populations of the callippe silverspot butterfly and patches of Johnny jump-up, and include eastern facing hillsides.

**4.3.5.3 Conservation Areas.** The Callippe Silverspot Butterfly Conservation Area encompasses all known occurrences within Solano County and additional areas within the Inner Coast Range (i.e., Nelson Hill in Cordelia and the Rockville Hills) that contain all three habitat conditions necessary to support the species (populations of Johnny jump-up, adult nectar plants and ridgelines or hilltops).. The Callippe Silverspot Butterfly Conservation Area is shown on Figure 4-14.

#### **4.3.6 Riparian, Stream, and Freshwater Marsh Natural Community**

This section outlines the conservation analysis for the Riparian, Stream, and Freshwater Marsh Natural Community and is applicable to all freshwater, aquatic, marsh, and riparian habitats within the Plan Area (Figure 4-2). Due to the links between aquatic habitat and adjacent natural communities, the conservation analysis for this Natural Community takes a watershed approach, however, conservation of the upland areas are addressed in the conservation analyses for the Valley Floor Grassland and Vernal Pool and Inner Coast Range Natural Communities and the Swainson's Hawk conservation analysis.

This section presents the conservation analysis for the Riparian, Stream, Freshwater Marsh Natural Community, including identification of key conservation elements and conservation areas. The conservation analysis is based on background information for this Natural Community including habitat types, ecological processes, habitat variables, and threats provided in Appendix B.

**4.3.6.1 Associated Covered Species and Special Management Species.** Two of the 37 Covered Species (5%) and three of the 36 Special Management Species (8%) depend on riparian habitat for all or part of their life cycle. Another three Covered Species and numerous other species will benefit from the conservation strategies outlined below. Table 4-1 lists the Covered Species and Special

Management Species that rely on riparian habitat, and the type of riparian vegetation they utilize most frequently.

**4.3.6.2 Key Conservation Elements.** Five key conservation elements were assessed for this Natural Community, including:

- Riparian Vegetation
- Key Corridor Streams
- Watershed Integrity
- Impaired Waters within the Plan Area
- Location of Covered Species and Special Management Species:
  - Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)
  - Chinook salmon (*Oncorhynchus tshawytscha*)
  - Steelhead – central California coast and Central Valley ESUs (*Oncorhynchus mykiss*)
  - California red-legged frog (*Rana aurora draytonii*)
  - Foothill yellow-legged frog (*Rana boylei*)
  - Western pond turtle (*Clemmys marmorata*)
  - Giant garter snake (*Thamnophis gigas*)
  - Yellow-breasted chat (*Icteria virens*)
  - Tricolored blackbird (*Agelaius tricolor*)

**Riparian Vegetation.** Well-developed riparian plant communities occur primarily in small areas along the banks of major creeks such as Putah Creek, Alamo Creek, Ulatis Creek, Dan Wilson Creek, Green Valley Creek, Ledgewood Creek, and Suisun Creek (Figures 3-4 and 4-16). Reconnaissance surveys conducted by the San Francisco Estuary Institute (SFEI) revealed that the riparian zones of Alamo, Ulatis, Suisun and Green Valley Creeks are largely intact upstream of Hwy 80 although the structure and species composition was not assessed (L. McKee, October 14, 2002 as reported in Noss et al. 2002). The quality of remaining riparian habitat within Solano County will ultimately need to be evaluated in more detail in order to refine priority areas for future acquisition, restoration, and habitat enhancement.

**Key Corridor Streams.** Many “riparian” habitats within and near cities, and in agricultural portions of the County, are very narrow (i.e., only 1 or 2 tree canopies wide) and are often characterized by non-native trees and shrubs. Nevertheless, with restoration and control of invasive species, urban riparian vegetation along parts of Ulatis, Alamo and Sweeny Creeks provides important habitat linking the Vaca Mountains to the valley floor. In addition, riparian corridors along Jameson Canyon, American Canyon, Green Valley, Suisun Valley and Ledgewood Creeks provide connectivity between the Inner Coast Range and Suisun Marsh.

**Watershed Integrity.** Uplands within a watershed strongly influence riparian and aquatic ecosystems. The flux of water and sediment from the upper portions of the watershed determine the form of channels and floodplains, and many associated attributes of riparian ecosystems (Naiman et al. 2005, Scott et al. 2004). Urbanization and intensive agriculture are the primary land uses within the Plan Area that adversely affect watershed integrity; therefore, the percentage

of each watershed under development or intensive agriculture was calculated (Figures 4-11 and 4-12). Most of the watersheds have been extensively impacted by either development or agriculture. However, Calhoun watershed, marsh watersheds 2, 3, 4, 5, 6 and 7, and river watersheds 5, 6, 7, 8 and 9 within the Valley Floor Grassland and Vernal Pools Natural Community remain relatively intact (Figures 4-11 and 4-12). Within the Inner Coast Range, Miller Canyon, Cold Canyon, Putah #1 and to a lesser degree, Jameson Canyon, American Canyon and Lagoon watersheds remain relatively intact (Figures 4-11 and 4-12).

**Impaired Water within the Plan Area.** Under Section 303(d) of the 1972 Clean Water Act, states are required to develop lists of impaired waters that do not meet water quality standards and action plans (known as Total Maximum Daily Loads or “TMDLs”) to improve the quality of impaired waters. Table 4-6 lists the impaired waterways within the Plan Area. Smaller waterways within Covered Activity Zone 1 (Urban Zone) are highlighted in Figure 4-12. Impaired waterbodies within the Suisun subbasin include Ledge wood Creek, Laurel Creek, Suisun Bay, the Suisun Marsh wetlands, and Suisun Slough. In the Napa River subbasin, the Napa River and San Pablo Bay are considered impaired. Streams in eastern Solano County drain to the Central Valley subbasin and flow to the Sacramento Delta, which is also listed as impaired. Because some pollutants can be conveyed long distances through stream networks, 303(d) listings can affect landowners within tributary watersheds of listed water bodies, as well as those who discharge directly into listed waterbodies.

**Location of Covered Species and Special Management Species.** The locations of Covered and Special Management Species associated with the Riparian, Stream, and Freshwater Marsh Natural Communities were assessed based on CNDDDB records and information on historic occurrence and suitable habitat. (Locations and conservation areas for California red-legged frogs and giant garter snakes are provided in Sections 4.3.4 and 4.3.7.)

**Valley Elderberry Longhorn Beetle.** Valley elderberry longhorn beetles in Solano County are known from a number of locations along Alamo and Ulatis Creeks in Vacaville (Figure 4-18), from areas along Putah Creek, and from one location in the Green Valley area of Fairfield. In addition, suitable habitat occurs along many streams and associated uplands throughout Solano County. Parts of the riparian zone around Putah Creek are considered essential habitat by the USFWS (1984).

**Salmonid Fish.** Within Solano County, streams that support or have the potential to support salmonids (steelhead and fall-run Chinook salmon in particular) include the main stems and tributaries of American Canyon, Jameson Canyon, Ledge wood, Green Valley, and Suisun Valley Creeks, and the Napa River (Figure 4-18). Steelhead have been documented in these streams, and relatively continuous corridors are available to allow these species to access suitable breeding habitats in the upper watersheds.

**Foothill Yellow-legged Frog.** The CNDDDB (CDFG 2004a) lists three records for the foothill yellow-legged frog: 1) Cold Creek Canyon, a tributary to Putah Creek in the northeastern part of the County; 2) a tributary to Ledge wood Creek in the Rancho Solano area in northeastern Fairfield (J. Zentner, Zentner and Zentner, pers. comm.); and 3) upper Alamo Creek (S. Foreman, LSA Associates, Inc., pers. obs.) (Figure 4-18). The lack of records probably relates more to the lack of survey effort for this species in the County than an absence of

other populations. Most suitable habitat in the County is located on private lands outside of urban areas within the upper reaches of streams, such as Green Valley Creek, Suisun Creek, Ledge wood Creek, Wild Horse Creek, Cook Canyon Creek, Laguna Creek, Alamo Creek and its perennial tributaries, and Ulatis Creek. Foothill yellow-legged frogs historically occurred in Sulphur Springs Creek, but were not found in this drainage during surveys in the mid 1990s as part of the Sky Valley-Benicia environmental analysis.

**Western Pond Turtle.** The CNDDDB (CDFG 2004a) lists five records for the Western pond turtle in Solano County: 1) Lagoon Valley Lake, between Vacaville and Fairfield; 2) south-southeast of Winters, along Putah Creek and an unnamed tributary; 3) south of Wild Horse Canyon, in the Vaca Mountains; 4) west of Highway 680, south-southwest of Fairfield; and 5) in a diked upland area adjacent to Montezuma Slough and Honker Bay (Figure 4-18). Pond turtles are widespread within Solano County and are reported from a number of other locations, including Sulphur Springs Creek/Sky Valley in Vallejo (S. Foreman, pers. obs.), a stock pond in northwest Fairfield in the upper Ledge wood Creek watershed (D. Muth, pers. obs.), along Putah Creek in the Dan Wilson/Green Valley Creeks watershed (Melanson 2004a), and in the Ulatis Creek watershed (Melanson 2004b).

**Yellow-breasted Chat.** The status, distribution, and population levels of the yellow-breasted chat in Solano County are unknown. Potential habitat for this species occurs along the Putah Creek riparian corridor and in riparian woodlands in the upper Delta region of Solano County. Occurrence at other locations in the County is likely limited to scattered individuals that forage in dense riparian habitats during migratory stopover periods in the spring and fall.

**Tricolored Blackbird.** The CNDDDB (CDFG 2004a) lists six records for the tri-colored blackbird in Solano County (Figure 4-18). Three of these records are considered extant, although the last recorded observations were from 1988. In addition to the CNDDDB records, nesting colonies of tri-colored blackbird have been observed at the Gridley Mitigation Bank and Jepson Prairie in 2003 (S. Foreman, LSA, pers. obs.) and just north of McCoy Basin in Fairfield in 2007 (R. Doubledee, LSA, pers. obs.).

**4.3.6.3 Conservation Areas.** All stream habitats have high conservation value because they contribute to regional water quality. However, certain stream areas have been preserved in a more 'natural' state have been less impacted by urban development and intensive agriculture, support populations of Covered Species and Special Management Species, and are more suitable for restoration. Priority Drainages and Watersheds were identified within the Plan Area (Figure 4-11) based on the following criteria:

- Streams and watersheds that have been maintained in a more 'natural' state (i.e., lower percentage of developed or intensively farmed land) with dense stands of riparian vegetation;
- Streams supporting or potentially supporting populations of Covered Species and Special Management Species;
- Disturbed stream habitats that are adjacent to other high quality habitat areas or serve as linkage habitat between high value conservation areas;

- Stream habitat that represents important transition zones between San Francisco Bay and the Sacramento-San Joaquin River Delta; and
- Streams known or suspected to support important populations of steelhead and other native fish species.

Future acquisition, restoration, adaptive management and monitoring efforts within Solano County should target the following Priority Drainages and Watersheds:

- Putah Creek
- Pleasants Creek
- Sulphur Springs Creek
- Jameson Canyon Creek
- American Canyon Creek
- Green Valley Creek
- Suisun Valley Creek
- Ledge wood Creek
- Gordon Valley Creek
- Laurel Creek
- Laguna Creek
- Alamo Creek
- Ulati s Creek
- Gibson Canyon Creek
- Sweeney Creek
- Baker Slough
- Calhoun Cut
- Hass Slough
- Duck Slough

The Priority Drainages and Watersheds are further sub-divided into three categories based on site-specific conservation actions, including preservation, restoration, invasive species control, protection of water quality and maintenance hydrological process.

**Conservation Area RSM 1 – Preservation and Restoration.** The upper watersheds of streams that have been maintained in a ‘natural’ state with stands of riparian vegetation are targeted for preservation with an emphasis on avoiding and minimizing impacts to sensitive resources. Several of the upper watershed areas within the Inner Coast Range remain relatively ‘pristine’ with little agriculture and urban development. These Priority Drainages and Watersheds are:

- Sulphur Springs Creek
- Jameson Canyon Creek, upstream of I-80
- American Canyon Creek, upstream of Oak Brook Drive
- Green Valley Creek-upstream of Interstate 80
- Suisun Creek
- Ledgewood Creek-upstream of Interstate 80
- Gordon Valley Creek
- Laurel Creek, upstream of Interstate 80
- Laguna Creek
- Alamo Creek-just downstream of the confluence with Encinosa Creek
- Ulatis Creek-upstream of Gibson Canyon Road
- Gibson Canyon Creek- headwaters to 3/10 of a mile west of I-505
- Sweeney Creek-upstream of Leisure Town Road and the existing flood control channel
- Pleasants Creek
- Miller Canyon Creek

The locations of these Priority Drainages and Watersheds are shown in Figure 4-11. For the majority of these streams, less than 10 percent of the watershed area is developed or intensively farmed (Figure 4-11). Maintaining the integrity of the watershed is the main conservation approach for this Conservation Area RSM 1. The conservation measures outlined in Section 5 are designed to fully minimize and mitigate direct and indirect impacts from new urban development projects within RSM 1 Conservation Areas. Implementation of the conservation measures in Section 5 will result in the preservation of natural hydrologic features, maintenance of water quality, and the preservation and restoration of additional Riparian, Stream, and Freshwater Marsh habitats.

**Conservation Area RSM 2 – Invasive Species Control, Maintenance of Hydro-geomorphic Processes, and Restoration.** Much of the riparian habitat within and near cities is very narrow (i.e., only 1 or 2 tree canopies wide) and characterized by non-native trees and shrubs. Despite the high level of disturbance, urban streams provide important corridors linking high value conservation areas together. For example, urban riparian habitat within Vacaville provides an important linkage between the pristine watersheds of the Inner Coast Range, the high value vernal pool conservation areas, and Swainson’s Hawk irrigated agriculture conservation areas. The conservation approach for riparian and stream habitat within and near cities focuses on invasive species control, riparian restoration, and maintenance of water quality and hydro-geomorphic processes. The urban creek areas targeted for riparian restoration and invasive species control include:

- Alamo Creek- below the confluence of Encinosa Creek and Nut Tree Road
- Old Alamo Creek – between Nelson Park and Leisure Town Road
- Ulatis Creek – between Gibson Canyon Road and Ulatis Drive

- Ledgewood Creek – downstream of Interstate 80
- Green Valley Creek – downstream of Interstate 80
- American Canyon – downstream of Oak Brook Drive
- Jameson Canyon - downstream of Interstate 80

With restoration and control of invasive species, urban riparian vegetation, particularly along parts of Ulatis, Alamo, and Sweeny Creeks will provide important corridor habitat linking the Vaca Mountains to the valley floor. In addition, Plan Participants will develop and implement programs to remove or minimize existing in-stream barriers and prevent creation of new in-stream barriers from development along Jameson Canyon, American Canyon, Ledgewood, Suisun, and Green Valley creeks, and their tributaries that contain suitable breeding and rearing habitat for steelhead.

**Conservation Area RSM 3 – Restoration.** Conservation Area RSM 3 Priority Drainages include stream reaches that meander through the alluvial fans, terraces and basins, and Delta and Bay marshlands of the County (Noss et al. 2002). Historically, Riparian, Stream, and Freshwater Marsh habitat within the Delta and Bay marshland geographical province represented an important habitat transition between San Francisco Bay and the Sacramento-San Joaquin River Delta. Within the alluvial fans, terraces, and basins geographical province (Noss et al. 2002), dense oak forests reportedly once covered the plains along the major streams (such as Putah Creek) and their fans, with high fans and terraces having more open stands of grasses and oaks. Lower lying basin deposits supported tules, reeds, and other water-tolerant plants (Burcham 1957, Bates et al. 1977).

Most urban development occurs on or downslope of the alluvial fans of the Vaca Mountains and upslope of the Delta and Suisun marshlands. As a result, palustrine wetlands, floodplains, and riparian forests that historically bordered the larger rivers and adjacent sloughs and waterways, have largely been drained and converted into farmland over the last century or more. Based on Kuchler's (1977) map (Figure 3-3), 34,720 acres of potential Riparian Forest occurred along Putah Creek. Presently, only 694 acres of riparian vegetation are present in this area, representing a 98 percent loss of this potential natural vegetation type. The primary conservation actions for these areas are restoration of natural floodplain corridors that allow development of natural channel meander patterns, and restoration of riparian and freshwater marsh habitat. Areas target for conservation include:

- The Old Alamo Creek Channel- east of Leisure Town Road to the Vacaville urban limit line
- The Old Ulatis Creek Channel- east of Leisure Town Road to the Vacaville urban limit line
- Baker Slough
- Calhoun Cut
- Hass Slough
- Duck Slough
- Putah Creek

Conservation of these stream reaches will require substantial restoration and creation of new habitat features. Restoration of a two-stage floodplain corridor that allows for development of natural channel meander patterns is considered a major restoration project. The Solano HCP Conservation

Strategy (Section 6.0) encourages this type of riparian and stream restoration by reducing the mitigation ratio for creation or major restoration of in-kind habitat. Major restoration efforts will focus on the Priority Drainages and Watersheds within Conservation Area RSM 3.

#### **4.3.7 Giant Garter Snake**

The giant garter snake was listed by the State of California as a threatened species on June 7, 1971. It was federally listed as a threatened species on October 20, 1993, (58 FR 54053) effective November 19, 1993. This species is one of the largest garter snakes, growing up to 4 feet in length (USFWS 1999b). Females are usually larger than males, weighing 1.1 to 1.5 pounds (500-700 grams). The dorsal coloration is brown to olive, with a black checkered pattern, a yellow dorsal stripe, and two light-colored lateral stripes (USFWS 1999b). The dorsal coloration and patterns of the species are highly variable depending on geographical location (Hansen 1980). The ventral coloration is cream to olive or brown, and often mixed with orange in the species' northern range (USFWS 1999b).

In the Draft Recovery Plan for Giant Garter Snake, the USFWS designated four recovery units within the potential historic range of this species (USFWS 1999b). Individual recovery units are geographical regions with similar land uses, conservation issues, and water supplies. The western edge of the potential historic range of the giant garter snake occurs in the eastern portion of Solano County within the Mid-Valley Recovery Unit (MVRU) (Figure 4-19). However, most of this area lacks suitable habitat for this species. In addition, few giant garter snake records are known from Solano County. Based on the lack of suitable habitat and recent observations, the giant garter snake is probably very rare or may have been extirpated from Solano County. However, a sizeable population of giant garter snakes was recently discovered in the western edge of the Yolo Bypass near Putah Creek (Hansen, pers. comm.), suggesting that populations could reestablish or expand into suitable habitat areas within Solano County in the future.

This section presents the conservation analysis for giant garter snake including identification of key conservation elements and conservation areas. Due to the lack of records and suitable habitat in the Plan Area, a habitat model was developed using basic information on the habitat and natural history of giant garter snakes (see Appendix B) as well as other applicable information. The conservation analysis is based on the results of the habitat model and information provided in Appendix B.

##### **4.3.7.1 Associated Natural Communities, Covered Species and Special Management Species.**

Giant garter snakes are associated with dense emergent aquatic vegetation, such as cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.), in freshwater marshes, oxbows, and backwaters along slow flowing creeks. Giant garter snakes are also found along canals supporting beds of fringing cattails or bulrushes. An important habitat component is the presence of upland areas where snakes can escape floods and seek winter retreats. Historically, upland areas within the range of the giant garter snake supported grassland or valley oak woodland.

Covered Species associated with the giant garter snake include: Sacramento splittail (*Pogonichneilus macrolepidotus*) and Delta smelt (*Hypomesus transpacificus*), which occur in the open water of sloughs and backwaters and may serve as prey items for the giant garter snake; and the tri-colored blackbird (*Agelaius tricolor*), which breeds in beds of cattails and bulrushes. In addition, one Special Management Species may be associated with the giant garter snake: the Western pond turtle

(*Actinemys marmorata*), which occupies the same type of aquatic habitat as giant garter snake and requires adjacent uplands for egg laying.

**4.3.7.2 Giant Garter Snake Habitat Model.** Potential giant garter snake habitat in Solano County was assessed using field analysis, review of aerial photographs, and information obtained from the Solano HCP Participants. A simple habitat model was developed using basic information on the habitat and natural history of giant garter snakes, detailed in Appendix B, as well as other applicable information. Data and observations from various sources were then used to rank habitats within the Plan Area (Figure 2-8) based on their ability to support giant garter snake.

**Methods.** Suitable giant garter snake habitat within the Plan Area includes marshes, sloughs, ponds, small lakes, low gradient streams, and agricultural-associated wetlands, such as irrigation, flood control, and drainage canals and the adjacent uplands. Upland habitat is defined here as the inside (waterside) bank, top, and landward slope of levees along various water facilities and adjoining areas of uncultivated land. Dry fallow fields, most of which have been plowed and/or are subject to winter flooding, are not considered part of giant garter snake upland habitat due to their high level of disturbance and lack of essential upland habitat components. For a Plan Participant facility to be considered potential giant garter snake habitat, it must be located within the historical range of the giant garter snake and contain the following habitat components:

- Presence of abundant emergent, herbaceous wetland vegetation (e.g., cattails and bulrushes) for escape cover and foraging habitat during the active season.
- Presence of adjacent upland habitat for basking, shelter, and retreat sites.
- Presence of adjacent upland habitat (levees or banks) high enough to provide refuge from winter floodwaters.
- Presence of a suitable prey base (fish and/or frogs).
- Presence of adequate water during the active season for giant garter snake (i.e., April through October).

The giant garter snake habitat model is based on a simple evaluation of the presence or absence of the essential habitat components described above. For the purposes of this model, areas with perennial water or continuous water during the giant garter snake active season were assumed to contain a suitable prey base of native or non-native fish and/or non-native frogs (habitat component #4).

Water facilities operated by the Plan Participants were evaluated using the checklist outlined below.

A) Wetland habitats along water facilities were evaluated in the field by noting the presence/absence of suitable vegetation (habitat component #1).

B) Upland habitats along water facilities were evaluated in the field by noting the presence/absence of basking and retreat habitat (habitat component #2) and winter upland habitat (habitat component #3).

C) Plan Participants data was used to evaluate food availability (habitat component #4) and aquatic habitat suitability (habitat component #5). Water features were classified into one of three categories:

- C1) Perennial water present.
- C2) Water present continuously during the giant garter snake active season.
- C3) Water present intermittently.

The presence of habitat components #1, 2, 3, and 5 indicated potential habitat.

Field studies were conducted during September and November 2003 by driving along public roads and accessible canal/irrigation ditch rights-of-way to assess and document site conditions.

Suitable habitat was assessed using GIS based data developed for the Solano HCP. The extent of potential habitat was calculated from aerial photos using the following formula:

$$\text{Total length of segment (in feet)} \times \text{average width (in feet)} / 43,560 \text{ ft.}^2$$

The width of a given water feature was measured every 2,000 to 3,000 feet, depending on the uniformity of the habitat and averaged over the total length of the segment. Upland habitat constitutes the sloped land surrounding the aquatic section of the channel, between the water line and the top of bank.

**Results.** The estimated extent of potential giant garter snake habitat within the Plan Area, based on the presence of the five essential habitat elements, is approximately 453 acres (Figure 4-19). Table 4-7 presents the amount of wetland and upland components within each of the Plan Participants' water features.

**Table 4-7: Estimated Potential Giant Garter Snake Habitat within the HCP Area**

HCP Participants	Aquatic Habitat Acres	Upland Habitat Acres	Total Acres
Solano Irrigation District	0	0	0
Maine Prairie Irrigation District	6	12	18
Dixon Resource Conservation District	6	17	23
Solano County Water Agency	70	112	182
Reclamation District (RD) 2068	88	79	167
City of Rio Vista	30	33	66
<b>Total HCP Area</b>	<b>200</b>	<b>253</b>	<b>453</b>

**4.3.7.3 Conservation Areas.** The extent of suitable habitat and occupied range for giant garter snake in Solano County encompasses the lower portions of Putah, Ulatis and Alamo Creeks, Hass Slough, the tidally influenced portions of the RD 2068 drains emptying into Hass Slough and Duck Slough, interconnected irrigation canals and ditches, and Delta sloughs in the southeastern portion of the Plan

Area (LSA 2004a; Figure 4-19). Figure 4-19 shows the location of remaining suitable habitat within the historic range of the giant garter snake, including high quality habitat within Plan Participant facilities. These areas, in particular, represent priority areas for habitat restoration and creation that will benefit giant garter snake conservation. This area is referred to as the Giant Garter Snake Conservation Area.

#### **4.3.8 Coastal Marsh**

Coastal Marsh habitat addressed in this section includes those areas that lie within the historic influence of tidal action and are either 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 the County.

This section presents the conservation analysis for Coastal Marsh, including identification of key conservation elements and conservation areas. The conservation analysis is based on background information for this habitat type including habitat types, distribution, ecological processes, habitat variables, and threats provided in Appendix B. Conceptual models developed for Suisun Marsh during a 2004 workshop sponsored by the San Francisco Bay-Delta Science Consortium are also summarized in Appendix B. This section also identifies the Covered Species associated with this Natural Community and gives a general overview of the regulatory framework governing marsh habitat within the Plan Area.

**4.3.8.1 Associated Covered Species and Special Management Species.** The severe disturbance and wholesale removal of tidal marsh from the San Francisco Bay/Estuary resulted in the reduction or extirpation of a number of species. Eleven of the 37 Covered Species (30%) and twelve of the 36 Special Management Species (33%) depend on Coastal Marsh habitat for all, or a portion of, their lifecycle. The relative richness of Covered Species found within marsh habitats is depicted in Figure 4-4, the Rarity-Weighted Richness Map. Table 4-1 lists the Covered Species and Special Management Species associated with the Coastal Marsh Natural Community.

**4.3.8.2 Conservation Background.** Significant ongoing conservation efforts are directed toward estuarine marsh protection, particularly within Suisun Marsh where CDFG owns and manages large portions of marsh habitat (see below). In addition to Suisun Marsh, CDFG has also purchased substantial portions of the Napa Marshes in Napa and Solano counties, and plans to restore these areas to tidal marsh for the purpose of endangered species restoration and recovery. USFWS also owns and manages the majority of the tidal marshes fronting San Pablo Bay, including the bay marshes on Mare Island, and plans to restore approximately 1,560 acres of the former Cullinan Ranch along Highway 37, just east of Vallejo. Southampton Marsh in Benicia is owned and managed by the California Department of State Parks.

Since the early 1970s, the California Legislature, the State Water Resources Control Board (SWRCB), USBR, CDFG, Suisun Resource Conservation District (SRCD), California Department of

Water Resources (CDWR), and other agencies have focused on preserving Suisun Marsh as a unique environmental resource (Suisun Marsh Program 2005).

In 1974, the California Legislature passed the Suisun Marsh Protection Act to protect Suisun Marsh from residential, commercial, and industrial development. The Act directs BCDC and CDFG to prepare the Suisun Marsh Protection Plan: "to preserve the integrity and assure continued wildlife use" of Suisun Marsh (BCDC 1976). The objectives of the Protection Plan are to preserve and enhance the quality and diversity of Suisun Marsh aquatic and wildlife habitats, and to assure retention of upland areas adjacent to the Marsh in uses compatible with its protection. Between 1974 and 2000, several agencies and working groups collaborated on a set of measures to meet the objectives of the Suisun Marsh Protection Plan. Figure 4-20 depicts the boundaries of the Suisun Marsh Protection Plan and the locations of tidal restoration projects in Suisun Marsh.

The 2000 CALFED Record of Decision and Ecosystem Restoration Plan called for the restoration of 5,000 to 7,000 acres of tidal wetlands in Suisun Marsh through cooperative programs that result in fee title or conservation easements. Restoration of tidal wetlands will be conducted as part of a marsh management plan, recognizing the importance of managed wetlands for wildlife protection. The focus of this regional management plan is on protecting water quality, endangered species, and heritage values in Suisun Marsh. In order to balance the goals and objectives of the Bay-Delta Program, the Suisun Marsh Protection Act, and other management and restoration programs within Suisun Marsh, a habitat management, preservation, and restoration plan was developed for the Marsh.

To ensure that the best available science would be used in developing the Suisun Marsh Protection Plan, the Bay-Delta Science Consortium sponsored a two-day workshop in March 2004 for a broad group of scientists, managers, and stakeholders to engage in scientific discussions regarding Suisun Marsh. The workshop consisted of 31 presentations on the physical and biological systems of Suisun Marsh, its management infrastructure, and methods for restoring (re-creating) an additional 5,000 to 7,000 acres of tidal marsh (Brown 2004). A summary of the workshop presentations was compiled for the San Francisco Bay-Delta Science Consortium and is available online at <http://www.baydeltaconsortium.org/education/workshops/index>.

The draft goals for the Habitat Management, Preservation, and Restoration Plan for Suisun Marsh (Suisun Marsh Plan) are:

- Rehabilitate natural processes where feasible in the Suisun Marsh to fully support, with minimal human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native species of those communities, with a particular interest in waterfowl and sensitive species.
- Protect, restore, and enhance habitat types where feasible in the Suisun Marsh for ecological and public values, such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics.
- Provide long-term protection for multiple Suisun Marsh resources by maintaining and improving the integrity of the Suisun Marsh levee system.
- Prevent the establishment of additional non-native species and reduce the negative ecological and economic impact of established non-native species in the Suisun Marsh.

- Improve and/or maintain water and sediment quality conditions to provide good quality water for all beneficial uses and fully support healthy and diverse aquatic ecosystems in the Suisun Marsh; and to eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.
- Maintain the heritage of waterfowl hunting and increase the surrounding communities' awareness of the ecological values of the Suisun Marsh.

The Coastal Marsh Conservation Strategy supports the goals of the Habitat Management, Preservation, and Restoration Plan for Suisun Marsh (the Suisun Marsh Plan) as well as conservation of other coastal marsh habitat within Solano County.

**4.3.8.3 Key Conservation Elements.** The following key conservation elements were identified for the Coastal Marsh Natural Community:

- Location of Tidal Marsh Habitat
- Location of Marsh Habitat
- Location of Covered Species and Special Management Species
- Suisun Marsh Protection Plan Primary and Secondary Management Zones
- Designated Critical Habitat

**Location of Tidal Marsh Habitat.** Presently, only 9,842 acres of high elevation tidal marsh remain within the Plan Area, approximately 16 percent of the historic tidal marsh area. Most of this remaining tidal marsh is located around the periphery of Suisun Marsh surrounding the Potrero Hills and within the San Pablo Bay National Wildlife Refuge, Napa-Sonoma Marshes, Sandpiper, and White Slough, just west of Vallejo (Figure 4-21)

**Location of Marsh Habitat.** Approximately 72,000 acres of marsh habitat was mapped within Solano County. The largest contiguous area is Suisun Marsh. Additional large marsh areas include Southampton Marsh and the San Pablo Bay and Napa Marshes (Figure 3-4).

**Location of Covered Species and Special Management Species.** As described in Section 4.3.1.2, areas of high richness of Covered Species and Special Management Species were identified using the RWRI. Based on the results of this analysis, Coastal Marsh habitat within the Plan Area has substantially higher levels of diversity than the majority of Solano County, with the exception of Jepson Prairie. Coastal Marsh habitat is a very restricted vegetation type and is becoming extremely rare within the San Francisco Bay. In addition, Suisun Marsh is known to host a suite of rare and threatened species, such as the Suisun thistle and Suisun shrew.

**Suisun Marsh Protection Plan Primary and Secondary Management Zones.** The Suisun Marsh Protection Plan divides Suisun Marsh into two zones: a primary management zone and a secondary management zone (Figure 4-20). The primary management zone encompasses 89,000 acres of tidal marsh, managed wetlands, adjacent grasslands, and waterways under the jurisdiction BCDC (Figure 4-20). The secondary management zone encompasses approximately 22,500 acres of buffer (Figure 4-20). Solano County administers the local protection program,

while BCDC represents the State's interest and serves as the land use permitting agency for major projects in the primary management zone.

**Designated Critical Habitat.** Critical habitat has been designated in the Plan Area for three coastal marsh Covered Species. Critical habitat for Delta smelt was designated on March 5, 1993 and encompasses Suisun Marsh and the Delta (Figure 4-21). Critical habitat for Suisun thistle and soft bird's-beak was designated on April 4, 2006. There are three Critical Habitat Units for the soft bird's-beak: Southampton Marsh, Hill Slough Marsh and Rush Ranch/Grizzly Island Wildlife Area (Figure 4-21). There are three Critical Habitat Units for the Suisun thistle: Hill Slough Marsh, Rush Ranch/Grizzly Island Wildlife Area, and Peytonia Slough (Figure 4-21).

**4.3.8.4 Conservation Areas.** All Coastal Marsh habitats, both tidal and managed, have extremely high conservation value. The Suisun Marsh is home to 221 bird species, 45 mammal species, 16 species of reptiles and amphibians, and more than 50 species of fish, twelve of which are either state or federally listed as threatened or endangered (Brown 2004). The Coastal Marsh Natural Community was divided into three geographical units reflecting the conservation, management, and restoration programs currently being conducted in these areas. The Coastal Marsh Conservation Areas are: Suisun Marsh; the San Pablo Bay and Napa Marshes; and tidally influenced freshwater marshes in the upper regions of the sloughs and creeks in the Delta Region of Solano County.

**Suisun Marsh.** As described above, the Suisun Marsh encompasses two zones: the primary management zone and the secondary management zone. The principal consideration in the primary management zone is the protection of environmental values and existing uses. Urban development is precluded and other uses such as oil and gas exploration and construction and operations of utilities and other facilities are highly regulated by BCDC. Activities that conflict with the protection of the Marsh are not permitted provided other practicable alternatives are available. Activities within the secondary marsh zone are also severely restricted to activities that will not adversely impact the Marsh.

**San Pablo Bay and Napa Marshes.** This Conservation Area encompasses Coastal Marsh habitat west of Vallejo and Southampton Marsh in the Carquinez Straits (Figure 4-21). CDFG has purchased substantial portions of the Napa Marshes in Napa and Solano Counties and plans to restore these areas to tidal marsh for the purpose of endangered species restoration and recovery. USFWS also owns and manages the majority of the tidal marshes fronting San Pablo Bay, including the bay marshes on Mare Island, and plans to restore approximately 1,560 acres of the former Cullinan Ranch along Highway 37 just east of Vallejo.

**The Delta Region.** This Conservation Area includes the tidally influenced freshwater marshes in the upper regions of the sloughs and creeks in the Delta Region of Solano County (Figure 4-21). Only a small area of marsh habitat remains in this area; the majority of historic marsh habitat has been converted for agricultural uses. Within this area, CDFG owns the Calhoun Cut Ecological Reserve, which contains the upper portions of marsh and riparian habitats and are currently being restored. This Conservation Area overlaps with the Giant Garter Snake High Value Conservation Area; therefore, most of the conservation activities for this area are addressed in the Giant Garter Snake Conservation Analysis (Section 4.3.7) and Conservation Strategy (5.3.7).

The combination of significant public ownership in Suisun Marsh, Southampton Marsh, and Napa and San Pablo Bay Marshes, and special regulatory restrictions in Suisun Marsh has resulted in the protection of over 95 percent of the Coastal Marsh habitats in Solano County from conversion to other land uses (Figures 3-7 and 4-20).

The primary threat to Coastal Marsh habitat is the potential for indirect effects associated with urban growth in Solano County. Specifically, the Fairfield Suisun Sewer District will upgrade their wastewater treatment plant, increasing plant capacity from 17.5 million gallons per day to 25 million gallons per day over the next 20 years. Most Coastal Marsh habitats do not occur within urban boundaries; Coastal Marsh habitats that do are managed as or incorporated into established open space areas to protect and enhance habitat values (e.g., White Slough, River Park, and Mare Island in Vallejo). Minor direct impacts may result from road projects (i.e., widening of Cordelia Road in Fairfield), construction of a redundant outfall pipeline for the Fairfield-Suisun Sewer District main effluent outfall, or maintenance of flood control channels.

The main conservation action for Coastal Marsh habitat within the Plan Area is to minimize secondary impacts to marsh habitat, hydrology and water quality using the best management practices (BMPs) (see Sections 5.3.7 and 6.8). To mitigate for direct and indirect impacts to marshes associated with population growth, the Solano HCP will establish invasive species control programs and assist in restoration of tidal marsh habitat throughout the Plan Area.

#### **4.3.9 Swainson's Hawk**

The California population of breeding Swainson's hawks has declined by approximately 90 percent since the 1940s, presumably due to habitat loss; however, other factors, such as mortality in wintering areas in Central America may also play a major role (Bloom 1980). Historically, this species was found throughout the Central Valley and Sierra Nevada foothills. One of the most secure aggregations of nesting Swainson's hawks (an estimated 420–1,000 pairs) occurs in the Central Valley, which includes portions of eastern Solano County. However, residential development, riparian habitat alteration, and agricultural conversion have caused annual declines in this population (CDFG 1988, Estep 1989).

Swainson's hawks have adapted well to agricultural landscapes, which constitute a large portion of Solano County. Alfalfa is the crop that provides the best foraging habitat because regular harvesting and irrigating makes prey available for capture. Alfalfa fields are also farmed over a relatively long period (typically 4–5 years), allowing rodent communities to establish and serve as a predictable prey base for Swainson's hawk. However, a variety of other crop types also provide valuable foraging habitat at differing times of the breeding season and for differing prey species. This mosaic of suitable foraging habitat provides the fullest opportunity for regular and successful hunting (Holt 2004). Crops that decrease the accessibility of small rodent and insect prey (e.g., mature row crops with tall plants, vineyards, orchards) provide few foraging opportunities for Swainson's hawks. An estimated 147,600 acres of suitable foraging agricultural crops (alfalfa, irrigated pasture, row and truck crops) are present in Solano County (Figure 4-31; California Department of Water Resources (CDWR) 1994, LSA 2002).

In addition to foraging habitat, Swainson's hawks require suitable nest sites. Within the Central Valley, natural nest sites for this species are the tops of trees along the edges of riparian forest and in

open oak savannah. However, they have also adapted to the agricultural and suburban landscape by nesting in roadside trees, farmyard trees, isolated oak trees, and adjacent urban residential areas (Estep 1989, England et al. 1995). Within Solano County, recent nest records (CNDDDB 2003) indicate that most Swainson's hawks nest in isolated, individual trees and groves of non-native trees (e.g., eucalyptus) planted for landscaping or as windbreaks, with only a few nests occurring in riparian areas and scattered oak trees on the valley floor. Nesting pairs are highly traditional in their use of nesting territories and nest trees (Estep and Teresa 1992), typically returning to the same nest site or area every year.

Protection of Swainson's hawks and their habitat in the Central Valley is strongly influenced by land ownership. In the Central Valley, 95 percent of known nest sites are on private lands, making them particularly vulnerable to changes in agricultural cultivation and development (Estep 1989); this is particularly true for Solano County. An effective conservation strategy will require close coordination with private landholders in the agricultural community to maintain or enhance the availability of foraging habitat and adjacent nest trees.

The Central Valley Swainson's hawk breeding population is concentrated in four counties (Solano, Yolo, Sacramento, and San Joaquin), where a diversity of row crops and abundant alfalfa fields, combined with accessible prey populations, have created ideal habitat conditions for this species. Solano County, with a high concentration of nest sites in the northeastern agricultural lands, are a critical component of this habitat. Primary threats to the Central Valley Swainson's hawk population are: 1) lack of and continued loss of preferred nesting habitat in mature riparian forest and isolated trees; 2) loss or adverse modification of foraging habitat due to urban development or conversion of agricultural land to unsuitable crop types; and 3) potential mortality due to pesticide use on agricultural land prior to migration and along the migration route (Woodbridge 1998). The long-term viability of the Solano County Swainson's hawk population will require, at a minimum, protection of existing breeding pairs by maintaining compatible land uses and suitable breeding sites. Availability of large areas of agricultural land and natural open spaces allows for land management practices that could result in an increase in the Solano County breeding population of Swainson's hawks.

This section presents the conservation analysis for Swainson's hawks, including identification of key conservation elements and conservation areas. The conservation analysis is based on background information on this species including habitat types, natural community associations, ecological processes, habitat variables, and threats provided in Appendix B.

**4.3.9.1 Associated Covered Species and Special Management Species.** Other Covered Species and Special Management Species that will benefit from the Swainson's Hawk Conservation Strategy include burrowing owl, tricolored blackbird, short-eared owl and northern harrier (Table 4-1).

**4.3.9.2 Key Conservation Elements.** The following key conservation elements are identified for the Swainson's hawk:

- Foraging Habitat
- Swainson's Hawk Nest Records

- Location of Existing and Potential Wind Resource Areas

**Foraging Habitat.** Potential foraging habitats for Swainson's hawk within the Plan Area include irrigated and non-irrigated agriculture, valley floor and vernal pool grasslands, oak savanna and Inner Coast Range grasslands (Figure 3-4). However, not all of the potential foraging habitat types provide equal value to Swainson's hawk. Based on the distribution of Swainson's hawk records within the Plan Area and studies by Estep (1989) in the Central Valley, irrigated agriculture, specifically irrigated agricultural land in alfalfa/pasture, grain and hay crops, and row or truck crops, represents the primary foraging habitat for Swainson's hawk within the Plan Area. Valley floor grassland and vernal pool habitats provide less suitable habitat for Swainson's hawk. Based on the distribution of Swainson's hawk records, the oak savanna and grassland habitats within the Inner Coast Range are the least often used.

**Swainson's Hawk Nest Records.** Within Solano County, recent nest records (CDFG 2004a) indicate that most Swainson's hawks nest in isolated, individual trees and groves of non-native trees (e.g., eucalyptus) planted for landscaping or as windbreaks, with only a few nests occurring in riparian areas and scattered oak trees on the valley floor. Most known Swainson's hawk records are concentrated in the irrigated agricultural area in northeastern and eastern Solano County, with a few scattered records in the Valley Floor Grassland Conservation Area. One nest record is located within the riparian area along Cordelia Slough and is surrounded by grazed annual grassland. Another record is located within the Lagoon Valley area between Vacaville and Fairfield (Figure 4-22).

**Location of Existing and Potential Wind Resource Areas.** Because wind turbines represent a potential source of Swainson's hawk mortality, lands within the existing Solano Wind Resource Area (WRA), as well as proposed future WRA expansion lands, are excluded from the high-value conservation areas defined below. Since habitat management within WRAs should focus on discouraging raptor foraging near wind turbines, these lands should not be managed to enhance Swainson's hawk foraging habitat, nor should additional nest trees be planted.

**4.3.9.3 Conservation Areas.** Swainson's hawk records within the Plan Area are not uniformly distributed corresponding to differences in the quality of potential foraging habitat. Consequently, not all potential habitat within the County contributes equally to the conservation of Swainson's hawks. Thus, it was necessary to define specific Swainson's hawk conservation areas based on the value of foraging habitat and 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.

**Irrigated Agriculture Conservation Area.** The Irrigated Agriculture Conservation Area was identified by reviewing the known nesting distribution in the County, and mapping high quality irrigated and non-irrigated agricultural lands and adjacent grasslands. This Conservation Area encompasses all of the irrigated and non-irrigated agricultural land and some grassland habitat in the northeastern and eastern portions of the Plan Area, and contains the majority of known Swainson's hawk records (Figure 4-22).

**Valley Floor Grassland Conservation Area.** The Valley Floor Grassland Conservation Area consists of the Valley Floor Grassland and Vernal Pool habitat in the central portion of the Plan

Area, the Montezuma hills, and the lands west of I-505 (Figure 4-22). Despite the large amount of open space, relatively few Swainson's hawk nests have been observed in this Conservation Area due to a lack of survey coverage and/or lower habitat quality. As such, the potential for this area to support additional Swainson's hawk pairs, and significantly contribute to conservation of the population, is unknown. Additional tree planting (i.e., potential nest trees) and maintaining existing open grasslands in this portion of the County may provide an opportunity to expand the Swainson's hawk population.

**Inner Coast Range Conservation Area.** Grassland and oak savanna habitat within the Inner Coast Range may provide suitable foraging and nesting habitat for Swainson's hawks, despite few records from these areas (Figure 4-22). One pair was observed in Lagoon Valley and another was recorded in Cordelia. However, if population expansion exceeds the carrying capacity of the Irrigated Agriculture and Valley Floor Grassland Conservation Areas, then hawks may disperse into these currently unoccupied areas of the County. Therefore, preserving grassland and oak savanna habitat in the Inner Coast Range may provide habitat for future populations of Swainson's hawk. Conservation of these areas may provide a stable source of foraging habitat for Swainson's hawk populations, as these areas are not susceptible to the market fluctuations that affect irrigated agricultural foraging habitat.

#### **4.3.10 Burrowing Owl**

Burrowing owls use a variety of natural, uncultivated, and agricultural habitats, which can support owls depending on the availability of burrows for cover and nesting and the presence of prey. In Solano County, most burrowing owls have been observed in and around agricultural areas, particularly in areas of irrigated and dry-farmed crops, pasture, and other grasslands. Most known burrows have been located along ditches and canal banks, roads and railroad rights-of ways, drainage pipes, and in other remnant areas where ground squirrel holes or debris piles provide suitable nesting and cover. However, vernal pool complexes and associated grasslands, open scrub, and vacant fields provide the highest quality habitat since the level of ground disturbance is less than in intensively cultivated areas. The Burrowing Owl Conservation Analysis is applicable to the approximately 323,600 acres of suitable burrowing owl habitat in the Plan Area, including grassland, pasture, grain/hay crops, row crops and other irrigated agriculture, vacant or fallow fields, and oak savanna (Figure 3-4).

This section presents the conservation analysis for burrowing owl including identification of key conservation elements and conservation areas. The conservation analysis is based on background information for this species including habitat types, natural community associations, distribution, ecological processes, habitat variables, and threats provided in Appendix B.

**4.3.10.1 Associated Covered Species and Special Management Species.** Special Management Species that could potentially benefit from conservation measures for burrowing owl include the short-eared owl, and northern harrier. These species are associated with the same open grasslands and agricultural lands in which burrowing owl often occur.

**4.3.10.2 Key Conservation Elements.** The following key conservation elements were identified for the burrowing owls:

- Suitable Foraging Habitat
- Burrowing Owl Records

**Suitable Foraging Habitat.** Burrowing owls use a variety of natural, uncultivated, and agricultural habitats, any of which can support owls depending on the availability of burrows for cover and nesting and the presence of prey. As such, Valley Floor Grasslands and Vernal Pools, grassland and oak savanna habitat within the Inner Coast Range, pasture, grain/hay crops, row crops, and other irrigated agriculture lands, vacant or fallow fields, and diked historic tidal wetlands within the Coastal Marsh Natural Community are all considered suitable habitat for this species.

**Burrowing Owl Records.** Unfortunately, the most important habitat element, the availability of small mammal burrows for breeding, has not been mapped in the Plan Area and could not be used as a key conservation element. Instead, burrowing owl records throughout the County were used; these records provide a good measure of the availability of burrows.

Most burrowing owl records in Solano County are from agricultural areas, however, the primary habitats for this species are the valley floor and low foothill grasslands, and the grassland and oak savanna habitat within the Inner Coast Range. The abundance of owl records in northeastern Solano County may reflect the greater accessibility of agricultural areas, rather than an actual preference for agricultural areas over natural grasslands. Within agricultural areas, burrowing owls occur where ground squirrel burrows or debris piles provide suitable nesting habitat, along ditches and canal banks, in vacant lots, weedy fields, and utility, railroad, and road/highway right-of-ways, and other remnant areas. A few owl records also occur around the periphery of Suisun Marsh, San Pablo Bay, and the Napa Marshes. Similar to agricultural areas, owls occur along levees, canals, and drainage ditches created in diked historic tidal wetland areas within the Coastal Marsh Natural Community.

**4.3.10.3 Conservation Areas.** Burrowing owls are an open-country species, naturally inhabiting grasslands, open shrublands, and open woodlands, but have also adapted to human-modified landscapes such as agricultural lands, disturbed fields, roadsides, and railroad right-of-ways. As a result, Solano County has an abundance of land that is known to, or could support burrowing owls (Figure 4-23) and provides opportunities to protect and expand burrowing owl populations without greatly inhibiting future development and agricultural practices. Burrowing owl conservation is tied to the preservation and management of open agricultural lands, similar to Swainson's hawk habitats, as well as Valley Floor Grassland and Vernal Pools and low-lying grassland communities associated with the Inner Coast Range. These three areas represent the main conservation areas for burrowing owls throughout the Plan Area and are the areas in which future preservation and management practices will be directed.

## 4.4 LANDSCAPE LEVEL CONSERVATION ANALYSIS

The Landscape Level Conservation Analysis combines key conservation elements identified for each Natural Community and Covered Species to identify conservation “hot spots” throughout the Plan Area. A key conservation element is defined as a habitat feature or characteristic of the environment that can be physically mapped within the Plan Area and reflects the conservation value and/or 1 habitat quality of the Natural Community. The results of this analysis are used to identify priority areas for acquisition and provide an overall reserve design vision for the Solano HCP. The relationship between the Landscape Level Conservation Analysis and the biological goals and objectives of the Conservation Strategy (Section 6.0) is also discussed.

### 4.4.1 Methods

To identify conservation “hot spots” throughout the Plan Area, a grid of equal-area hexagonal cells, with sides ¼ mile-long and averaging 2,286ft (0.433 miles) between centers, was overlaid onto the Plan Area (Figure 4-24). The key conservation elements identified for each Natural Community was assigned a value of one, except for the RWRI (see detailed list of key conservation elements below). For each key conservation element that overlapped a hexagonal cell, the point assigned to that key conservation element was added to the value of that cell so that the ‘value’ of a cell equaled the sum of the points assigned to each key conservation element. For example, if a hexagonal cell overlapped with oak woodland vegetation it received a point value of one. If that same cell also overlapped with California red-legged frog potential breeding and hydration habitat, the cell received another point, increasing its ‘value’ from one to two. All cells with a value of one or more correspond to an area associated with at least one key conservation element and can be considered to have conservation value. Cells with a value of two or more represent an area encompassing two, three, four, or more key conservation elements (Figure 4-24). Cells with higher point totals do not necessarily have more conservation value, rather they contain more than one key conservation element and are, therefore, more likely to meet multiple conservation goals and objectives if preserved.

The key conservation elements from each Natural Community assessed in the Landscape Level Conservation Analysis are:

#### Landscape

- Corridors (Figure 4-3)
- Rarity Weighted Richness Index for all Covered Species and Special Management Species within the Plan Area (Figure 4-4; all green hexagons were assigned a value of one and all blue hexagons were assigned a value of 2 reflecting the relative irreplaceability of the cell).

#### Valley Floor Grassland and Vernal Pools

- Disturbance levels
  - Low disturbance areas on claypan soils (Figure 4-6)
  - Low and moderate disturbance areas on hardpan soils (Figure 4-6)
- Contra Costa goldfield known core populations (Figure 4-7)
- Unique environmental features
  - Playa pools (Figure 4-5)
  - Hardpan soil (Figure 3-6)

#### Inner Coast Range

- Keystone vegetation/habitat types (Figure 3-4)
  - Oak woodland
  - Oak Savana
  - Riparian vegetation as listed under the Riparian, Stream, and Freshwater Marsh Section
- Valley Oaks as mapped by FRAP (Figure 4-10)

#### California Red-legged Frog

- California red-legged frog potential breeding and hydration habitat (Figure 4-16), with a 300ft terrestrial buffer

#### Callippe Silverspot Butterfly

- Johnny jump-up known occurrences (Figure 4-14)
- Major ridgelines connecting known Johnny jump-up and callippe silverspot butterfly occurrences buffered by 300 feet

#### Riparian, Stream, and Freshwater Marsh

- Riparian vegetation (Figure 4-17)
- Watersheds or subwatersheds with less than 10 percent developed or irrigated agriculture (Figures 4-11 and 4-12)
- Priority drainages buffered by 300 feet (Figure 4-11)

#### Giant Garter Snake

- Giant Garter Snake Priority Conservation Area (Figure 4-19)

#### Coastal Marsh

- Marsh habitat (Figure 3-4)
- Boundaries of the Suisun Marsh Protection Plan, including secondary management areas (Figure 4-20)

#### Swainson's Hawk

- Swainson's hawk nest records buffered by a 1/4 of a mile.
- All suitable foraging habitat within the Swainson's Hawk irrigated agriculture primary conservation area (Figure 4-22).

#### Burrowing Owl

- Burrowing owl records buffered by 1/3 of a mile.

### **4.4.2 Results**

The results of the Landscape Level Conservation Analysis (Figure 4-24) indicates that most of the Plan Area has some conservation value (i.e., contains one or more key conservation elements), not surprising given the ecological diversity of Solano County and of the Greater San Francisco Bay Area (Figure 3-1). Only the Montezuma Hills, just west of Rio Vista (Figure 4-24) exhibit little conservation value (i.e., hexagons with a value of zero) due to the lack of available survey data or the

types of conservation criteria (i.e., key conservation elements) used in the analysis. Selection or addition of different criteria, such as important foraging habitat for migratory raptors, would likely change the conservation value of this area. The analysis shows the relative conservation value for those species and natural communities covered under the Solano HCP; therefore, the relative conservation value of this area may also change if future surveys yield populations of Covered Species or unique habitat features.

In general, two areas are rich in key conservation elements (i.e., values of three or more): Jepson Prairie and Suisun Marsh. Other areas that contain three or more conservation elements include:

- the northern hardpan vernal pool conservation subarea 1G (Figure 4-9) and the oak woodland/oak savanna area adjacent to this subzone in the area identified as the North Vacaville corridor (Figure 4-3);
- the majority of the Jameson Canyon-Lower Napa River Core Recovery Area for California Red-legged frog (Figure 4-16);
- the Callippe Silverspot Butterfly Conservation Area north of Vallejo (Figure 4-14); and
- the Suisun Valley, Putah, Ulatis and Alamo Creek riparian corridors.

The results of the Landscape Level Conservation Analysis, depicted in Figure 4-24 provides an overall vision for the design of reserves in the Plan Area. The reserve system should, at minimum, encompass all of the areas highlighted with at least three key conservation elements. Priority areas for acquisition and restoration under the Solano HCP correspond to cells with four or more overlapping key conservation elements. Cells with values of one or two also contain conservation value relative to the biological goals and objectives of the HCP, and should be incorporated or considered in the reserve system. Conservation of these outlier areas may be necessary to provide connectivity and buffers (Reserve Design Principles 6 and 8; Section 4.2) onto preserve Covered Species/Special Management Species, such as Swainson's hawk or burrowing owl, for which limited key conservation elements exist. The results of this analysis outline a list of priority conservation efforts. Prior to final acceptance in the HCP reserve system, biological resources in each area must be verified by appropriately timed field surveys conducted by qualified biologists (see Sections 5.2 and 10.4).

The results of the Landscape Level Conservation Analysis can be used to assess the Plan's ability to achieve the biological goals and objectives outlined in the Conservation Strategy (Section 6.0), which are closely linked to the Conservation Analysis (Figure 4-1). The majority of the goals and objectives correspond to one or more key conservation elements. For example, Landscape Level Objective LAN 1.1 is to protect and maintain important landscape corridors between representative natural communities within the Plan Area. The important landscape corridors listed in the objective are the same corridors identified in Figure 4-3 and identified in the Landscape Level Conservation Analysis as a key conservation element. Similarly, Callippe Silverspot Butterfly Objective CSB 1.3 is to maintain connectivity between core breeding sites and existing subpopulations within the Callippe Silverspot Butterfly Conservation Area by preserving 300-foot corridors along hilltops and ridgelines. Major ridgelines connecting known Johnny jump-up and callippe silverspot butterfly occurrences buffered by 300 feet is one of the key conservation elements incorporated into the landscape level analysis. Preservation of high value cells containing more than one key conservation element are more likely to meet multiple conservation goals and objectives. Given limited resources for land

acquisition, areas that meet multiple goals and objectives must be high on the list of priorities. The Landscape Level Conservation Analysis will be updated as new information becomes available as a result of adaptive management, monitoring, and targeted studies, to determine if conservation efforts need to be redirected as the Plan progresses during the implementation phase. The analysis will also be used to identify gaps in the reserve system as the Solano HCP is implemented.

## 4.5 CONSERVATION TARGETS

The most difficult task in conservation planning is determining the extent of habitat/proportion of an ecosystem needed to sustain viable populations of targeted species, preserve ecological processes, and maintain native species composition and structure (Groves 2003). A variety of methods, including population viability analyses (Morris et al. 1999) and other established ecological theories, such as island biogeography (Simberloff and Wilson 1969), have been developed to address this question in the context of conservation planning. In this section, various methods, including the species-area relationship model, recovery plans, and expert opinion, are employed to determine 'how much is enough' for each Natural Community.

These conservation targets were initially calculated to address the California NCCPA standards that require a commitment from Plan Participants to conserve Covered Species and Natural Communities in the Plan Area at the level of recovery. However, the Solano HCP is not an NCCP and the conservation targets calculated in this section are not equivalent to the conservation objectives described in the Conservation Strategy (Section 6.0). This section relates to broader conservation issues beyond the commitments of an HCP. Despite this, Plan Participants incorporated these higher recovery standards into the Conservation Analysis for the Solano HCP and will work with state, federal, and private agencies for additional funding and/or land acquisition to achieve these larger conservation targets.

### 4.5.1 The Species-Area Relationship Model

The species-area relationship was one of the first ecological relationships to be established empirically (Arrhenius 1921) and is commonly expressed as

$$S = cA^z$$

where  $S$  is the number of species,  $A$  is equal to area, and  $c$  and  $z$  are constants fitted to the data (Meffe and Carroll 1997; Figure 4-26). This relationship between number of species and area plots as a straight line on a logarithmic scale. On a logarithmic scale,  $c$  is the y-intercept and  $z$  is the slope. The constant  $z$  represents the rate at which new species will be encountered, or added to the sample, as more area is surveyed. In other words, from a reserve design perspective, as the value of  $z$  increases, a larger area is required to capture a higher proportion of the total species diversity (Figure 4-26). Studies from different regions for several species types suggest that values for  $z$  usually fall between 0.15 and 0.35 (Groves 2003, Meffe and Carroll 1997). Several speculations have been made as to what affects the value of  $z$ . Values of  $z$  have been shown to depend on the size of the surrounding region, degree of isolation, evolutionary history (Anderson and Marcus 1993, Rosenzweig 1995, Rosenzweig and Ziv 1999), and all factors influencing species distribution. For large regions, rates of species turnover also influence the value of  $z$ . The size of the species range and its adaptability (i.e.,

extent of habitat specialization) determine the rate at which the species composition of communities changes across environmental gradients (Meffe and Carroll 1997).

Conservation planners have applied the species-area relationship to determine conservation targets to identify the amount of habitat that must be maintained to avoid significant species loss (Boecklen and Simberloff 1986, Groves 2003). These relationships suggest that conservation targets ranging from 20 to 40 percent of any given community or ecosystem type are likely to conserve, on average, 70 to 90 percent of the species in these habitats in continental situations (Groves 2003, Figure 4-26). The actual percentage will vary depending on the value of  $z$ , which is related to the regional distribution of the community targeted for conservation. Generally, conservation targets (i.e., 20%, 30% or 40%) are assigned for each species or vegetation community based on their distribution. For example, the Nature Conservancy's ecoregion-based conservation blueprint for the Great Basin Ecosystem aimed to preserve 30 percent of the historic distribution of endemic large patch and matrix-forming terrestrial ecosystems. This goal was reduced to 20 percent for more widespread terrestrial ecosystems (Nachlinger et al. 2001).

Where applicable, the Solano HCP uses the species-area relationship to identify conservation targets for preservation of each Natural Community based on its regional distribution and the average range size of species associated with it. The distribution classes assigned to each Natural Community in the Plan Area include endemic, widespread, and peripheral. Natural communities classified as endemic or restricted, such as vernal pools and tidal marsh, contain species or vegetation communities that primarily occur within one ecoregion, either entirely endemic to the ecoregion or more than 80 percent of its range within the ecoregion (Anderson et al. 1999, Marshall et al. 2000). Natural communities that were classified as widespread, such as oak woodlands and valley floor grassland, contain species or vegetation communities that occur in several ecoregions, and are distributed relatively equally among those ecoregions (Anderson et al. 1999, Marshall et al. 2000). Widespread does not necessarily mean "common". For example, the total acreage of riparian vegetation is small and the occurrences are widely separated, but the species and vegetation communities found in riparian areas are in fact widely distributed. Natural communities and/or species classified as peripheral, such as tule marsh and the callippe silverspot butterfly, are more commonly outside of the Plan Area (i.e., less than 10 percent of its total distribution falls within the Plan Area; Anderson et al. 1999, Marshall et al. 2000). In determining conservation targets for peripheral communities, it is assumed that most of the conservation of this Natural Community will be focused in other ecoregions. However, these peripheral occurrences may represent separate evolutionarily significant units with high conservation value.

When using the species-area relationship model was infeasible and/or conservation targets derived from the model were impractical, conservation targets were derived from recovery plans, other conservation plans, and expert opinion. The species-area relationship model could not be directly applied to the Riparian, Stream, and Freshwater Marsh Natural Community; the Coastal Marsh Natural Community; California red-legged frog; burrowing owl and Swainson's hawk. The historic distribution of the Riparian, Stream, and Freshwater Marsh Natural Community could not be calculated and a significant amount of riparian habitat has been lost, so the conservation target reflects the amount of restoration needed to preserve habitat values. Similarly, because only 16 percent of the historic tidal marsh remains in the Plan Area, the conservation target for this Natural Community was expressed as a restoration target based on the restoration target identified by CALFED. The species-area relationship model could not be applied to California red-legged frog,

burrowing owl or Swainson's hawk because these species utilize man-made or artificial environments, such as agricultural resources, for which no historic distribution could be calculated. Therefore, the USFWS Recovery Plan was used to define a conservation target for California red-legged frogs and expert opinion was used to define conservation targets for burrowing owl and Swainson's hawk.

#### **4.5.2 Valley Floor Grassland and Vernal Pool Natural Community**

The Valley Floor Grassland and Vernal Pool Natural Community is dominated by two, typically intermixed associations: vernal pool system grasslands and grassland associated with low hills (i.e., Montezuma Hills and Potrero Hills) and upper terraces along the valley floor. Vernal pool ecosystems harbor a different suite of species than the average valley floor grassland ecosystem. As a result, separate conservation targets were developed for vernal pools and the valley floor grassland community. Conservation targets for these two vegetation types and a conservation target for Contra Costa Goldfields are discussed below.

**4.5.2.1 Vernal Pool Ecosystems.** Vernal pool ecosystems have high numbers of endemic species and habitat specialists with relatively small range sizes and high levels of among-population genetic variation (Elam 1998). Based on these characteristics, vernal pools were classified as having an endemic distribution type. Meaning that vernal pool habitats contain species or vegetation communities that primarily occur within one ecoregion; either being entirely endemic to the ecoregion or having more than 80 percent of its range within the ecoregion. The USFWS Vernal Pool Recovery Plan defines 16 vernal pool regions within California; 24 of 32 species mentioned in the recovery plan occur in fewer than four vernal pool regions, and 12 of those species occur in one vernal pool region (USFWS 2004a). For the Solano-Colusa region these species are Solano grass, Delta green ground beetle and bearded popcorn flower (*Plagiobothrys hystriculus*), all of which are found specifically within the Plan Area. The justification for an endemic classification for vernal pool habitats assumes that each vernal pool region may also harbor genetically distinct populations of each species.

As an endemic habitat type, the conservation target for vernal pools was set at 40 percent of the historic distribution within the Plan Area (Table 4-8). The historic distribution of vernal pools was derived from the range of vernal pool soil types within the Plan Area and was estimated to be 118,230 acres (Figure 3-6). Based on the habitat mapping conducted for the Solano HCP, 50,760 acres of vernal pool habitat remain in the County. Forty percent (47,290 acres) of the historic vernal habitat equates to 93 percent of its current distribution (Table 4-9). Within Solano County, approximately 16,540 acres are currently protected (Table 4-9). To meet the conservation target of 40 percent (47,290 acres) an additional 35,440 acres would need to be protected.

The 40 percent conservation target closely matches the USFWS's recovery goal in the Vernal Pool Recovery Plan of 95 percent of suitable vernal pool habitat within the Jepson Prairie Core Recovery Area n (USFWS 2005a: Figure 4-5). Although the amount of remaining vernal pool habitat is sufficient to meet the 40 percent conservation target, much of this habitat has been highly disturbed (see Section 4.3.2.5 and Figure 4-6) and will require considerable restoration to achieve historical levels of productivity and value.

**4.5.2.2 Contra Costa Goldfields.** Contra Costa Goldfields have an extremely limited distribution and each remaining population is under intense development pressure (i.e., all remaining occurrences within the Plan Area fall within the urban limits of Fairfield and Suisun; Figure 4-7). Recent studies suggest that a high level of genetic variability and distinctness exists both among and between each Contra Costa goldfield population (Ramp 2004; three populations were sampled in Solano County, at least six additional populations need to be assessed). Because of these factors, a separate conservation target has been developed for Contra Costa Goldfields as a sub-component of the vernal pool conservation target discussed above.

Several approaches can be taken to develop a conservation target for this species. A population viability analysis (PVA) could be developed that incorporates both genetic and ecological aspects of the species biology to estimate how much habitat is required to preserve a viable population. Genetic data and population data are currently being collected to develop a PVA for this species; unfortunately, this information is not yet available.

Another approach would be to use the conservation target identified by the species-area relationship model for the Valley Floor Grassland and Vernal Pool Natural Community. The species-area relationship model, applied to a single species, would not determine the amount of habitat needed to preserve species richness, but rather the amount of habitat needed to maintain genetic diversity. Using the species-area relationship model for a single species, with a preservation target of 40 percent of the species' historic distribution, would capture, on average, 70-90 percent of its genetic diversity. For this analysis, the historic range for Contra Costa goldfields is assumed to coincide with the historic vernal pool areas within the San Francisco Bay Drainage Province (Figures 3-5 and 3-6) minus the historic vernal pools south of Highway 12. This lower terrace area appears to support the majority of Saline Clover occurrences within the Plan Area (Appendix B) and corresponds to 39,760 acres of historic species habitat. Within this area, 17,470 acres of vernal pool habitat remain, corresponding to 44 percent of its historic range.

Not all of the 17,470 acres of vernal pool habitat are currently occupied by Contra Costa goldfields. Approximately 6,140 acres occur within known Contra Costa goldfields core population areas; in addition, 1,280 acres of valley floor grassland and 120 acres of open water are mapped within the core population areas, approximately 7,550 acres total. However, the extent of vernal pool grassland habitat provides a rough estimate of the amount of habitat currently occupied by Contra Costa goldfields, since the uplands are not occupied. Currently occupied habitat represents approximately 36 percent of its current potential range (42% if non-vernal pool valley floor grassland habitat is included) and 16 percent of its potential historic range (19% if non-vernal pool valley floor grassland habitat is included).

Given that a 40 percent conservation target is no longer practicable for Contra Costa goldfields, the next logical approach for developing a conservation target for this species, is to use the recovery targets set in the Vernal Pool Recovery Plan developed by the USFWS (2005a). This plan identifies two distinct recovery targets, one to preserve a certain percentage of occurrences, and the other to preserve a certain percentage of suitable species habitat within designated core areas.

The recovery plan sets a conservation target of protecting 90 percent of known Contra Costa goldfields occurrences, where occurrence is defined as "an occupied area at least 0.4 kilometers ( $\frac{1}{4}$

mile) away from the next occupied area” (USFWS 2005a). Based on the USFWS definition of occurrence, eight extant Contra Costa goldfield occurrences are known within Solano County. However, in urban areas locations isolated by existing development and roads also needs to be included when defining an occurrence. Combining multiple Contra Costa goldfield records that are within a 1/4 of a mile from each other results in one large occurrence in north east Fairfield that is better separated into three occurrences because they are isolated from each other by existing development and roads. Therefore, subareas 1B, 1D and 1E, though within 1/4 mile from each other are considered separate occurrences. Making a total of ten Contra Costa goldfield occurrences occur within the Plan Area. To meet a conservation target of 90 percent, nine of these known occurrences would need to be protected. This conservation target may change as new genetic information becomes available.

Two Core Recovery Areas are located within the range of Contra Costa goldfields in the Plan Area: the Jepson Prairie Core Recovery Area and the Suisun Marsh Core Recovery Area. The conservation target for the Jepson Prairie Core Recovery Area is protection of 95 percent of suitable species habitat; the conservation target for the Suisun Marsh Core Recovery Area is protection of 85 percent of suitable species habitat. Within Solano County, seven geographically distinct subareas containing Contra Costa goldfields have been identified (see Appendix B and Figure 4-7). Five of these core population areas fall within the Jepson Prairie Core Recovery Area and two fall within the Suisun Marsh Core Recovery Area. The 95 percent and 85 percent conservation targets were applied to these areas assuming that they represent the remaining suitable habitat for Contra Costa goldfields within each Core Recovery Area. Table 4-10 below lists the conservation target for each Contra Costa Goldfields Conservation Area based on the 95 percent and 85 percent recovery criteria.

**Table 4-10: Conservation Targets for Contra Costa Goldfields**

<b>CCGF Conservation Area</b>	<b>Total Potential Habitat Area (Acres)*</b>	<b>Conservation Target (Percent)</b>	<b>Conservation Target (Acres)*</b>
Subarea 1B - McCoy Basin Core Area	610 acres	95%	580 acres
Subarea 1C – Upper Union Creek Core Area	1,380 acres	95%	1,310 acres
Subarea 1D – Vanden Core Area	100 acres	95%	95 acres
Subarea 1E – Walters/Air Base Parkway Core Area	170 acres	95%	160 acres
Subarea 1F -Lower Union Creek	4,990 acres	95%	4,740 acres
Subarea 1G - Ledgewood Creek	280 acres	85%	240 acres
Subarea 1H – Cordelia	15 acre	85%	13 acres
<b>Total</b>	<b>7,545 acres</b>	<b>NA</b>	<b>7,138 acres</b>

\* Acres include vernal pool grasslands, surrounding non-vernal pool valley floor grasslands and open water habitat within each subarea.

**4.5.2.3 Valley Floor Grassland.** Valley floor grasslands more widespread than the vernal pool ecosystem subcomponent and is largely dominated by introduced annual grasses. Based on the definition of a widespread community, valley floor grassland contains species or vegetation communities that are distributed widely in several ecoregions. As a widespread habitat type, the conservation target for valley floor grasslands is 20 percent (Table 4-8). The historic distribution for the valley floor grassland community is based on the distribution of “California Prairie” classified by Kuchler (1977). Kuchler (1977) identifies roughly 249,420 acres of potential California Prairie in Solano County, resulting in a conservation target of 49,880 acres. Based on vegetation mapping conducted for the Solano HCP (see Section 3.3.1), approximately 115,340 acres of valley floor grassland, or roughly 46 percent of historical California Prairie, remain in Solano County. To achieve the 20 percent conservation target of 49,880 acres, 43 percent of the remaining valley floor grassland would need to be preserved. Within the County, approximately 16,540 acres are currently protected (Table 4-9); therefore, an additional 33,340 acres would need to be protected.

Unfortunately, the current valley floor grassland classification does not correspond to the historic California Prairie habitat defined by Kuchler (1977). Most of the land classified as valley floor grassland is regularly cultivated, but nevertheless, retains many of its ecosystem functions and provides important habitat for wildlife, thus it is worth preserving. The vernal pool grassland community, a subset of the valley floor grassland, is likely the closest remaining habitat type to what was historically considered California Prairie and even this region is dominated by introduced annual grasses and forbs. As a result, the majority of the valley floor grassland conservation target will consist of vernal pool grassland (47,000 out of approximately 50,000 acres or roughly 95%). Additional conservation efforts will focus on native grassland restoration.

### 4.5.3 Inner Coast Range

The Inner Coast Range consists of a mosaic of habitat types: oak woodland, oak savanna, mixed chaparral/scrub, and grassland. Conservation targets were not developed for this Natural Community, but for individual vegetation types, specifically oak woodland and chaparral/scrub. The entire area recognized in the Solano HCP as the Inner Coast Range was historically dominated by blue oak-foothill pine forest, mixed hardwood forest, chaparral, and coastal prairie-scrub mosaic (Figure 3-3) as identified by Kuchler (1977). For this analysis, the historic distribution of oak woodlands in the Plan Area were determined by combining areas of blue oak-foothill pine forest and mixed hardwood forest identified by Kuchler (1977). The current distribution of this habitat type was determined by combining the oak woodlands and oak savanna habitat mapped for the Solano HCP. Oak savanna habitat may function differently from dense stands of oak woodlands; but still provides significant habitat value to wildlife and has the potential for restoration. The historic distribution of chaparral/scrub habitat mapped for the Solano HCP was based on the area identified as chaparral and coastal prairie-scrub mosaic (Kuchler 1977; Figure 3-3).

Both the oak woodland and chaparral/scrub vegetation types were classified as widespread, occurring in several different regions throughout California. In addition, species occurring in both oak woodland and chaparral/scrub habitat are distributed relatively equally over several ecoregions. For example, raptor species dependent on the woodland resources within the Plan Area, such as Cooper’s hawk (*Accipiter cooperii*), sharp-shinned hawk (*Accipiter striatus*) and golden eagle, have very

widespread distributions. Additionally, most of the reptile and mammal species associated with these two habitat types, such as Western fence lizard (*Sceloporus occidentalis*), Western skink (*Eumeces skiltonianus*), gopher snake (*Pituophis catenifer*), dusky-footed woodrat (*Neotoma fuscipes*) and Western gray squirrel (*Sciurus griseus*) have widespread distributions.

As widespread habitat types, the conservation targets for oak woodland/oak savanna and chaparral/scrub communities were set at 20 percent of the historic distribution of each community within the Plan Area (Table 4-8). Based on Kuchler's (1977) map of the natural vegetation of California (Figure 3-3), historically, 73,845 acres of oak woodland habitat were located within Solano County. Presently, 36,910 acres of oak woodland/oak savanna habitat remain. To achieve a conservation target of 20 percent of the historic distribution of oak woodland habitat, 40 percent (14,770 acres) percent of the current oak woodland/oak savanna habitat in the County would need to be preserved (Table 4-9). Approximately 7,180 acres of oak woodland/oak savanna is currently protected (Table 4-9); therefore, an additional 7,590 acres of this vegetation type would need to be protected.

Based on Kuchler's (1977) map of the natural vegetation of California (Figure 3-3), 17,610 acres of Chaparral and 29,640 acres of Coastal Prairie-scrub Mosaic were located within Solano County. Presently, 11,260 acres of chaparral/scrub habitat remain. To achieve a conservation target of 20 percent of its historic distribution, 84 percent (9,450 acres) of the current chaparral/scrub habitat in the County (Table 4-8) would need to be preserved. Approximately 1,880 acres of chaparral/scrub habitat is currently protected (Table 4-9); therefore, an additional 7,570 acres of this vegetation type would need to be protected.

#### **4.5.4 California Red-legged Frog**

Before the settlement of Europeans on the west coast, the California red-legged frog was probably common throughout the Coast Range and the northern Central Valley (Zeiner et al. 1988; Jennings and Hayes 1985 and Hayes and Krempels 1986). Historic records of this frog occur from the floor of the Central Valley, but these populations likely did not persist due to extensive flooding during heavy winter storms or spring snowmelt (Fellers 2005). In Solano County, California red-legged frogs likely occupied the drainages within the Inner Coast Range with populations extending into parts of the valley floor, particularly within the riparian forest areas of Solano County. For this analysis, the historic range was determined using habitat historically mapped as chaparral, coastal prairie-scrub mosaic, blue oak-foothill pine forest, mixed hardwood forest, and riparian forest (Kuchler 1977). This historic distribution totals 155,800 acres and corresponds to the area in the Solano HCP classified as the Inner Coast Range, with an addition of the riparian forest area along Putah Creek. The current distribution encompasses the Jameson Canyon and Lake Berryessa Core Recovery Areas for California red-legged frog, totaling approximately 31,520 acres.

As a widespread species, a 20 percent conservation target was established for California red-legged frogs. To achieve the 20 percent conservation target, 31,160 acres, or 99 percent of the Core Recovery Areas identified in the USFWS Recovery Plan, would need to be preserved. Approximately, 8,320 acres are currently protected; therefore, an additional 22,840 acres would need to be preserved. The largest threat to the persistence of California red-legged frogs in the Plan Area is the spread of introduced predators and competitors. Even if the conservation target is achieved, these conservation lands must be properly and actively managed to extirpate populations of invasive

species and prevent their invasion into adjacent habitat areas in order to ensure the long-term viability of the California red-legged frog population.

#### **4.5.5 Callippe Silverspot Butterfly**

The historic range of the callippe silverspot butterfly encompassed the Inner Coast Range on the eastern shore of San Francisco Bay, from northwestern Contra Costa County to the Castro Valley in Alameda County. On the west side of San Francisco Bay, it ranged from San Francisco south to La Honda in San Mateo County. Currently, extant colonies are known only from San Bruno Mountain in San Mateo County, a city park in the Oakland Hills in Alameda County, and the hills between Vallejo and Cordelia in Solano County.

The status, distribution, and population levels of the callippe silverspot butterfly in Solano County are largely unknown. Western Solano County is an area of overlap and intergradation of the characters that distinguish three subspecies: *callippe callippe*, *callippe comstocki*, and *callippe liliana* (Noss et al. 2002). The darker color morph, representative of *callippe callippe*, occurs less frequently among populations from southwestern Solano County, than those from San Bruno Mountain (San Mateo County), and more frequently than it occurs among populations of the other subspecies (*callippe comstocki* and *callippe liliana*). Because most populations in Solano County exhibit the higher frequency of the darker color morph, USFWS treats these populations as the listed subspecies *callippe callippe* at least until additional taxonomic work proves otherwise (USFWS 1997). Based on the known distribution of this species in Solano County, it was classified as being peripheral; meaning that less than 10 percent of its total distribution falls within the Plan Area. Most of the conservation efforts for this species are happening in other portions of its range (e.g., San Bruno HCP in San Mateo County).

Habitat for the callippe silverspot butterfly is grassland, often with a significant component of native grasses, and characterized by shallow rocky soils or numerous rock outcrops. For the subspecies *callippe callippe*, the darker coloration, a distinguishing characteristic, is speculated to be an adaptation to living in foggy areas (such as San Francisco and southwestern Solano County) enabling them to warm up more quickly on foggy days. Fog is an important environmental factor in California coastal prairie grassland systems (Corbin et al. 2005); therefore, coastal prairie-scrub mosaic, mapped by Kuchler (1977) was likely the extent to which fog was a strong environmental factor, shaping the ecological community. For this analysis, the historic distribution of callippe silverspot butterfly is assumed encompass the southwestern portion of the Inner Coast Range mapped by Kuchler (1977), as coastal prairie-scrub mosaic, or 29,640 acres. As a peripheral distribution type with a conservation target of 10 percent, the acreage conservation target for callippe silverspot butterfly in the Plan Area is approximately 2,970 acres.

The current distribution of this species in Solano County is likely confined to the hills between Vallejo and Cordelia (i.e., the Tri-City/County Planning Area). However, additional potential habitat for this species occurs in Nelson Hill in Cordelia and the Rockville Hills, although no records occur from these areas (Figure 4-14). The current distribution corresponds to roughly 28,570 acres of potential habitat with an additional 6,220 acres of upland grassland habitat preserved within the Conservation Area. The current distribution for this species is more widespread than it was historically, based on Kuchler's vegetation map (i.e., the area mapped by Kuchler (1977) as mixed hardwood forest in the hills between Vallejo and Cordelia, now dominated by introduced annual grassland), indicating that the 10 percent conservation target has already been achieved. However, the *callippe callippe* subspecies may not occupy all of this area, and environmental conditions may not be

suitable to sustain a higher frequency of the darker color morph. In addition, only one of the three known occurrences of this species are preserved, the other two known occurrences fall within the urban limit line of Vallejo and are under high risk of development (Figure 3-10). Additional conservation is needed to protect remaining known occurrences of this species within their historic range.

#### **4.5.6 Riparian, Stream, and Freshwater Marsh**

The Riparian, Stream, and Freshwater Marsh Natural Community provides food, cover, breeding sites, and water for a diversity of wildlife. Overall, riparian or streamside vegetation provides important habitat for over 225 species of fish, amphibians, reptiles, birds, and mammals in California (RHJV 2000). Riparian habitats are considered to be particularly valuable for neo-tropical migratory songbirds, and function as important corridors between coastal (or bayshore) marsh habitats, floodplains, upland grasslands, and oak woodlands. Despite the high species diversity found in riparian areas, the average range size of the species that occupy this habitat is widespread (ex. neo-tropical migratory songbirds). In addition, the dominant plant species that comprise this Natural Community are also widespread. Riparian vegetation is classified as having a widespread distribution with a conservation target of 20 percent. Riparian vegetation makes up a relatively small portion of the total acreage of the Plan Area, and the occurrences are widely separated, but the species and vegetation communities, characteristic of riparian areas, are widely distributed.

The methods used to calculate conservation targets for vernal pools and oak woodlands could not be applied to this habitat type because the historic distribution of riparian vegetation could not be accurately calculated. The only riparian forest mapped by Kuchler (1977) occurred along Putah Creek, with a large riparian forest flood plain extending southeast towards Dixon (Figure 3-3). Historically, riparian vegetation was likely more extensive throughout Solano County than is depicted by Kuchler (1977) and more extensive within the Plan Area than it is currently. Based on Kuchler's (1977) map, 34,720 acres of riparian forest historically existed along Putah Creek, currently only 694 acres of riparian vegetation remain in this same area, representing a 98 percent loss of this habitat type. To achieve the 20 percent conservation target, 6,940 acres of riparian habitat would need to be preserved; however, only 690 acres are left to be preserved. Currently 3,430 acres of riparian vegetation exist throughout the Plan Area. Preservation of all these lands would not be sufficient to meet the 20 percent conservation target; therefore, approximately 3,500 acres of riparian vegetation would need to be restored (Table 4-9).

Rather than preservation, the conservation target for riparian and stream habitat is to restore or enhance 20 percent of the existing 3,430 linear miles of streams within the Plan Area, roughly 685 linear miles of stream habitat (Table 4-9). For riparian vegetation, the conservation target aims to increase the extent of riparian vegetation within the Plan Area by 20 percent of current levels, resulting in an additional 720 acres of riparian vegetation within the Plan Area (Table 4-9).

#### **4.5.7 Giant Garter Snake**

The giant garter snake historically inhabited wetlands in the Central Valley of California (USFWS 1999b) and currently occupies a variety of agricultural, managed, and natural wetlands including their waterways and adjacent upland habitats. Based on a visual assessment of potentially suitable habitat

(aquatic habitats with some emergent and bank vegetation), many of the Plan Participants' irrigation and flood control facilities in eastern Solano County appear to provide suitable habitat for giant garter snake (Figure 4-19). However, a more refined habitat model indicates that the extent of higher quality habitat for the giant garter snake encompasses the lower portions of Putah, Ulatis and Alamo Creeks, Hass Slough, the tidally influenced portions of the RD 2068 drains emptying into Hass Slough and Duck Slough, some of the interconnected irrigation canals and ditches, and the associated Delta sloughs in southeastern Solano County (LSA 2004a: Figure 4-19). The area identified as potentially supporting giant garter snakes (Figure 4-19) corresponds to the historic distribution of tule marsh habitat mapped by Kuchler (1977), minus Suisun Marsh (Figure 3-2). This area in southeastern Solano County historically supported giant garter snakes prior to agricultural development. Therefore, the historic distribution of tule marsh representing the historic distribution of giant garter snake habitat was used to calculate the conservation target for this species.

Based on Kuchler (1977) the entire Central Valley of California was dominated by tule marshes, roughly 1,894,260 acres. Based on this information, the distribution type for this vegetation type and for giant garter snake which is so closely associated with it, would likely be classified as restricted, occurring primarily within one ecoregion, the Central Valley. Out of 1,894,260 acres of historic tule marsh mapped by Kuchler (1977), only 58,670 acres (approximately 3%) falls within Solano County, a small percentage, compared to Sacramento, Yolo, and San Joaquin Counties, which historically contained 8 percent, 10 percent and 12 percent of the historic tule marsh in California. Additionally, the historic distribution of tule marsh occupies less than 10 percent of the Plan Area, as opposed to 26 percent, 27 percent and 31 percent for Sacramento, San Joaquin and Yolo Counties. Because only a small portion of this habitat type and therefore, the historic range of giant garter snake occurs within the Plan Area, the distribution of giant garter snake is defined as peripheral, with a conservation target of 10 percent (Table 4-8).

Historically, 58,670 acres of tule marsh were located within the Sacramento-San Joaquin River Delta of Solano County (i.e., within the historic range of the giant garter snake). To achieve the 10 percent conservation target, 5,867 acres of remaining aquatic habitat would need to be preserved for this species. Currently, 5,520 acres of aquatic habitat occurs within the historic range including riparian vegetation (710 acres), open water (4,480 acres), and remaining marsh habitat (330 acres). The 10 percent conservation target of 5,870 acres exceeds the amount of aquatic habitat remaining within these areas; therefore, an additional 350 acres of aquatic habitat would need to be created to meet the conservation target. Existing aquatic habitat for giant garter snake is significantly different from the historic tule marsh habitat classified by Kuchler (1977). In addition to the creation of 350 acres of aquatic habitat, habitat restoration and enhancement would be required within existing areas to achieve its historical levels of productivity and value for giant garter snake.

#### **4.5.8 Coastal Marsh**

Coastal salt marsh is a highly "productive" plant community consisting of plants that are tolerant of saline soils and regular tidal inundations. Coastal salt marsh is restricted to the upper intertidal zone of protected shallow bays, lagoons, and estuaries. For this analysis, coastal salt marsh or tidal marsh habitat has been classified as a restricted distribution type (Anderson et al. 1999, Marshall et al. 2000) with a conservation target of 40 percent (Table 4-9).

The San Francisco Estuary Institute (SFEI), as part of the EcoAtlas project, mapped the historic and current extent of vegetation types throughout the San Francisco Estuary. Historically, approximately 62,990 acres of high elevation tidal marsh occurred within the Plan Area (SFEI 1999), resulting in a conservation target of 25,200 acres. Presently, only 9,840 acres of high elevation tidal marsh remain within the Plan Area, corresponding to 16 percent of historic tidal marsh. The majority of existing marsh habitat consists of managed wetlands. Substantial restoration, including a 24 percent increase in marsh habitat (15,350 acres) and preservation of remaining marsh habitat would be required to achieve the 40 percent conservation target (Table 4-8).

CALFED and the Suisun Marsh Conservation Plan established marsh restoration targets within the Plan Area. The 2000 CALFED Record of Decision (ROD) called for the creation of an additional 5,000 to 7,000 acres of tidal wetlands in Suisun Marsh. Based on these restoration targets, the conservation target for tidal marsh habitat in Solano County would be between 24 percent and 27 percent (14,800 to 16,800 acres). Although restoration of tidal marsh habitat is difficult to achieve, once the conservation target is reached, an additional 8,000 acres of marsh habitat may be restored.

#### **4.5.9 Swainson's Hawk**

The historic range of nesting Swainson's hawks in California was widespread, and included the Southern Transverse Ranges, Central Coast Ranges, Central Valley, Great Basin, and Mojave-Colorado Desert (Bloom 1980). These regions included desert, shrubsteppe, grassland, agricultural, canyon, foothill, and interior valley habitats. Today, Swainson's hawks are still locally common in the Central Valley and the Great Basin (Woodbridge 1998), with populations centered in Sacramento, San Joaquin, Yolo and eastern Solano counties. Populations also remain within Butte Valley, the Klamath Basin, Antelope Valley (Los Angeles County), Owens Valley, Lassen County, and the east side of the Sierra Nevada.

The Swainson's hawk population within the Plan Area is primarily dependent on the irrigated agricultural resources of central and northeastern Solano County. The highest nest densities and the majority of Swainson's hawk records are found in this region of the County. As a result of the Swainson's hawks dependency on irrigated agricultural land as a foraging resource, the species-area relationship model could not be applied to develop a conservation target for Swainson's hawks because agricultural lands do not have a naturally occurring 'historic' distribution. In addition, because of the lack of substantial data available for this species, a population viability analysis (PVA), another method used for setting conservation goals for target species, could not be used.

Unfortunately, no quantitative method is available for developing a conservation target for Swainson's hawks. Instead, a qualitative assessment has been made based on expert opinion and the known needs of the species. Members of the Swainson's hawk technical advisory committee and the Solano HCP Science Advisors argue that the long-term viability of the Solano County population of Swainson's hawk will require conservation of the existing agricultural lands in appropriate crop types (i.e., alfalfa, tomatoes, other specific row crops) in reasonable proximity to nest sites (Micheal Bradbury, personal communication). If these lands are maintained, the Swainson's hawk population will likely remain at its current level, and may rise to a level that meets recovery standards in accordance with recent observations that Swainson's hawk population levels throughout the Plan Area appear to be stable and/or expanding (Steve Foreman, LSA Associates, pers. obs.). In recent

years (2004 and 2005), Swainson's hawks have begun to establish nest territories in Napa County and in Coastal Marsh and Inner Coast Range habitat.

In addition to the conservation of agricultural resources, conservation of Valley Floor Grasslands and Vernal Pools and lower-lying grassland communities associated with the Inner Coast Range Natural Community will also benefit Swainson's hawk populations. Therefore, conservation targets set for these two habitat types also apply to Swainson's hawks.

#### **4.5.10 Burrowing Owl**

Like the Swainson's hawk, burrowing owl conservation is tied to the preservation of open agricultural lands. Therefore estimating conservation targets based on the species-area relationship model is difficult and little data is available for the parameterization of a PVA. As a result, no quantitative or qualitative methods exist for estimating a conservation target for burrowing owls within the Plan Area. However, conservation of irrigated agricultural lands for Swainson's hawk also provides habitat protection for burrowing owls. Burrowing owls use a variety of natural habitats, including valley floor grassland and vernal pool habitats, and the grasslands and oak savanna habitat within the Inner Coast Range. Any of these habitat types can support owls if burrows are available for cover and nesting, and the prey is present. As such, the conservation targets developed for these natural communities also apply to burrowing owls.

### **4.6 RESERVE DESIGN AND CONSERVATION APPROACH**

The results of the Conservation Analysis (Sections 4.3 and 4.4), Risk Analysis (Section 3.6), Conservation Targets (Section 4.5) and the Reserve Design Principles (Section 4.2) combine to form an overall vision for the design of reserves in the Plan Area and specific reserve design criteria for each Natural Community. Based on the species-area relationship curve and distribution types (Table 4-8), Section 4.5 identifies conservation targets for each Natural Community to capture the diversity of species throughout the Plan Area. To maintain species diversity, the reserve system must also incorporate the reserve design principles outlined in Section 4.2.

The key to fulfilling the overall reserve design vision is to maintain existing habitat either through protection of these areas in preserves/reserves or preservation of existing land uses. Working farms and ranches provide several thousands of acres of valuable habitat for Covered Species. Maintaining the economic viability of these farms and ranches should be an objective of the HCP. Based on a biosphere reserve design model, lands managed for a range of uses from complete protection to sustainable agricultural production are important for achieving long-term conservation goals.

#### **4.6.1 Valley Floor Grassland and Vernal Pool Natural Community**

As described in Section 4.3, the Valley Floor Grassland and Vernal Pool Natural Community has been divided into low, medium, and high values conservation categories (Figure 4-9) based on the key conservation elements identified in Section 4.3.2.5. The Conservation Strategy (Section 6.0) uses these categories to establish mitigation ratios for the entire Natural Community. This section focuses primarily on the reserve design and conservation approach for vernal pool grasslands.

Vernal pool grassland habitat within the High and Medium Value Conservation Areas were separated into four categories based on their restoration and management needs, including: (1) conservation areas with high preservation potential, (2) conservation areas with high preservation and restoration potential, (3) Contra Costa goldfield potential reserve areas and (4) potential outlier areas (Figure 4-27). Conservation areas with high preservation potential correspond to minimally-disturbed vernal pool grasslands (Figure 4-6). Conservation areas with high preservation and restoration potential correspond to moderate to highly disturbed vernal pool grasslands and some agricultural lands on historic vernal pool soils. The degree to which preservation and/or restoration applies to individual sites will vary with the level of disturbance. Some of these areas may also contain transition habitat between Natural Communities and unique habitat features. Contra Costa goldfield potential reserve areas correspond to the core population areas for Contra Costa goldfields and surrounding watershed lands identified in Figure 4-7. These areas were distinguished from the previous two categories because several of these areas contain small isolated parcels that will require special management and restoration. Potential outlier areas represent isolated patches of vernal pool grassland habitat within the agricultural lands of the Plan Area. These areas will be considered as potential reserves if they are found to contain unique habitat features, rare or range limited species, or genetically distinct population segments of Covered Species. These areas would also require special management and restoration due to their relatively small size and isolation.

Reserve Design Principle 15 identifies restoration as an important component of the Solano HCP reserve system. In addition, Section 4.5 (Conservation Targets) identifies the need for considerable restoration of existing vernal pool grasslands to achieve its historical levels of productivity and value, even though sufficient habitat remains to meet the 40 percent conservation target. The conservation measures outlined in the Conservation Strategy (Section 6.0) include restoration to mitigate for impacts to vernal pool habitat. Restoration efforts should occur adjacent to existing high quality preserves in order to contribute to the overall value of the reserve system and increase the potential for successful restoration. Figure 4-27 identifies the appropriate location for preservation and restoration efforts in order to properly implement the reserve design principle.

Reserve Design Principle 14 identifies long-term management or stewardship, as critical to maintaining the biological values of preserved lands. All reserves and preserves established under the Solano HCP will be required to implement long-term management plans. However, some reserves, particularly those established to preserve isolated populations of extremely rare or range-limited species will have special management needs due to their small size and proximity to incompatible land uses, such as urban development and agriculture. Both the Contra Costa goldfield conservation areas and potential outlier reserve areas may have special management requirements. These special management requirements need to be considered during the development of the reserve's Resource Management Plan (see Section 10.5.3).

#### **4.6.2 Inner Coast Range**

The conservation target for oak woodland/oak savanna/chaparral/scrub habitat is roughly 24,000 acres. Of the 48,000 acres of existing habitat, 9,000 acres are currently protected and an additional 28,900 acres are within the low risk category (Table 4-8), encompassing roughly 79 percent of the total habitat and 120 percent of the conservation target. However, to meet other reserve design principles (Section 4.2) for preserving corridor habitat, a range of environmental conditions, transition areas, and areas of high diversity, roughly 8,000 acres of oak woodland/oak savanna habitat at lower

elevations, within the moderate to very high-risk classes would also need to be preserved. Since the conservation targets for these community types have been achieved, additional conservation efforts should be directed towards preserving oak woodland/oak savanna habitat within corridor areas at lower elevation, and within moderate to very high risk classes, in order to meet the additional reserve design criteria and provide for preservation of a range of community conditions (e.g., vegetation cover and interspersions, soils, elevation, and topography).

The Inner Coast Range conservation approach focuses on avoiding and minimizing impacts to sensitive areas, such as key watershed lands and areas occupied by Covered Species, enhancing existing preserves through restoration and adaptive management, and if funding becomes available, protecting additional Inner Coast Range habitat that provides important corridors between Natural Communities. Priorities for acquisition include California red-legged frog and Callippe Silverspot Conservation Areas and if resources permit, linkages and corridor habitats in the Vacaville/Fairfield Greenbelt and between the English Hills and Valley Floor Grasslands and Vernal Pool High Value Conservation Subarea 1K (the hardpan pools near Vacaville).

### **4.6.3 California Red-legged Frog**

In 2002, the USFWS published a recovery plan for the California red-legged frog, which designated core recovery areas throughout the species current and historic range. The core recovery areas represent a system of areas that, when protected and managed for will allow for long-term viability of existing populations and reestablishment of populations within the historic range (USFWS 2002a). Portions of two core recovery areas fall within Solano County: the Jameson Canyon-Lower Napa River Core Recovery Area (27,270 acres, located in the hills west of Green Valley and into the Tri-City/County Planning Area) and the Lake Berryessa Tributaries Core Recovery Area (4,253 acres, located in the extreme northwestern corner of the County, in the area of the University of California's Stebbins Cold Canyon Preserve) (USFWS 2002a; Figure 4-16).

Section 4.5.4 identifies a conservation target of 20 percent (31,160 acres) of the historic range of California red-legged frog within the County, approximately 99 percent of the Core Recovery Areas established in the Recovery Plan (USFWS 2002a). The Tri-City and County Cooperative Plan for Agriculture and Open Space Preservation aims to protect approximately 10,000 acres of open space between Benicia, Fairfield, and Vallejo in Solano County, falling within the Jameson Canyon-Lower Napa River Core Recovery Area. Currently, 6,842 acres of land is protected. In addition, 8,700 acres fall within the Secondary Marsh Management Zone of the Suisun Marsh Protection Plan (i.e., falls within a very low risk category; Figure 3-10). Within the Lake Berryessa Tributaries Core Recovery Area, 1,596 acres is protected within existing preserves and reserves, and the remaining area is zoned as watershed land (i.e., falls within a very low risk category; Figure 3-10). If the Tri-City County Open Space JPA is able to protect 10,000 acres, a total of 24,500 acres of land within both Core Recovery Areas would either be protected within reserves/preserves or in very low risk areas, achieving close to 79 percent of the conservation target identified in Section 4.5.4.

The network of reserves currently being developed by the Tri-City County Open Space JPA, in conjunction with the Solano Land Trust, meets the following Solano HCP Reserve Design Principles: preserve large blocks of habitat (1), conserve target species throughout the Plan Area (2), prioritize habitat with high conservation value at high risk of being developed (3), incorporate a range of environmental gradients (4), preserve blocks of habitat close together (7), preserve ecotone and

transition areas (11) and minimize human disturbance (13) (see Section 4.2 for details). To add to the overall quality and value of the existing reserve network, the Conservation Strategy for the Solano HCP focuses on addressing the additional reserve design principles of: protecting regional water quality (5), maintaining connectivity (6), incorporating sufficient buffer zones between reserves and new development (8), minimizing edge effects (9), incorporating adaptive management and monitoring (14) and restoring and creating additional habitat within preserve areas (15).

The overall strategy for the recovery of the California red-legged frog as identified in the Recovery Plan (UFWS 2002a) 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.

The overall conservation approach for California red-legged frog addresses both the reserve design principles outlined in Section 4.2 and the overall recovery strategy identified in the Recovery Plan. Existing populations will be protected through avoidance and minimization measures, and preventing the expansion of invasive exotic predators (e.g., bullfrog, crayfish, and warm water fish species) into currently undeveloped and unoccupied areas. Passive control of invasive species includes conservation measures to avoid creating perennial ponds, small lakes, and excess urban runoff leading to the “perennialization” of intermittent creeks. Plan Participants will, to the maximum extent practicable, limit additional development within the Jameson Canyon-Lower Napa River Core Recovery Area and will develop and implement a coordinated watershed management plan for the recovery area. The coordinated watershed management plan will provide basic guidance on the use of conservation/mitigation funds acquired through HCP implementation, management practices that can be implemented on public and private lands to benefit the California red-legged frog, and public outreach and awareness programs. Implementation of the conservation measures will also result in the creation and restoration of additional breeding habitat within the Core Recovery Area that will be managed for the benefit of California red-legged frogs.

#### **4.6.4 Callippe Silverspot Butterfly**

The overall conservation goal for the callippe silverspot is to preserve multiple populations in secure core areas and provide connectivity between these preserved areas. The conservation approach for callippe silverspot butterfly is to permanently protect existing butterfly populations where they occur (primarily through avoidance and minimization), minimize activities that could lead to the expansion of invasive plant species, and provide appropriate funding for land management, to maintain and possibly improve, the distribution and abundance of the larval host plant, Johnny jump-up.

Section 4.5.5 identifies a conservation target of 10 percent (2,965 acres) of the historic habitat for callippe silverspot butterfly. Currently 6,222 acres of habitat in the Callippe Silverspot Butterfly Conservation Area are preserved. However, not all of this habitat may be occupied by the species and only one of the two known occurrences within the Plan Area is protected. Preserved lands do not

contribute to the conservation and recovery of the species unless they are occupied and contain sufficient resources to maintain viable populations (i.e., large stands of the larval host plant, *Viola pedunculata* and sufficient densities of adult nectar plants on ridgelines and hilltops for mating and dispersal purposes).

Limited information is available on the distribution and status of callippe silverspot butterfly in Solano County. As part of the Conservation Strategy, a population assessment, involving appropriately timed surveys for adults and larvae, will be conducted to help fill this data gap and prioritize conservation actions. If survey results identify additional occurrences within preserve lands, resources should be directed towards habitat enhancement within existing preserves to expand current populations. However, if no or limited additional occurrences are found, conservation resources should be directed towards preserving remaining known occurrences. The Watershed Management Plan for the conservation area identified in Conservation Measure CSB1 and subject to approval by SCWA will guide these decisions.

Acquisition priorities for callippe silverspot butterfly are the areas just northeast of Vallejo that encompass two of the three occurrences within Solano County, and the majority of known *Viola pedunculata* patches large enough to support callippe silverspot populations (Figure 4-14). Other key core areas and interconnecting ridgelines are already protected in the Kings and Swett Ranches Open Space Areas and have been identified as priorities for the reserve/preserve system because they fall within the urban limit line of Vallejo and are at high risk of development (Figure 3-10).

#### **4.6.5 Riparian, Stream, and Freshwater Marsh**

Riparian, stream and freshwater marsh habitats play an important role in the overall reserve design of the Solano HCP. Riparian and streamside habitats support high species diversity providing important habitat for over 225 species of fish, amphibians, reptiles, birds, and mammals in California (RHJV 2000) and provide connectivity between high value conservation areas due to their linear nature. Because stream environments are sensitive to development in the surrounding watershed, conservation issues for this Natural Community should be addressed at a landscape scale.

The conservation approach for this Natural Community involves preservation, restoration, invasive species control, and protection of water quality and hydro-geomorphic processes. Section 4.3.6.6 identifies Priority Drainages and Watersheds based on specific conservation criteria (Figure 4-11) and further subdivides them into specific conservation areas based on targeted conservation actions. These conservation actions define the overall conservation approach for the Riparian, Stream, and Freshwater Marsh Natural Community.

Due to the extensive loss of riparian and freshwater marsh vegetation, preservation is a key component of the conservation approach. Preservation of existing riparian, stream and freshwater marsh habitat will be accomplished primarily through habitat avoidance and minimization measures. Permanent impacts to riparian, stream, and freshwater marsh habitats will be mitigated either through preservation and enhancement of existing habitat, or major restoration/creation of new in-kind habitat. Implementation of the conservation measures will result in a net increase in the quantity and quality of Riparian, Stream, and Freshwater Marsh habitat within the Plan Area.

Preservation and enhancement of existing habitats will occur within the Priority Drainages and Watersheds in Conservation Area RSM 1 (Figure 4-11). Major restoration or creation efforts, such as restoration of a two-stage floodplain corridor, will be targeted within Priority Drainages and Watersheds in Conservation Area RSM 3, including the stream reaches that meander through the alluvial fans, terraces, basins, and Delta marshlands of the County (Noss et al. 2002; Figure 3-2). Residential, commercial, and agricultural development has significantly altered the riparian, stream and freshwater marsh habitat within this portion of Solano County. Urban development occurs on, or upslope, of the alluvial fans, terraces, and basins, and upslope of the Delta marshlands. The majority of the palustrine wetlands, floodplains, and riparian forests that historically bordered the larger rivers and adjacent sloughs and waterways in these areas, have been drained and converted into farmland over the last century or more. Priority Drainages and Watersheds highlighted within Conservation Area RSM 3 represent the drainages, within the alluvial fans, terraces, basins and Delta marshland geographical provinces of the County that have been the least altered by residential, commercial, and agricultural development, and have the highest restoration potential.

In general, Solano HCP targets both the upper and lower reaches of Priority Drainages for preservation and restoration (Conservation Areas RSM 1 and 3). For example, Ulatis Creek, upstream of Gibson Canyon Road falls within Conservation Area RSM 1, and the Old Ulatis Creek channel east of Leisure Town Road to the Vacaville urban limit line falls within Conservation Area RSM 3. Similarly, Alamo Creek from the confluence with Encinosa Creek and up, falls within Conservation Area RSM 1, and Old Alamo Creek east of Leisure Town Road to the Vacaville urban limit line falls within Conservation Area RSM 3 (Figure 4-11). The portions of Alamo and Ulatis Creeks between Conservation Areas RSM 1 and 3, fall within Conservation Area RSM 2. Riparian and stream habitat designated as Conservation Area RSM 2 represents key urban streams that provide connectivity between other high value conservation areas within the County.

The conservation approach for Conservation Area RSM 2 (i.e., riparian and stream habitat within and near urban areas) focuses on maintaining and enhancing the quality of the riparian corridor, and protecting water quality and hydro-geomorphic processes. Much of the “riparian” habitat within and near cities (i.e., within Conservation Area RSM 2) is very narrow and characterized by non-native trees and shrubs. Maintaining and enhancing the quality of the remaining riparian corridor will be accomplished through implementation of set backs and buffer zones within new urban development projects, targeted revegetation of severely degraded areas, removal and control of aggressive invasive species, and removal of in-stream barriers to dispersal and migration. With restoration and control of invasive species, urban riparian vegetation, particularly along parts of Ulatis and Alamo Creeks, will provide important corridor habitat linking the Vaca Mountains to the valley floor. In addition, Plan Participants will develop and implement programs to remove in-stream barriers at existing facilities and prevent the creation of new in-stream barriers associated with development along the lower reaches of Jameson Canyon, American Canyon, Ledge wood, Suisun, and Green Valley Creeks and their tributaries.

Maintaining water quality and hydro-geomorphic processes within Conservation Area RSM 2, primarily involves minimizing and mitigating for impacts resulting from new urban development upstream in Conservation Area RSM 1. Conservation measures include providing appropriate native vegetated buffers between development and stream corridors to protect water quality, avoiding excessive erosion, maintaining base flood elevation and 24-hour storm event discharge, and minimizing impervious surface areas directly connected to storm drain systems. These conservation

measures, in addition to NPDES permit requirements established by the RWQCB to minimize non-point source pollution, are designed to maintain water quality and the natural hydro-geomorphic processes of riparian, stream, and freshwater marsh habitat throughout the Plan Area.

#### **4.6.6 Giant Garter Snake**

Giant garter snakes occur within the eastern Plan Area beyond the limits of urban expansion as identified in the HCP. Section 4.3.7.3 identifies the Giant Garter Snake Conservation Area. This area encompasses the lower portions of Putah, Ulatis and Alamo Creeks, Hass Slough, the tidally influenced portions of the drains of the RD 2068 Irrigation District emptying into Hass Slough and Duck Slough, some of the interconnected irrigation canals and ditches, and the associated Delta sloughs in the southeastern portion of the Plan Area (LSA 2004a: Figure 4-19).

Because suitable habitat for this species falls outside of anticipated urban expansion, primary concerns for this species involve indirect effects associated with increased urban runoff in downstream receiving waters and flood control channels, and direct impacts resulting from operation and maintenance of Plan Participant facilities. Therefore, the main conservation approach for giant garter snakes is to implement avoidance and minimization measures to minimize these indirect and direct impacts. However, certain operation and maintenance activities, such as clearing waterways, cannot be accomplished during the time-frames necessary for avoiding and minimizing impacts to this species (Conservation Measure GGS 3). To mitigate for the take of giant garter snakes resulting from routine operations and maintenance activities, Plan Participants will provide a single, 0.5:1 ratio creating new aquatic habitat as mitigation for temporary impacts associated with channel clearing within high quality habitat areas. As a result, approximately 95 acres of aquatic and associated upland habitat in the Giant Garter Snake Conservation Area will be preserved and restored (Figure 4-19). Conservation areas will be located to maintain interconnected blocks of habitat that support natural movement patterns, provide opportunities to reestablish populations in Solano County, and will be appropriately restored and managed to achieve historical levels of productivity and value for giant garter snakes.

#### **4.6.7 Coastal Marsh**

As described in Section 3.5, significant ongoing conservation efforts are directed toward estuarine marsh protection. CDFG owns and manages large portions of Suisun Marsh and the Napa Marshes in Napa and Solano Counties, and plans to restore these areas to tidal marsh for the purpose of endangered species restoration and recovery. USFWS owns and manages the majority of the tidal marshes fronting San Pablo Bay and plans to restore approximately 1,560 acres to tidal marsh. In the Delta region, CDFG owns and manages the Calhoun Cut Ecological Reserve that contains the upper portions of marsh and riparian habitats.

Because of public ownership in the Suisun Marsh, Southampton Marsh, and Napa and San Pablo Bay Marshes, combined with special regulatory restrictions governing Suisun Marsh, over 95 percent of the coastal marsh habitats in Solano County are protected from conversion to other land uses (Figures 3-9 and 4-20). The conservation approach for coastal marsh habitat focuses on avoiding and minimizing impacts associated with Covered Activities and facilitating ongoing conservation and restoration activities in marsh habitat within Solano County.

## 4.6.8 Swainson's Hawk

In this section, the conservation areas identified in section 4.3.9.3 are further refined to identify potential reserve areas, criteria for agricultural reserves, and requirements for planting future nest trees.

**4.6.8.1 Potential Reserve Areas.** Based on specific reserve design criteria, the conservation areas identified in Section 4.3.9.3 were further refined to identify potential reserve areas, including Irrigated Agriculture, Valley Floor Grassland and Vernal Pools, and Inner Coast Range Potential Reserve Areas (Figure 4-28). These reserve areas were established because not all potential foraging habitats equally benefit Swainson's hawk conservation.

The majority of Swainson's hawk records are located within the irrigated agricultural areas in northeastern Solano County; therefore, the conservation approach for Swainson's hawk focuses on maintaining suitable foraging and nesting habitat within the Irrigated Agriculture Potential Reserve Area (Figure 4-28). The Irrigated Agriculture Potential Reserve Area includes all irrigated agricultural land excluding areas within the urban limit lines of the Plan Participants, areas zoned for development under the 2008 General Plan Update (Solano County 2008) and areas below sea level. Exclusion of these areas, even those in proximity of a nest, was largely based on recommendations from CDFG. CDFG encourages cities to focus development within urbanized areas, since small disjunct parcels of habitat seldom provide the foraging habitat needed to sustain reproduction of Swainson's hawk pairs. Delta areas below sea level were also excluded based on the potential for loss of these areas as foraging habitat due to levee failures and subsequent long-term flooding.

The Valley Floor Grassland Potential Reserve Area includes portions of the Valley Floor Grassland Conservation Area (Figure 4-9), minus the wind resource area in the Montezuma Hills. Because wind turbines represent a potential source of Swainson's hawk mortality, lands within the existing Solano Wind Resource Area (WRA), as well as proposed future WRA expansion lands, are excluded from the Valley Floor Grassland Potential Reserve Area. Habitat management within WRAs discourages raptor foraging near wind turbines; therefore, these lands should not be managed to enhance Swainson's hawk foraging habitat, nor should additional nest trees be planted within the WRA. The Inner Coast Range Potential Reserve Areas encompass key corridor areas between the valley floor and the Coast Range, the North Vacaville Corridor and the Vacaville-Fairfield Green Belt (see Section 4.3.1.1) and grassland habitat within the core recovery areas for California red-legged frog (Figure 4-15).

Because not all foraging habitats equally benefit Swainson's hawk, mitigation for impacts to habitat within the Irrigated Agriculture Conservation Area can occur only within the Irrigated Agriculture Potential Reserve Area. Mitigation for impacts to foraging habitat within the Valley Floor Grassland Conservation Area can occur within the Irrigated Agriculture or Valley Floor Grassland Potential Reserve Areas. Finally, mitigation for impacts to the Inner Coast Range Conservation Area can occur for within the Irrigated Agriculture, Valley Floor Grassland, or Inner Coast Range Potential Reserve Areas.

**4.6.8.2 Criteria for Establishment of Agricultural Reserves.** The reserve design criteria for Swainson's hawks are different from the Reserve Design Principles (Section 4.2) and were

established based on the needs of Swainson's hawks and on potential logistical issues associated with maintaining and managing agricultural reserves. To identify the best reserve design scenario, three conceptual reserve design models were evaluated:

- 1. Several Small Reserve Design:** This model consisted of 75, 80-acre parcels/reserves dispersed throughout the Irrigated Agriculture Potential Reserve Area.
- 2. Multiple Medium Reserve Design:** This model consisted of six, 1,000-acre reserves, dispersed throughout the Irrigated Agriculture Potential Reserve Area.
- 3. Single Large Reserve Design:** This model consisted of one, 6,000-acre reserve strategically centered in the Irrigated Agriculture Potential Reserve Area.

Of these conceptual reserve designs, the multiple medium reserve design was determined to most benefit Swainson's hawks. Several small reserves would be difficult to manage and monitor and would create a scattered pattern of reserves that might not be beneficial to foraging Swainson's hawks. The small size of each reserve would provide limited foraging opportunities due to similar planting, harvest, irrigation, and land disturbance patterns that would occur throughout the reserve. Because Swainson's hawk foraging activities typically track harvest activity, reserves with staggered planting, harvest, irrigation, and land disturbance patterns would be more beneficial for Swainson's hawks by providing them with temporally spaced foraging opportunities. The single large reserve design would concentrate protected habitat in one area, and would provide foraging for a limited number of hawks. The multiple medium reserve design would provide a number of larger reserves with a range of crop types and/or variable patterns of disturbance (harvest, planting, irrigation, etc.), extending periods of high prey availability.

The logistical disadvantage to both the multiple medium or single large reserve design is the practicability of obtaining large reserves (1,000 acres or larger). Typical parcel sizes in northeastern Solano County, within the Irrigated Agriculture Potential Reserve Area, range from 80 to 160 acres with few farming operations large enough to qualify as a medium or large reserve (less than 1,000 acres). Since the reserve program under the Solano HCP relies on willing sellers to establish reserves, the most likely reserve design scenario lie somewhere between conceptual designs 1 and 2, with most reserves ranging from 80 to 600 acres. However, larger reserves will be preferred over smaller reserves, to allow for a multiple range of crop types and disturbance patterns.

Given the unpredictability of size and location, minimum habitat criteria must be defined for a reserve to receive credit for Swainson's hawk conservation. These criteria are based on known foraging and nest-site requirements of the species, summarized in Appendix B. For a site to qualify as mitigation for impacts to Swainson's hawk habitat or as conservation lands (i.e., mitigation bank, conservation easement, habitat reserve), the following minimum criteria must be met:

- Reserves must contain crop types suitable for Swainson's hawk foraging, including in order of suitability (follows): alfalfa, dry-land pasture, fallow fields, wheat, barley, oats, tomatoes, beets, beans, potatoes, and irrigated pasture (Estep and Teresa 1992). At least 75 percent of each reserve should be grown in alfalfa or other irrigated hay crops.
- Suitable nest trees must be located within one mile of the proposed reserve. Sites where nest trees are already present (i.e., on or immediately adjacent to the parcel under review) should receive higher priority for reserve designation. In addition, higher priority should be placed on sites

within two miles of known Swainson's hawk nests to better serve existing nesting populations (Two miles is within the average home range of a nesting Swainson's hawk as measured by Estep [1989] and Babcock [1995]).

- Reserves should be a minimum of 80 acres in size (note: minimum reserve size is limited by parcel size) and should not exceed 1,000 acres to avoid concentrating too much foraging habitat into one area.
- No reserves should be established within one mile of existing or planned development, to avoid future abandonment of nest territories due to increased human disturbance.
- Reserves should incorporate filter strips or other areas of natural vegetation.

**4.6.8.3 Tree Planting Criteria.** Another important component of the Swainson's hawk conservation approach is the establishment of potential nest trees as mitigation for loss of known and/or potential nest trees. Swainson's hawks are not selective about the species of tree for nesting. However, in the Central Valley, native trees most commonly used for nesting include Fremont's cottonwood (*Populus fremonti*), willows (*Salix sp.*), sycamores (*Platanus sp.*), valley oaks (*Quercus lobata*), and walnut (*Juglans sp.*). Important design considerations include:

- having sufficient high-quality foraging habitat protected near the nest site,
- providing trees that are tall enough (usually above 30 feet) to provide protection for young and strong enough to support a nest,
- having sufficient nesting material nearby to construct and repair the nest,
- providing alternate nest trees in the same nesting location, and
- providing a lookout roost nearby.

Tree plantings should be conducted to ensure long-term success of the trees themselves and to provide nesting habitat for 15 to 30 years from the time of planting. Riparian plantings are preferred over long linear rows of trees along, or adjacent to farm roads. Trees situated along farm roads are disturbed by farm equipment, road maintenance, and widening/resurfacing/repaving projects. In addition, these trees can become disfigured by tree trimming to protect utility lines, and their root systems can be compromised during the widening and maintenance of drainage ditches, both of which may result in the decline and ultimate mortality of the planted trees. Ideally, trees should be planted to expand an existing riparian area or other type of native tree stand. Plantings should consist of a mix of three or four native species, ideally from local stock, suitable for the area's hydrology and soils. Trees should be planted in clusters, or in a matrix design, to minimize edge habitat and should be located within at least one mile from occupied foraging habitat, either grasslands or cropland. Preferably, trees should be planted in areas where they are needed, have been removed historically, are within or immediately adjacent to dense nesting areas, are on fully protected landscapes that can support them edaphically and hydrologically, where they can be assured survival for the longest term possible for that tree species and preferably within riparian areas.

#### 4.6.9 Burrowing Owl

Solano County has an abundance of land that is known to support or is potentially suitable for burrowing owls (Figure 4-23). As a result, significant opportunities exist for land protection and changes in land management to protect existing burrowing owl populations and provide habitat for a larger population without greatly inhibiting future development and agricultural practices. The primary approach to the conservation and expansion of the burrowing owl population within the Plan Area is to increase the availability of suitable nesting habitat (i.e., burrows) through design of agricultural reserves, management practices, and addition of artificial burrow complexes.

Burrowing owls are an open-country species, naturally inhabiting grasslands, open shrublands, and open woodlands and have adapted to human-modified landscapes using agricultural lands, disturbed fields, roadsides, and railroad right-of-ways. This pattern is evident in the distribution of burrowing owl records throughout Solano County (Figure 4-23). Although most records fall within agricultural areas, the adaptability of agricultural areas is limited since site suitability depends on an abundant prey base, and the availability of small mammal burrows or other sites suitable for cover or breeding. Suitable sites for cover and breeding usually occur along irrigation canals and levees, on vacant lots, railroad right-of-ways, and drainage ditches, with adjacent agricultural fields providing an abundant prey base. Recent studies by Gervais et al. (2003) and Rosenberg and Haley (2004) demonstrate that agricultural fields and associated habitat features (i.e., levees and irrigation ditches) support substantial burrowing owl populations in the Central and Imperial Valleys because they provide owls with these two main habitat features.

Unfortunately, the persistence of owls in these settings is dependent on the management practices of private landowners and local irrigation districts (Rosenberg and Haley 2004). Owls nesting in burrows along irrigation canals are extremely susceptible to road grading operations, dredging of drains, flooding, and other operation and management practices (Coulombe 1971, Rosenberg and Haley 2004). In addition, small mammal species (i.e., California ground squirrel) that create suitable burrows are usually targeted for extermination in agricultural areas, creating unique challenges for burrowing owl conservation in northeastern Solano County.

Since ongoing agricultural operations in these areas do not result in direct loss of foraging habitat, primary concerns related to Covered Activities are: (1) loss of agricultural foraging habitat and active nest burrows to development, (2) destruction of active nest burrows during operation and maintenance activities and (3) reduced burrow availability due to rodent control programs. To compensate for the loss of agricultural foraging habitat, agricultural reserves will be established outside of the urban limit lines of the Plan Participant cities. These reserve areas will also contribute to the conservation of Swainson's hawks. A portion of the reserve area will be preserved to provide suitable cover and breeding habitat for burrowing owls. Although existing rodent control programs within agricultural areas indirectly affect burrowing owls via the reduction of burrow availability, these programs are firmly established within current agricultural practices and the Solano HCP does not intend to alter or abolish these practices. Instead, artificial burrow complexes will be installed to provide additional suitable cover and breeding habitat and alleviate threats associated with occupying burrows along irrigation canals, levees, and drainage ditches.

Despite the creation of additional cover and breeding habitat, burrowing owls will continue to occupy burrows along irrigation canals, levees and drainage ditches. Rosenberg and Haley (2004) state that conservation of burrowing owls in the Imperial Valley will require collaboration among the Imperial

Irrigation District, state and federal agencies, and landowners, to develop strategies that allow maintenance of the irrigation system, while minimizing nest destruction. Similarly, burrowing owl conservation in northeastern Solano County will require collaboration between SCWA, and the three agricultural irrigation districts (SID, MPWD, and RD 2068) as the key entities whose operations affect owls. As such, the Operations and Maintenance Manual (Appendix C) contains avoidance and minimization measures for impacts to active burrowing owl nest burrows, further alleviating the threats associated with occupying burrows along irrigation canals, levees and drainage ditches.

To compensate for impacts to potential burrows during operation and maintenance activities, Plan Participants will install and maintain artificial burrows, within or adjacent to, existing irrigation management facilities (see Section 6.0). The number of artificial burrows to be installed will depend on the extent of impact from operation and maintenance activities, and baseline estimates of the number of breeding pairs in the agricultural portions of the Plan Area (see Section 7.0 for monitoring methods).

Although substantial effort will be devoted to conserving burrowing owls in agricultural portions of the County, additional conservation efforts will focus on promoting expansion of the existing owl population in association with preservation of valley floor grasslands, vernal pool complexes, and foothill grassland associations. Population expansion will be accomplished by providing increased nesting habitat and cover (i.e., burrows) through reducing ground squirrel control measures, installing artificial burrows, and minimizing vegetation height on Valley Floor Grassland, Vernal Pool, and Inner Coast Range Preserves/Reserves (see Sections 5.0 and 6.0). Long-term conservation focuses on re-establishing fossorial mammal populations within preserve lands; however, in instances where re-establishment of populations is not feasible due to rodent control concerns/good neighbor policies, and in the interim before fossorial mammal populations increase, artificial burrow systems will be an integral part of the Solano HCP conservation strategy. Artificial burrows have been shown to provide effective management tools for providing long-term nest sites for burrowing owls with a high rate of re-occupancy equal to or higher than natural burrows (Belthoff and Smith 2003).

In summary, the approach to conserving and expanding burrowing owl populations varies by Natural Community, but relies on maintaining suitable foraging habitat and increasing suitable cover and breeding habitat. In agricultural areas, small areas within reserves will be set aside to establish suitable cover and breeding habitat adjacent to suitable foraging habitat via the installation and maintenance of artificial burrow complexes. Avoidance and minimization measures will be implemented to reduce impacts to active burrowing owl nest burrows associated with routine operation and maintenance of irrigation canals, levees, and drainage ditches. In addition, Plan Participants will compensate for impacts to potential burrows through the installation of additional artificial burrow complexes within or adjacent to existing irrigation management facilities. In valley floor grasslands, vernal pool complexes, and foothill grassland habitat, conservation efforts to promote the expansion of burrowing owl populations will focus on providing increased nesting habitat and cover (i.e., burrows) through reducing ground squirrel control measures, installing artificial burrows, and minimizing vegetation height on preserves. The conservation approach combines conservation and management activities in agricultural, valley floor grassland, vernal pool, and foothill grassland habitats to expand existing owl populations.

Figure 4-1: Overview of the Conservation Analysis

Figure 4-2: Natural Community Boundaries

Figure 4-3: Key Corridors within the Plan Area

Figure 4-4: Rarity Weighted Richness Map of Covered Species and Special Management Species within the Plan Area

Figure 4-5: Distribution of Playa Pools and Vernal Pool Critical Habitat

Figure 4-6: Vernal Pool Disturbance Results, Barriers and Development

Figure 4-7: Contra Costa Goldfield Areas

Figure 4-8: California Tiger Salamander Known and Potential Range

Figure 4-9: Vernal Pool Conservation Areas

Figure 4-10: FRAP Vegetation Data, Barriers and Development

Figure 4-11: Priority Drainages and Associated Watershed

Figure 4-12: Percent of Development within Each Watershed/Sub watershed

Figure 4-13: Percent of Irrigated Agriculture within Each Watershed/Sub watershed

Figure 4-14: Callippe Silverspot Butterfly Conservation Areas

Figure 4-15: California Red-Legged Frog Conservation Area

Figure 4-16: California Red-Legged Frog Potential Breeding and Hydration Habitat

Figure 4-17: Location of Major Riparian Vegetation Stands Within the Plan Area

Figure 4-18: Covered Species, Special Management Species, and Streams

Figure 4-19: Giant Garter Snake Conservation Areas

Figure 4-20: Suisun Marsh Protection Plan Map and Suisun Tidal Wetland Restoration Projects

Figure 4-21: Coastal Marsh Conservation Areas and Designated Critical Habitat for associated Covered Species.

Figure 4-22: Swainson's Hawk Conservation Areas

Figure 4-23: Burrowing Owl Conservation Areas

Figure 4-24: Conservation Analysis

Figure 4-25: Vegetation Category by Conservation Class

Figure 4-26: Relationship Between Habitat Area and Number of Species

Figure 4-27: Vernal Pool Potential Reserve Areas

Figure 4-28: Swainson's Hawk Potential Reserve Areas

**Table 4-1: Covered Species and Special Management Species and Natural Community Associations**

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**Table 4-2: Valley Floor Grassland and Vernal Pool Associated Covered and Special Management Species**

**Table 4-6: Impaired Waterways within the Plan Area**

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**Table 4-8: Definitions of distribution types found within the Solano HCP Plan Area**

**Table 4-9: Conservation Targets for Natural Communities, Vegetation Types and Covered Species**