Chapter 5

Conservation Strategy

This excerpt showcases the goals and objectives of this HCP. To view the complete HCP, please visit this website:
http://www.co.contra-costa.ca.us/depart/cd/water/HCP/index.html

5.1 Summary of Conservation Strategy

This chapter describes the creation and management of the Preserve System. These actions include land acquisition, habitat enhancement, restoration, creation, and species population enhancement[1]. The conservation strategy is designed to create a fully functioning Preserve System that will accomplish the following.

- Preserve approximately 23,500 acres of land under the initial urban development area (range = 20,950–26,350 acres) or approximately 30,000 acres of land under the maximum urban development area (range = 25,850–33,950 acres) for the benefit of covered species, natural communities, biological diversity, and ecosystem function.
- Preserve major habitat connections linking existing and future protected private and public lands.
- Manage habitats to enhance populations of covered species and maintain ecosystem processes.
- Compensate for habitat loss by restoring or creating approximately 424–586 acres (under the initial or maximum urban development areas, respectively) of specific habitats and land-cover types.
- This conservation strategy will be implemented to protect and recover listed covered species in the inventory area and help avoid the listing of nonlisted covered species by protecting and, where appropriate, enhancing their populations. The conservation strategy is a program of conservation

[1] Habitat enhancement is defined as the improvement of an existing degraded community; habitat restoration is defined as the establishment of a vegetation community in an area that historically supported it, but no longer does because of the loss of one or more required ecological factors; habitat creation is defined as the creation of a habitat in an area that previously did not support it; see below for more detailed explanations. Population enhancement is defined as an improvement in the probability of long-term persistence of a population, through increases in population size, decreases in mortality, increases in reproduction, or other vital rates that affect population persistence.

measures[2] that, when implemented in concert, will achieve the biological goals and objectives of this Plan (Table 5-1).

- The heart of the conservation strategy is a system of new preserves linked to existing protected lands to form a network of protected areas outside the area where new urban growth will be covered under the HCP/NCCP. In addition to supporting ecosystem processes, habitat, and species, the preserves will also support other uses such as recreation, grazing, and crop production, as long as these uses are compatible with the biological goals and objectives of the HCP/NCCP.

The conservation strategy combines conservation measures at three ecological scales: landscape, natural community (or habitat), and species. Landscape-level conservation measures will be applied on a geographically broad scale (i.e., the inventory area) to achieve multiple goals and objectives. These measures relate to overall design and assembly of the Preserve System and are structured to benefit all natural communities and covered species, as well as to foster the conservation of biodiversity. Landscape-level measures address such parameters as preserve location, size, shape, composition, and connectivity; and ecological processes. These landscape-level measures are determined by the spatial needs of vegetation communities and associated species and the management activities necessary to maintain a well-functioning Preserve System.

Community-level measures apply to each natural community and include such parameters as vegetation management, habitat restoration, enhancement of ecosystem function, control of exotics, and increasing prey abundance. These community-level measures are determined by the habitat needs of covered species and by actions required to conserve vegetation communities. Measures at this level will conserve most covered species indirectly through conservation of their habitats.

However, some covered species will also require direct (i.e., not habitat-related) population management and population augmentation. Species-level measures employed in these cases will provide additional conservation tailored specifically to each covered species that requires it at the individual or population level. These actions augment the landscape-level and community-level measures.

5.2 Methods

5.2.1 Approach to the Conservation Strategy

The conservation strategy was designed using a multi-scale approach in accordance with principles of conservation biology. Landscape-level elements of the strategy (landscape-level conservation measures) were developed to encompass diverse vegetation communities and the spatial requirements of wide-

[2] Conservation measures are defined broadly as specific actions taken to avoid or minimize take, compensate for loss of habitat, or provide for the conservation of covered species.

ranging covered species. Community-level measures address, primarily, the enhancement, restoration and management of vegetation and species habitat. Species-level measures address the remaining needs of covered species for protection of individuals and populations. Species-level measures were developed only when landscape- and community-level measures were not sufficient to address the conservation needs of the species. In other words, if full protection was achieved through the preservation and management of landscape and natural-community attributes, species-level conservation measures were not needed.

The conservation strategy was designed to meet the regulatory requirements of ESA, NCCPA, Clean Water Act Section 404, and Section 1602 of the California Fish and Game Code (see discussion in Chapter 1). The conservation strategy provides mitigation for impacts on covered species based on species and habitat needs (see Appendix D for species profiles and models of species habitat). The conservation strategy also provides mitigation for loss of functions resulting from impacts on waters of the United States and waters of the State.

To meet the NCCPA permit standards, the conservation strategy contributes to species recovery and the prevention of listing of nonlisted species through the protection, restoration, and enhancement of species habitat. The conservation strategy also achieves the following objectives pursuant to the NCCPA (Section 2820)

- Conserves, restores, and provides for the management of representative natural and semi-natural[3] landscapes.
- Establishes preserves that provide conservation of covered species within the inventory area and linkages to adjacent habitat outside the inventory area.
- Protects and maintains habitat areas that are large enough to support sustainable populations of covered species.
- Incorporates a range of environmental gradients and high habitat diversity to provide for shifting species distributions due to changing circumstances.
- Sustains the effective movement and interchange of organisms between habitat areas in a manner that maintains the ecological integrity of the Preserve System.

The conservation strategy is based on the best scientific data available at the time of its preparation and takes into account the limitations of the baseline data available for the inventory area (see Chapter 3).

Sections describing the conservation measures also provide biological goals and objectives to be achieved and principles to be followed. In most cases, these measures prescribe general techniques to be used because specificity will depend on the final configuration, location, and site conditions of the preserves. For

[3] A seminatural landscape is defined as one that is disturbed by human activity but still provides important habitat for a variety of native species.

example, enhancing grassland as habitat for covered species may require seasonal livestock grazing in one area and a combination of prescribed burning and livestock grazing in another area, depending on the density of exotic grasses and herbs and the depth of dead plant material, or thatch (see Conservation Measure 2.4). The conservation measures have been designed to provide flexibility for future land managers to implement specific techniques on the ground that are best suited to site conditions.

Implementation of most measures will require the preparation of site-specific implementation documents (e.g., preserve management plans, plans and specifications for wetland creation). These plans will be prepared during HCP/NCCP implementation after land is acquired and specific restoration and management needs are determined. Preserve management plans are intended to guide activities within a preserve. In some cases, management documents will be prepared for the entire Preserve System (e.g., recreation management, exotic plant management). A framework management plan is included in this HCP/NCCP (see the Conservation Measures below). Preserve management plans will be completed within 1 year of acquisition of individual preserve sites. All conservation measures will be implemented using an adaptive management approach (see Chapter 7, *Monitoring and Adaptive Management Program*).

The conservation strategy relies on several types of conservation measures:

- Avoidance and minimization.
- Habitat preservation.
- Habitat enhancement.
- Habitat restoration.
- Habitat creation.
- Population enhancement.

Each of these types of conservation measures is defined below. The relationship of the type of conservation measure to conservation scale (i.e., landscape-level, community-level, or species-level) is shown in Table 5-2.

5.2.2 Biological Goals and Objectives

The conservation strategy is designed to achieve the biological goals and objectives established for each natural community and the covered species that each community supports. Goals are broad, guiding principles based on the conservation needs of the resources. Biological objectives are expressed as conservation targets or actions. Objectives are measurable and achievable within a given time frame; they clearly state a desired result and will collectively achieve the biological goals.

Biological goals for covered species are required by USFWS's *5-Point Policy* to be included in HCPs (65 FR 35242, June 1, 2000). All the biological goals and objectives on which this Plan is based are presented in Table 5-1. The biological goals are provided for context below. They were developed using several sources:

- Ecological data from species profiles (Appendix D) and natural community descriptions (Chapter 3),
- Federal recovery plans for covered species,
- Critical habitat rules for covered species,
- Species-habitat models developed for 21 covered species,
- Input from resource specialists including staff from CDFG and USFWS, and
- Documentation of ongoing resource management in the inventory area (e.g., management and monitoring in the Los Vaqueros Watershed and in EBRPD preserves).

Biological objectives are meant to be clear, succinct, and measurable. As a whole, they are designed to articulate the broad, long-term vision of species and community conservation in the Preserve System. The conservation measures in this chapter contain detailed information on all aspects of preserve management. They describe the biological goals and objectives and provide a strategy for how the goals and objectives will be achieved. It is expected that many of the details of the conservation measures will be modified during Plan implementation through the monitoring and adaptive management program while goals and objectives will remain relatively static.

The biological goals and objectives in Table 5-1 are organized by natural community type and by scale (natural community-level and species-level). Covered species are grouped according to the natural community with which they are most strongly associated. For the most part, the biological goals and objectives for covered species are addressed through the goals and objectives for the natural communities with which species are associated. In cases where all the biological goals and objectives for covered species were addressed within the context of the natural community, no additional species-specific goals were needed. The conservation measures in Chapter 5 that were designed to achieve each objective are shown in Table 5-1; one conservation measure may help achieve multiple objectives.

All goals are listed below by natural community type. Goals and objectives that guide specific conservation measures are also listed throughout this chapter with the conservation measure.

Wetlands and Ponds

Natural Community-Level Goals

- Preserve wetlands and ponds in the inventory area
- Maintain and enhance hydro-geomorphic and ecological function of wetlands and ponds to promote covered species, native biological diversity, and habitat heterogeneity
- Restore wetlands and create ponds in Preserve System to compensate for permanent loss of these habitats
- Restore wetlands and create ponds in the Preserve System to contribute to recovery of covered species

Species-Level Goals

- Enhance habitat for tricolored blackbird in the Preserve System
- Compensate for temporary and permanent loss of giant garter snake habitat
- Maintain or increase the population and distribution of western pond turtle
- Compensate for loss of occupied covered shrimp habitat
- Protect populations of adobe navarretia within wetlands

Grassland

Natural Community-Level Goals

- Preserve sufficient habitat in the inventory area to maintain viable populations of grassland-dependent covered species
- Enhance grassland to promote native biological diversity and habitat heterogeneity
- Increase availability of burrows within grassland for San Joaquin kit fox, California tiger salamander, California red-legged frog, and western burrowing owl

Species-Level Goals

- Preserve the most important movement routes and core habitat for San Joaquin kit fox
- Increase the prey base for San Joaquin kit fox
- Maintain or increase population size and distribution of Townsend's western big-eared bat in the Preserve System

- Maintain or increase population size and distribution of golden eagles in the inventory area
- Increase population size and distribution of western burrowing owl
- Protect and maintain populations of silvery legless lizard
- Protect in the Preserve System at least 11 occurrences of grassland-dependent covered plants
- Enhance populations of grassland-dependent covered plants

Oak Woodland

Natural Community-Level Goals

- Preserve oak woodland and oak savanna in the inventory area
- Maintain the current canopy coverage of oaks and other over-story trees within oak woodland and oak savanna land-cover types
- Enhance oak woodland and oak savanna to promote biological diversity and habitat heterogeneity
- Restore oak savanna to compensate for its loss from covered activities

Species-Level Goals

- Protect populations of showy madia within oak woodland

Chaparral/Scrub

Natural Community-Level Goals

- Preserve chaparral/scrub in the inventory area
- Enhance chaparral to promote native biological diversity and habitat heterogeneity

Species-Level Goals

- Contribute substantially to the recovery of Alameda whipsnake in the inventory area by protecting and enhancing chaparral/scrub
- Protect in the Preserve System at least eight occurrences of chaparral-dependent covered plants

Riparian Woodland/Scrub

Natural Community-Level Goals

- Preserve streams and riparian woodland /scrub in the inventory area
- Enhance riparian woodland/scrub to promote native biological diversity and habitat heterogeneity
- Maintain and enhance instream aquatic habitat for covered species and native fish
- Restore streams and riparian woodland/scrub

Species-Level Goals

- Maintain or increase population size and distribution of Swainson's hawk in the inventory area
- Protect, maintain, or increase populations of foothill yellow-legged frog

Avoidance and Minimization Measures

As required by ESA, the conservation strategy includes measures to avoid and minimize take of covered species. The primary focus of these avoidance and minimization measures is to avoid and minimize take of individuals within the permit area. The intent of these measures is, in part (and when possible), to encourage individuals of covered wildlife species within the permit area to avoid or escape project construction zones. Populations of covered plant populations will be avoided when adequate conservation of these species is not available within HCP/NCCP preserves. Impacts will also be minimized by designing development projects adjacent to the HCP/NCCP Preserve System in ways that reduce their impacts on covered species and habitats.

The permit area excludes most high-quality habitat for covered species and biological diversity. This exclusion eliminates the need to avoid or minimize impacts on large tracts of habitat within the permit area. Instead, impacts on low-quality habitat for covered species will be allowed under the Plan. Habitat preservation and enhancement will be concentrated outside the permit area within the high-quality habitat of the proposed HCP/NCCP Preserve System. Avoidance and minimization measures at the landscape level are therefore built into the Plan. Avoidance and minimization measures that apply to all covered activities (i.e., those at the community and species levels) are described in Chapter 6.

Land Preservation

Land preservation—in fee title or through establishment of conservation easements to create the HCP/NCCP Preserve System—is the foundation for conservation in this conservation strategy. In areas with active cropland or irrigated pasture, emphasis will be given to acquiring conservation easements on land suitable for restoration of riparian woodland/scrub. Outside active cropland or irrigated pasture, emphasis will be given to acquiring property in fee title to ensure full protection of resource values and land uses that are compatible with HCP/NCCP biological goals and objectives.

Preserve Design Process

The process for delineating and prioritizing land for acquisition corresponds to the scalar approach of the conservation measures (landscape, habitat, species). Firstly, consideration was given to large, core preserves that could accommodate major vegetation communities and covered species with large geographical ranges and specific habitat needs. Linkages were also considered so that habitat connectivity goals and objectives could be met. Next, the conservation of rare vegetation communities (e.g., alkali grassland) was considered. Finally, the conservation of species with small ranges was considered. For resources not protected by the core preserves or the habitat linkages, smaller, "satellite" preserves are proposed when necessary to protect isolated but important resources such as populations of covered plants and rare vegetation communities. The first maps of the preserve considered biological goals and objectives and maximized conservation benefit with the minimum amount of land. The second iteration of the maps took into account relevant land use and broad financial considerations. For example, areas with larger parcel sizes were selected over areas with very small parcels, all else being equal, due to the higher per-acre cost of small parcels. Areas without extensive rural development (e.g., along Morgan Territory Road) were favored over areas with such development, all else being equal, due to the habitat incursions and edge effects around rural development.

The independent Science Advisors and stakeholders provided early feedback on draft preserve design principles and the preliminary preserve design process. Their valuable input was incorporated into the conservation strategy presented here. The important results of the San Francisco Bay Area Gap Analysis project (Wild 2002) were also considered. Although that study was conducted using an older and much coarser dataset, it provided a wider regional context and established important priorities for conservation in the area. The six vegetative communities listed below were identified as being underrepresented in protected status in the San Francisco Bay Area (Wild 2002) and will receive substantial protection by this Plan:

- Coastal and valley freshwater marsh (a component of wetlands in this Plan).
- Great Valley cottonwood riparian forest (equivalent to riparian woodland in this Plan).

- Coast live oak woodland (a component of oak woodland in this Plan).
- Blue oak woodland (a component of oak savanna and oak woodland in this Plan).
- Nonnative grassland (equivalent to grassland in this Plan).
- Diablan sage scrub (equivalent to chaparral/scrub in this Plan).

Preserve Design Principles

The preserve design process utilized scientifically accepted tenets of conservation biology in concert with the best available biological data (Noss et al. 1997). Information on species (e.g., population biology, genetics, distribution, life history characteristics) and information on habitats (e.g., distribution, composition, ecological functions) informed the preserve design process. Relevant ecological data for covered species are summarized in the species profiles in Appendix D. Note that detailed biological data are lacking for many of the covered species. The Plan includes funding for research into key management questions that will fill some of these data gaps (see Chapter 6, *Conditions on Covered Activities*, and 8, *Plan Implementation*, and 9, *Funding*).

To be successful, a preserve system must be designed in consideration of multiple ecologically relevant spatial scales. Small- and medium-scale considerations will be driven by the needs of covered species and natural communities. For example, at a small scale, a preserve system must contain the microhabitats necessary for target species (e.g., covered species) to survive. At a medium scale, habitat patches must be large enough to support populations or important portions of populations of covered species and the seasonal movement of species (e.g., aquatic habitat for winter breeding of amphibians and upland habitat for their aestivation [summer hibernation]). At a larger scale, preserves must be linked to allow movement of wide-ranging species for genetic exchange and for recolonization following local extirpation. At the largest scale (landscape or regional), preserves must be able to support ecological functions (e.g., watershed functions, natural disturbance regimes) and conserve regional biodiversity within a matrix of urban development, agricultural land, and other land use features. Larger-scale issues will be guided by the conservation principles for preserve design, landscape-level ecological functions, biological goals for natural communities, and biological goals for wide-ranging covered species.

The following principles of conservation biology (Soule and Wilcox 1980; Soule 1986; Primack 1993; Meffe and Carroll 1997; Noss et al. 1997) were used to guide the design criteria for the Preserve System and will be used to guide the assembly of the Preserve System during implementation.

- **Maximize Size.** The Preserve System should be as large as possible within funding and management limits. It must be large enough to mitigate impacts of covered activities and contribute to the recovery of covered species in the

Plan area. A large Preserve System is important to ensure viable populations or portion of populations of covered species, to maximize protection of species sensitive to disturbances from adjacent land use, and to maximize the protection of biodiversity. Large preserves tend to support more species for longer periods of time than small preserves. Large preserves are also generally easier to manage on a per-acre basis because, for example, a large preserve reduces conflicts that may arise when managing for covered species with very different habitat requirements. Large preserves also better allow for large-scale management treatments such as prescribed burning and grazing and the maintenance of natural disturbance regimes such as flooding.

- **Preserve the Highest-Quality Communities.** The Preserve System should preserve the highest-quality natural communities and habitat for covered species in the inventory area. *Highest quality* is defined using various parameters (many of which are listed below) and differs according to community type, but highest quality habitats are frequently characterized by a high abundance of native species and few roads, trails, or other human disturbances. Degraded communities may need to be preserved as well to capture unique habitats or populations of covered species, to link preserve areas together, or to provide opportunities for habitat restoration required by this Plan.
- **Link Preserves.** The Preserve System should link existing and proposed preserves inside and outside the inventory area to maximize the ability of organisms to move between preserves; facilitate exchange of genetic material, species migration, dispersal, and colonization; and increase the integrity of the network of preserves (e.g., reducing the extent of preserve edge that is in contact with adjacent land uses). Linking preserves may require acquisition of disturbed habitats that can be restored to facilitate better habitat and wildlife movement value. A single large preserve is generally better than several small, linked preserves of equal area in the context of maintaining viable populations of species. (In some cases, however, small and isolated preserves are necessary to protect isolated features or populations with high biological importance [e.g., covered plant species populations, unique or especially diverse land-cover types such as alkali wetlands and serpentine grassland/scrub]).
- **Buffer Urban Impacts.** The Preserve System should include buffer land within its boundaries. This comprises undeveloped land at the urban edge that ensures a fixed and adequate separation between urban development and natural communities. The purpose of this buffer land is to minimize indirect effects from urban development and to provide a zone for fuel load management while minimizing adverse effects on covered species and communities. The size of the buffer lands depends on site-specific conditions such as topography, the intensity of adjacent urban development, the natural community being separated from the development, the condition of the buffer lands, and whether covered species are or will be present on these lands.
- **Minimize Edge.** The Preserve System should share a minimum amount of edge (i.e., should have the greatest possible area-to-perimeter ratio) with non-

preserve land, especially urban development, to minimize the indirect effects of adjacent land uses on the preserve resources and to minimize management costs. For example, preserves should tend towards round or square configurations rather than long and narrow ones. In some cases, however, preserves with low area-to-perimeter ratios may be appropriate to protect linear features with high biological value, such as streams, riparian woodland, valley bottoms, or ridgelines essential to wildlife movement.

- **Fully Represent Environmental Gradients.** The Preserve System should include a range of contiguous environmental gradients (e.g., topography, elevation, soil types, geologic substrates, slopes, and aspects) to allow for shifting species distributions in response to catastrophic events (e.g., fire, prolonged drought) or anthropogenic change such as global warming.
- **Consider Watersheds.** The Preserve System should include, when possible, entire watersheds, subwatersheds, and headwater streams that are not already in protected status; this approach can help to maintain ecosystem function and aquatic habitat diversity.
- **Consider Full Ecological Diversity within Communities.** The Preserve System should include the full ecological diversity within natural communities in the inventory area (e.g., species composition, dominant species, physical and climatic factors) in order to maintain sufficient habitat diversity and species and population interactions.
- **Consider Management Needs.** Preserves should be manageable. That is, desired management treatments such as livestock grazing, prescribed burning, or exotic species control must be feasible on the preserve land. In general, larger preserves are easier to manage on a per-acre basis, but other factors, such as adjacent land uses and parcel configuration, must also be considered. Management needs may be driven by factors on or off site (e.g., adjacent land uses, watershed processes such as upstream erosion or ongoing contamination).

Requirements of Covered Species

The HCP/NCCP Preserve System is intended to preserve and in many cases enhance populations of covered species. The ecological information used to determine the needs of covered species is summarized in the species profiles (Appendix D) and in this chapter. The following principles that apply to all covered species were also used to design the Preserve System.

- **Protect Multiple Populations of Covered Species.** In order to maintain viable populations of covered species, multiple populations of covered species will need to be protected and linked through existing or new protected lands to reduce the risk of local extirpation and ensure the genetic connectivity of populations. This is especially important for species that may

function as metapopulations[4] or for species that naturally occur at low density or small population sizes.

- **Protect Higher-Quality Habitat for Covered Species.** HCP/NCCP preserves were designed to protect higher-quality habitat for covered species and allow some impacts to occur on lower-quality habitat.
- **Protect Suitable but Unoccupied Habitat for Covered Species.** Protecting suitable but unoccupied habitat for covered species allows for future shifts in population size and location in response to natural and anthropogenic environmental change.

Consistent with the preserve design approach described above, the needs of covered species were considered at the landscape and habitat levels, and then independently at the species level to ensure that each species' biological goals and objectives would be met.

Requirements of Key Covered Species

Early in the development of this Plan, it was recognized that two covered species, San Joaquin kit fox and Alameda whipsnake, would greatly influence the design of the Preserve System. San Joaquin kit fox exerts a substantial influence on the Preserve System design because of the species' extensive range and movement requirements. Alameda whipsnake is important because the inventory area contains several of the largest populations of this narrowly restricted species. This species is characterized by specialized habitat requirements in chaparral/scrub, and there is a need to link isolated patches of chaparral throughout the area. Linkages between patches of chaparral are needed to provide movement routes for Alameda whipsnake among isolated breeding sites.

All other covered species also have specialized and important habitat requirements that were considered in the overall Preserve System design. However, their habitats are either localized (e.g., alkali soils) or distributed relatively widely across the landscape (e.g., ponds), and their needs accordingly did not influence the preserve design to the same extent as the requirements of San Joaquin kit fox and Alameda whipsnake. To ensure that the Preserve System would satisfy the habitat needs of Alameda whipsnake and San Joaquin kit fox, the first step in the preserve design process was initiated with both species in mind. These species were not used as umbrella species[5] but as a starting point in the preserve design process.

[4] A *metapopulation* is a group of partially isolated populations belonging to the same species that are connected by pathways of immigration and emigration. Exchange of individuals occurs between such populations, enabling recolonization of sites from which the species has recently become extirpated (locally extinct).

[5] *Umbrella species* are species whose occupancy areas are large enough and whose habitat requirements are broad enough that, once protection is established, it will bring other species under that same protection (e.g., Lambeck 1997; Fleishman et al. 2000; Rubinoff 2001; DeNormandie and Edwards in press).

Acquisition of cultivated agriculture in Zone 6 is limited to 250 acres for several reasons. First, as of 2004, there has been little history in Zone 6 of successful purchase of conservation easements on irrigated agricultural land. Because landowners have had limited exposure to conservation easements, finding willing sellers is expected to be difficult. Second, in order to meeting biological goals and objectives, land acquired through conservation easements must be conditioned to prohibit conversion to vineyards or orchards. This limit on crop type will further reduce the pool of willing sellers in Zone 6. Lastly, the primary function for covered species of cropland and pasture in Zone 6 is as foraging habitat for Swainson's hawk. (Acquisition of cropland or pasture near Dutch Slough will also provide habitat and restoration opportunities for giant garter snake.) Approximately 6,000 acres of cropland and pasture is expected to be lost to covered activities during the permit term (Table 4-3). However, the vast majority of the remaining 18,782 acres of these land-cover types is already protected by strong zoning in Contra Costa County. For example, the entire approximately 6,000 acres of cropland in Subzone 6b is within the Agricultural Core designation in the County General Plan, which strictly limits development. Assuming much of this habitat remains cropland or pasture, it will remain foraging habitat for Swainson's hawk (some will also remain upland habitat for giant garter snake) whether or not the Implementing Entity acquires it. Acquisition of cropland and pasture in Zone 6 is focused on creating opportunities for riparian restoration to expand cottonwood and other riparian forest types that are very rare and underprotected in the San Francisco Bay Area (Wild 2002).

If conservation easements are used, these easements will require that all enrolled agricultural lands be managed to support new foraging habitat or to improve existing foraging habitat for tricolored blackbird, golden eagle, western burrowing owl, or Swainson's hawk. Management that will be required under the easements will be compatible with an ongoing economically viable agricultural operation. Agricultural conservation easements will be in perpetuity.

Conservation easements in Zone 6 are not subject to the Stay-Ahead provisions of the Plan in order to allow time for the Implementing Entity to develop relationships with landowners in this area and slowly assemble the agricultural conservation easements.

In the event that cropland or pasture cannot be acquired in Zone 6 or within the ULL along Marsh Creek to meet land acquisition requirements (e.g., due to a lack of willing sellers), a contingency is provided:

- Preservation of cropland or pasture in Zone 6 can be substituted for preservation of grassland habitat that is suitable foraging habitat for Swainson's hawk (see species habitat model in Appendix D for suitable habitat in Subzones 5a and 5c) on an acre-for-acre basis.
- Preservation of cropland or pasture in Zone 6 can also be substituted for preservation of riparian woodland/scrub at a 5:1 ratio (i.e., 5 acres of cropland preservation can be substituted for 1 acre of riparian woodland/scrub preservation).

- Cropland or pasture preservation in Zone 6 can also be substituted for riparian restoration at a ratio of 10:1.
- Riparian woodland/scrub preservation or restoration can only count toward this substitution if it occurs within the range of Swainson's hawk within the inventory area as mapped by the species model or based on the best available information.

The Implementing Entity will also acquire at least 100 acres (21%) of the alkali grassland in Zone 6 to preserve potential habitat for alkaline plants and to protect alkali sink scrub, a rare vegetation association (Table 5-11). The Implementing Entity will also acquire at least 20 acres of alkali wetland, which occurs primarily in Subzones 6d and 6e. The Implementing Entity will protect at least two occurrences of recurved larkspur in Subzone 5a or 6d to meet biological objectives for this species (Tables 5-1 and 5-20).

Acquisition under Maximum Urban Development Area. Land acquisition requirements for Zone 6 under the maximum urban development area are the same as those under the initial urban development area except that land acquisition requirements for cropland/pasture are increased to 400 acres (Table 5-11). Land acquisition requirements for alkali grassland and alkali wetland in Zone 6 increase to 300 and 40 acres, respectively.

Preservation of Habitat Continuity for San Joaquin Kit Fox

An important regional goal of this HCP/NCCP is to provide a viable connection for San Joaquin kit fox between the large block of public lands in and around the Los Vaqueros Watershed and Black Diamond Mines Regional Park. Because this habitat continuity spans several Zones (2, 4, and 5), a separate analysis was conducted to determine the needs of San Joaquin kit fox across the Zones. This analysis and the requirements to preserve habitat continuity across the inventory area for San Joaquin kit fox are presented below.

San Joaquin kit foxes occur in the Los Vaqueros Watershed and Black Diamond Mines Regional Park and are assumed to move regularly between them. This movement must continue in order to ensure a viable population in the area and to maintain kit foxes in Black Diamond Mines Park. There have been only two sightings of kit foxes between these areas; consequently, their movement patterns between these public lands are largely unknown.

Four potential movement routes or habitat linkages[14] are predicted for San Joaquin kit fox between Black Diamond Mines Regional Park and the Los Vaqueros Watershed (and adjacent public lands) (Figure 5-5). This prediction of movement routes is based on the land-cover mapping and habitat modeling conducted for this HCP/NCCP, verified sightings of kit foxes, topography, and field visits. All four routes are in Zones 2 and 4, and each is described below.

[14] "Movement habitat" is defined as areas though which San Joaquin fox will move but not remain long enough to establish dens, breed, or forage extensively. "Habitat linkages" are areas that provide important connections (i.e., support movement) and there is enough suitable habitat for San Joaquin kit fox to breed and forage.

until a recreation plan has been prepared and adopted for that site by the Implementing Entity, CDFG, and USFWS. The recreation plan will be revised as needed as the Preserve System expands. Formal evaluations and revisions must occur at least every 5 years until all preserve acquisition has been completed. Once the entire preserve system has been acquired, the recreation plan will be reviewed for effectiveness (i.e., compatibility with the preservation of vegetation communities, covered species, and biological diversity) at least every 5 years.

Rationale

Recreational uses may have impacts on biological resources, including vegetation communities and covered species. However, the societal benefit of recreational uses within limited areas of the preserves justifies accepting some minimal level of impact on these resources. Allowing limited recreational use within preserves will broaden the appeal of this HCP/NCCP; such access can be an important tool in educating the public about the value of protecting and properly managing biological resources. An educated and supportive public is essential for securing additional funds for HCP/NCCP implementation.

Recreational users who understand the sensitivity of the resources in the preserves may help patrol the preserves and provide valuable assistance to preserve managers in ensuring that users follow the rules. Responsible users can also become volunteers to assist preserve managers in maintaining preserves (e.g., trail maintenance) and in complying with the terms of the HCP/NCCP (e.g., covered species monitoring and habitat stewardship). This involvement will reduce the overall cost of HCP/NCCP implementation.

Recreation within HCP/NCCP preserves is limited to low-intensity uses because of the primary function of the preserves as habitat for covered species. A wide variety of recreational opportunities are already available in rural parks throughout the inventory area; these include Black Diamond Mines, Round Valley, and Morgan Territory Regional Preserves; Mount Diablo State Park; and the Los Vaqueros Watershed. These parks and open spaces total over 35,000 acres within the inventory area. Any funds generated as a result of recreational activities will be invested in the preserve system.

5.3.2 Natural Community–Level Conservation Measures

Multiple Communities

Conservation Measure 2.1. Enhance, Restore, and Create Land-Cover Types and Species Habitat

Enhancement is required for all land-cover types on all acreage, where appropriate, to improve the function of natural communities, maintain or increase

populations of covered species, and promote native biological diversity within the preserves. Enhancement will be accomplished through the conservation measures listed in Table 5-18.

Restoration or creation is also required for impacts on some land-cover types to ensure no net loss of these land-cover types, to replace the functions of natural communities and species habitat lost to covered activities, and to contribute to the recovery of covered species. These requirements are in addition to the preservation requirements described in Conservation Measure 1.1. Table 5-18 lists the type of compensation that is required for each land-cover type. An important goal of enhancement, restoration, and creation is to create self-sustaining natural systems with minimal artificial inputs (e.g., supplemental water, pesticides, exclusion fencing, artificial perches and burrows).

Land-cover restoration or creation will be conducted for land-cover types that have been lost or seriously degraded due to past activities, and for which restoration is feasible and success has been demonstrated elsewhere: oak savanna, riparian woodland/scrub, wetlands, and streams (Table 5-18). Where restoration is infeasible, in-kind or out-of-kind/like-function creation of land-cover types is required.

Restoration and creation will be accomplished in two ways. The Implementing Entity will be required to compensate for impacts of covered activities on specific land-cover types through either restoration or creation at the ratios listed in Tables 5-16 or 5-17 for the initial urban development area or maximum urban development area, respectively. These ratios were determined on the basis of current regulatory standards for compensation and the likelihood and time requirements of successful restoration. For example, oak savanna, riparian woodland/scrub, perennial wetlands, and ponds have ratios of 1:1 because replacement of these land-cover types is relatively simple, techniques are reliable, and there is a high likelihood of success. Other factors were considered such as required preservation ratios and restoration for species recovery (see below). Ratios for alkali wetland and seasonal wetland are 2:1 because these land-cover types are rare in the inventory area, so compensation should be undertaken at a higher ratio to offset losses. Required restoration ratios for all wetland land-cover types and oak savanna will apply at the end of the vegetation-establishment period (i.e., compliance with required ratios will be assessed once restoration has met its success criteria, see Table 5-2).

The actual acreage of compensation will be determined through planning surveys conducted at project sites to determine the actual extent of impacts (see Chapter 6, *Conditions on Covered Activities*). The Implementing Entity will also restore or create land-cover types to contribute to the recovery of covered species. Tables 5-16 and 5-17 list the acreage requirements for recovery contributions that are required in addition to compensatory habitat restoration and creation.

Land for the preserve system will be acquired that includes areas suitable for restoration or creation as specified in the Conservation Strategy. Restoration and creation will be designed within preserves to meet the goals and objectives for

each relevant habitat and covered species. Land-cover restoration and creation will increase habitat for specific life history requirements of covered species. Sites selected for restoration will support soils and topography suitable for restoring the target land-cover type that was historically present at the site. Restoration and creation will be designed and constructed to avoid or minimize direct or indirect impacts on existing functioning habitat for covered species.

All habitat enhancement activities will be conducted within HCP/NCCP preserves. Restoration and creation of habitat will also be conducted in HCP/NCCP preserves except in rare instances. If no suitable sites are present or actions are not biologically practicable in HCP/NCCP preserves (e.g., because they may substantially adversely affect habitat for a covered species), then restoration and creation may be conducted on lands in the inventory area permanently protected for conservation (e.g., owned by EBRPD, CDPR, CCWD, or a local land trust, or on a private mitigation bank[18]). Such habitat restoration and creation sites must be located in areas of existing protected lands that are managed consistently with HCP/NCCP Preserve System principles. To allow restoration to occur on lands outside the HCP/NCCP Preserve System, the Implementing Entity will enter into a binding agreement with the landowner ensuring that management of the area surrounding the restoration site will continue to be consistent with the HCP/NCCP. The Implementing Entity may share management responsibilities of the site and must maintain access in order to monitor restoration development.

Habitat restoration and creation conducted on existing conservation lands will be funded and conducted by the Implementing Entity. Responsibilities for ongoing management and monitoring of these sites will be determined on a case-by-case basis but will always be funded by the Implementing Entity. Every effort will be made to find suitable restoration or creation sites in HCP/NCCP preserves.

Restoration or creation conducted as mitigation for impacts must stay ahead of impacts, just as land acquisition must stay ahead of impacts (see Conservation Measure 1.1). Restoration or creation that contributes to recovery effects can be implemented at any time. Restoration or creation conducted to mitigate impacts must be initiated so that mitigation requirements are ahead of impacts on each land-cover type by at least 5%. For example, if after 5 years, impacts on oak savanna total 20 acres, the Implementing Entity must initiate at least 22 acres of oak savanna restoration. If restoration or creation cannot keep pace with impacts, then impacts cannot be permitted under the HCP/NCCP.

As described in the preserve assembly measure (Conservation Measure 1.1), a major focus in Zone 6 is acquisition of land along Marsh Creek, Kellogg Creek, or adjacent to Dutch Slough to provide opportunities for restoration of riparian woodland/scrub. Most of the riparian woodland/scrub restoration required by this Plan is expected to occur on these sites (see Figures 5-2 and 5-3). The Implementing Entity must also consider investing habitat restoration effort on

[18] See Chapter 8, *Plan Implementation*, for more details on when private mitigation banks can be used for credit under the HCP/NCCP.

Dutch Slough. According to preliminary assessments, there are opportunities for extensive restoration on the site for wetland and upland habitat consistent with the restoration requirements of this Plan (see Conservation Measures 2.1, 2.3, 2.7, and 2.10) including seasonal marsh and floodplain (137 acres), mixed riparian-oak woodland (82 acres), and emergent marsh (224 acres) (California Coastal Conservancy 2002). The Implementing Entity could contribute significantly to the goals of the Dutch Slough project and help meet HCP/NCCP requirements for restoration. Several covered species have been observed on or near Dutch Slough, including Swainson's hawk, western pond turtle, and silvery legless lizard; the site also provides suitable habitat for giant garter snake. Restoration at this site could enhance habitat for these covered species.

Restoration procedures and guidelines for specific vegetation communities are found in the conservation measures listed in Table 5-18. Restoration actions are covered activities because some of the restoration techniques are expected to have temporary adverse impacts on covered species and may result in take of these species. Mitigation for these impacts is included in the conservation strategy.

Almost all restoration or creation projects within the Preserve System are expected to be completed (i.e., reach project success criteria) within the permit term (30 years) because

- almost all restoration or creation is linked to impacts of covered activities,
- most impacts are expected within the first half of the permit term,
- restoration projects must be started before impacts occur, and
- most restoration projects are expected to reach success criteria within 5 years of construction.

Oak savanna restoration may take up to 50 years to reach maturity, which is well outside the permit term. However, no covered species are dependent on oak trees, or the restoration of this land cover type. Instead, oak savanna restoration is included to comply with NCCP requirements for natural communities. See Conservation Measure 2.6 for more details.

Wetlands and Ponds

Conservation Measure 2.2. Manage Wetlands and Ponds

Wetlands and ponds within HCP/NCCP preserves will be managed to increase hydrogeomorphic and ecological functions, and improve habitat for covered species (see Conservation Measures 2.9 and 2.10 for measures related to streams and riparian woodland/scrub). Management techniques will be applied to wetlands within the preserves. Conservation measures to be applied will depend on the type, location, extent, and condition of the wetlands as determined by the wetland delineation conducted in accordance with Conservation Measures set

forth in Chapter 6, *Conditions on Covered Activities*. Wetland enhancement measures must be designed for specific wetland types (i.e., hydrogeomorphic context) and, in some cases, for specific sites. As described below, the success of various techniques depends on the wetland type and the site conditions under which they are applied. Wetlands that are highly degraded may require more intensive management. Wetlands already in good condition (e.g., that support populations of covered species) may require little or no enhancement measures. The biological goal and objectives are as follows:

Goal: Maintain and enhance hydrogeomorphic and ecological function of wetlands and ponds to promote covered species, native biological diversity, and habitat heterogeneity

- **Maintain or increase native emergent vegetation, where appropriate**
- **Reduce sediment deposition and transport where appropriate**
- **Maintain or increase wetland and pond capacity and water duration as appropriate**
- **Maintain or increase flows to and connectivity among wetlands and wetland complexes as appropriate**
- **Eliminate or reduce non-native animals**
- **Eliminate or reduce exotic plants**
- **Maintain or enhance upland habitat adjacent to wetlands and ponds to support the life-history requirements of wetland-dependent covered species**

Establish Baseline Conditions

Wetland delineations will be required in all impact areas in order to quantify the impacts on jurisdictional wetlands. Similarly, wetland delineations are required within all preserves in order to demonstrate that the compensation requirements of the HCP/NCCP, as well as those of the Regional General Permit that will be developed from it, are being met. Wetlands within preserves will also be surveyed to determine whether they support covered aquatic or amphibian species or have the potential to support these species. In addition, stockponds will be assessed to determine if they maintain water in typical rainfall years for periods sufficient to support aquatic life stages of California tiger salamander or California red-legged frog.

Guidelines for and Uncertainties in Applying Management Techniques

The techniques listed below may be employed to enhance and manage wetlands; however, this is not an exhaustive list.

- Where appropriate, minimize grazing pressure to reduce trampling of vegetation, soil compaction, development of "cow contours," and bank destabilization. .Livestock surrounding wetlands and ponds should be managed to maintain and enhance upland breeding, aestivation, and hibernation habitat for wetland- and pond-dependent species such as

If no opportunities exist for in-kind compensation, it is estimated that the Implementing Entity will restore an additional 37 acres of riparian woodland/scrub with the maximum urban development area in existing streams and channels that historically supported riparian woodland/scrub vegetation (in addition to riparian vegetation restored to compensate for losses of riparian habitat) (Table 5-17). Lost sloughs or channels may be difficult to recreate because of the constraints of existing agricultural operations in Zone 6 and the difficulty of creating the topographic and hydrologic conditions to support them. By replacing lost sloughs and channels with riparian woodland/scrub, there will be a net increase in high-quality habitat for covered species and biological diversity. Any sloughs or channels supporting giant garter snake will be addressed in accordance with Conservation Measure 3.6.

Open water. Impacts on open water (aquatic land cover) will be compensated by the creation of additional ponds at a ratio of 1:1 to support breeding habitat for California red-legged frog, California tiger salamander, western pond turtle, and tricolored blackbird. Restoration or creation of large bodies of open water is not required because this land-cover type provides limited values to wildlife. Under the maximum urban development area, it is estimated that the Implementing Entity will create 17 acres of additional ponds to offset open water impacts.

Grassland

Conservation Measure 2.4. Manage Grassland

Native grasslands will be enhanced in the preserves by using techniques tailored to the grassland type (i.e., the vegetation alliance) and the site. All stands of grasslands with at least 25% relative cover of native species (grasses or forbs) will be mapped within the preserves to identify areas suitable for special management practices to maintain and enhance the proportion of native grass cover. Each grassland stand will be classified to the alliance level according to the CNDDB vegetation classification scheme (California Natural Diversity Database 2002).

Grassland communities in the inventory area are complex and occur at all spatial scales. There is also uncertainty about the proper management regime necessary to maintain this complexity and enhance each grassland vegetation alliance. To determine the best management strategy, pilot studies will be initiated on small scales to determine the feasibility of enhancement activities on a larger scale. The pilot studies will utilize a research design that addresses management actions to promote native grassland species. The pilot studies will be conducted as part of the Monitoring and Adaptive Management Program (see Chapter 7).

If monitoring demonstrates that the treatments are effective at increasing the relative cover of native grasses and forbs, the preserve manager should evaluate whether these treatments can be applied to the entire stand of the grassland vegetation alliance to achieve enhancement objectives of grassland on a larger scale. In some cases, management regimes could be shifted in time, location, or intensity to achieve these objectives (or at least to partially achieve them). In

other cases, large-scale application of the techniques may not be feasible due to their environmental impacts or hazard risk. This evaluation must be done on a case-by-case basis in which the expected benefits of the techniques to grassland are weighed against the environmental impact, risk, and increased cost of applying the technique on a larger scale. The biological goal and objectives are as follows:

Goal: Enhance grassland to promote native biological diversity and habitat heterogeneity.

- **Increase the relative cover of native grasses and forbs in native grassland vegetation alliances and other grassland types**
- **Increase structural diversity by creating and maintaining a mosaic of grassland types and conditions**
- **Reduce the biomass, cover, and extent of exotic plants (i.e., non-native invasive plants) in the Preserve System**

Guidelines and Uncertainties in Applying Management Techniques

Techniques that could be used to enhance grassland include but are not limited to those listed below.

- Prescribed burning,
- Mowing and mulching,
- Supplemental seeding,
- Livestock grazing, including variation in timing, frequency, intensity, grazer,
- Raking,
- Herbicide application (herbicide application is not a covered activity under the ESA permit),
- Grazing exclusion ,
- Combination of techniques across different temporal or spatial scales.

Enhancing grasslands within HCP/NCCP preserves will likely require applying many of these management techniques simultaneously at different sites and on different scales in order to create a mosaic of grassland conditions. Applying different management techniques across different spatial and temporal scales will maximize habitat heterogeneity across the landscape and will tend to increase native biological and structural diversity (Fuhlendorf and Engle 2001). For example, the buildup of dead plant material, or thatch, has been implicated in the suppression of native annual forbs in unmanaged wet grasslands in California (Hayes and Holl 2003), but it may enhance annual forb cover in drier grasslands (Meyer and Schiffman 1999). Techniques to reduce thatch (e.g., livestock grazing, prescribed burning, raking) should be applied only where the treatment is expected to benefit native grassland species.

Managers must consider the impacts of management treatments on other covered species. For example, if burns occur within Alameda whipsnake habitat, burning in September, October, or November may be compatible with whipsnake protection goals (Jones & Stokes Associates 1992a; Swaim pers. comm.). Ongoing research within the inventory area includes experimental burns to determine the effects of this management tool on Alameda whipsnake (Swaim pers. comm.). Management treatments may affect covered plants in both positive and negative ways (Gillespie and Allen 2004), so it is important to monitor several life stages to determine the net effect of management actions.

Warm-season (late spring and fall) prescribed burning has been effective in some areas at increasing the cover of native species in grasslands and reducing the cover of exotic species (Menke 1992; Meyer and Schiffman 1999; Fehmi and Bartolome 2003; Gillespie and Allen 2004). Late fall (September–October) burning is recommended for native grassland enhancement plots on Los Vaqueros Watershed lands (Brady/LSA 1996, 1999).

Once native species cover is increased, repeated burning, or a combination of burning and mulching or grazing over several years, may be necessary to maintain the increased cover of native species (Parsons and Stohlgren 1989). Short-term winter grazing following burning may help to control exotic grasses as they germinate after winter rains (Brady/LSA 1999). Alternatively, mid-summer grazing may be effective because by then most native perennial grasses would be dormant and not substantially damaged by grazing. Herbicide application may be necessary in particularly heavy infestations of exotic plants (e.g., Transline herbicide is effective in controlling yellow star-thistle in the inventory area [Olson pers. comm.]; see also Conservation Measure 1.4).

Site conditions (both physical and biological) and land use history will be important in developing appropriate management techniques to attempt to enhance native grassland alliances (Hamilton et al. 2002). For example, in the Los Vaqueros Watershed, native grasslands occur primarily on steep north- or east-facing slopes where soil moisture tends to be higher (Jones & Stokes Associates 1989). Management strategy at these sites will differ from sites on more level topography and drier, south-facing slopes. Huntsinger et al. (1996) showed that different populations of purple needlegrass may respond differently to the same treatments of grazing or burning. Bunchgrass stands in areas that have been cultivated may require more intensive management than stands outside cultivated areas (Hamilton et al. 2002). Management techniques to increase the cover of native perennial grasses will likely be most successful in areas that already have a substantial proportion of native perennial grass cover.

Livestock grazing is an important management tool currently used in the inventory area on a regional scale by land management agencies (e.g., EBRPD) to enhance vegetation, and reduce the biomass and spread of exotic plants. Grazing is an important economic and cultural activity in the inventory area that can be consistent with good stewardship of grassland and oak woodland communities. In general, moderate livestock grazing can benefit many plants and animals, including covered species. After extensive fieldwork in the Los

Vaqueros Watershed, biologists have observed that many special-status wildlife species either benefit by grazing or are unaffected by it (Jones & Stokes Associates 1989, 1992a; Contra Costa Water District 1993; Brady & Associates 1996). For example, moderate intensities of livestock grazing tends to increase densities of California ground squirrels (Fitch 1948; Jones & Stokes 1992c), which in turn benefits San Joaquin kit fox, western burrowing owl, California tiger salamander, and California red-legged frog among other species.

The flora of the East Bay evolved under the influence of prehistoric herbivores, large herds of deer, elk, antelope, and other grazing animals. At present, livestock grazing utilizing cattle, sheep and goats can be useful as a vegetation-management tool to maintain and improve habitat conditions for resident plants and animals and to reduce fuel loads for wildfires. Animals have different preferences and abilities to be selective grazers and therefore have different impacts on vegetation. Sheep and goats are the most selective, followed by horses and then cattle. Management plans should take these differences into consideration. Livestock grazing may be compatible with the maintenance and even the enhancement of native plant communities, including some native grassland associations. For example, moderate grazing levels may help to maintain purple needlegrass (Menke 1992).

Experimental treatments to increase the cover of native species could include supplementing the seed rain of native forbs to increase their opportunities to establish and outcompete the exotic grasses and forbs (Seabloom et al. 2002). Any seed supplements in native grasslands must use locally derived genetic stock. To maximize the success of seed addition, pretreatment (e.g., burning 1 year prior to seeding to reduce weed seeds on the surface and in litter) may be required (Brady/LSA 1996). Recent research conducted on serpentine grasslands in Santa Barbara suggests that seedlings of California native forbs can be excellent competitors when enough seeds are present to overcome the dominance in the seed pool of the exotic grasses and forbs (Seabloom et al. 2002). In a 5-year experiment, burning or mowing had no effect on the abundance or the proportion of native forbs without seeding. Experimental treatments could include testing this approach by seeding grasslands with native and locally collected seeds within the preserves.

Grazing in certain native grassland communities, however, may be inappropriate or may need to be reduced to maintain or enhance these communities. For example, five approximately 0.2-acre grazing exclosures were established in 1991 in alkali vegetation communities and alkali scalds in the Los Vaqueros Watershed (Jones & Stokes 1992b). The results of this experiment suggest that alkali grasslands and meadows interspersed with barren scalds respond quickly to the exclusion of grazing through increases in native plant biomass, density, and species diversity.

Rationale

Native grassland vegetation alliances are expected to be found within the preserves, but these grasslands are expected to be degraded (i.e., low relative cover of native species) due to past or current land uses practices and the spread of nonnative plants. California native grasslands have been identified as one of

the most endangered ecosystems in the United States (Noss et al. 1995). Accordingly, their maintenance and enhancement within HCP/NCCP preserves should be a high priority.

Enhancing grasslands may benefit covered plants such as big tarweed, Mount Diablo fairy lantern, recurved larkspur, showy madia, Diablo helianthella, and Brewer's dwarf flax. Research on a rare plant endemic to the East Bay, large-flowered fiddleneck (*Amsinckia grandiflora*), has shown that native grasslands provide better habitat than grasslands dominated by exotic annual grasses (Carlsen et al. 2000).

Enhancement of native grassland alliances must be implemented using an experimental approach (i.e., adaptive management), because site-specific conditions of species composition, topography, and soils will determine which techniques will work best.

Conservation Measure 2.5. Manage Natural Burrow Availability and Prey Base in Grasslands

California ground squirrels provide burrows that provide substantial benefits to several covered species, including San Joaquin kit fox (den sites), western burrowing owl (nesting and roosting habitat), and California red-legged frog and California tiger salamander (upland burrows). Small mammals, particularly California ground squirrels, are important prey for San Joaquin kit fox, and are a component of the prey base for western burrowing owl, golden eagle, and Swainson's hawk. Preserved grasslands will be managed to enhance small mammal populations (e.g., voles, mice, rabbits). The biological goals and objectives are as follows:

Goal: Increase availability of burrows within grassland for San Joaquin kit fox, California tiger salamander, California red-legged frog, and western burrowing owl

- **Increase the number and distribution of California ground squirrel burrows**

Goal: Increase the prey base for San Joaquin kit fox

- **Increase California ground squirrel and other small mammal populations within suitable core habitat for San Joaquin kit fox**

Establish Baseline Conditions

On preserve lands where rodent control measures are being implemented, the Implementing Entity will conduct a baseline survey to estimate the distribution and abundance of ground squirrels. Follow-up monitoring will be conducted to determine the effect of removing control measures on ground squirrel abundance and distribution.

Guidelines for and Uncertainties in Applying Management Techniques

Management techniques that will be considered to achieve these objectives include the following:

- Livestock grazing,
- Eliminating or reducing rodent control in preserves,
- Creating debris piles or soil disturbance to encourage rodent colonization.

The Implementing Entity will minimize existing rodent control measures (e.g., poisoning, hunting, and trapping) in preserves. Minimizing existing ground squirrel control measures may be sufficient to increase squirrel populations in some areas. However, some rodent control measures will likely remain necessary in certain areas where dense rodent populations may compromise important infrastructure (e.g., pond berms, road embankments).

If ground squirrel populations do not increase using passive means, then active measures, such as creating soil or debris piles (while not promoting weed infestations), will be taken to encourage rodent use in the area. Where lands neighboring preserves require ground squirrel management to protect agricultural uses or public health, the Implementing Entity will establish a buffer zone in the preserve within which ground squirrel colonies will not be encouraged or may be controlled. The width of this buffer will be determined by the preserve manager in consultation with neighboring landowners and Implementing Entity scientists. The buffer width will depend on site conditions, the size and density of the local ground squirrel population, and the intensity of control methods used adjacent to the preserve. The use of rodenticides or other rodent control measures will be prohibited in preserves except as necessary to address adverse impacts on levees, road-beds, railroad-beds, pond berms, or other essential structures within or immediately adjacent to preserves.

Other ecological factors, in addition to the size and density of rodent populations, may limit the populations of covered species in the inventory area. For example, the population of San Joaquin kit fox in the inventory area may be limited by mortality from road kill, poisoning, coyote predation, or competition from nonnative red foxes (U.S. Fish and Wildlife Service 1998). However, there is evidence in other parts of the kit fox range that the abundance of prey affects reproductive success (Egoscue 1975; White and Ralls 1993). Although research to date suggests that prey abundance is important, a lack of studies in the northern part of the kit fox range contributes to uncertainty about the efficacy of this conservation measure in the preserves. Because of this uncertainty, adaptive management and research studies are required to understand factors controlling kit fox population and to improve management techniques.

Pilot studies of management methods that enhance the rodent prey base, and particularly the populations of ground squirrels, will be conducted through the Adaptive Management Program (see Chapter 7), and effective management

measures will be incorporated into grassland management actions (See Conservation Measures 1.2 and 2.4).

Rationale

This measure is intended to supplement other conservation measures to increase the population size of several covered wildlife species. Enhanced rodent populations will increase the prey base for San Joaquin kit fox and covered raptor species and will increase the availability of potential den sites for San Joaquin kit fox, nest and roost sites for western burrowing owl, and aestivation sites for California tiger salamander and California red-legged frog. Historically, measures such as hunting and rodenticides have been used extensively in the inventory area to control rodents and reduce conflicts with livestock. This has greatly decreased the populations of rodents, reducing prey availability for their predators. In 1975, California ground squirrel, which is the main prey item for San Joaquin kit fox in Contra Costa County, was severely reduced countywide after extensive rodent eradication efforts (Bell et al. 1994; U.S. Fish and Wildlife Service 1998). California ground squirrel populations have been increasing in Contra Costa County since then; however, the extent of their regional recovery may still limit San Joaquin kit fox and western burrowing owl presence and abundance in the eastern portion of the County (Orloff and Johnson pers. comms.).

Oak Woodland and Oak Savanna

Conservation Measure 2.6. Manage Oak Woodland and Oak Savanna

Protecting and enhancing the major vegetation and structural components of these communities (i.e., tree canopies, grassland understory, dead and downed wood) will benefit the important guilds of wildlife species that use the oak woodlands and oak savannas. The Implementing Entity is required to acquire 900 acres of oak woodland and oak savanna (Table 5-7 or 5-8). However, several thousand acres of oak woodland and savanna are expected to be included in the Preserve System (possibly as much as 9,000 acres) because this land cover type is found throughout the inventory area. The Implementing Entity will maintain or enhance oak savanna and oak woodlands within preserves through a process of assessment, factor analysis, active management, and long-term monitoring. The biological goals and objectives are as follows.

Goal: Maintain the current canopy coverage of oaks and other native overstory trees within oak woodland and oak savanna land-cover types

- **Ensure tree recruitment and age structure are adequate to replace lost trees and maintain canopy coverage**
- **Reduce competition between tree seedlings and other plants to enhance survival rates of tree seedlings and saplings**

Goal: Enhance oak woodland and oak savanna to promote biological diversity and habitat heterogeneity

- **Increase the proportion of native species in oak woodland and oak savanna understories**
- **Leave in place snags, dead trees, and downed wood**

Establish Baseline Conditions

Oak stands will be assessed in each preserve within 2 years of acquisition to identify factors that may be limiting ecological functions. Tree recruitment, percent canopy coverage and site-specific goals are discussed in Chapter 7 for the Oak Woodland natural community type. Oak stands in preserves will be evaluated in accordance with the decision-making process adopted by the California Department of Forestry and Fire Protection (Jones & Stokes Associates 1988) (Figure 5-12) and used for management of oak stands in the Los Vaqueros Watershed (Brady and Associates 1997). If canopy coverage is declining, stands will be surveyed to determine if recruitment is adequate to replace lost trees and meet canopy coverage goals. The age structure of the tree population should also be considered to determine if stands may be increasing or in decline. If surveys indicate that recruitment is insufficient, management actions will be implemented to improve recruitment.

Guidelines for and Uncertainties in Applying Management Techniques

Appropriate management techniques will be determined on a site-specific basis and may include those listed below:

- Modifying livestock stocking rates, timing of grazing, grazer, or livestock access to certain areas (see Conservation Measures 1.2 and 3.9).
- Planting acorns or seedlings of locally collected stock of the species in decline within existing oak stands.
- Fencing seed trees or stands of juvenile oaks to exclude native herbivores such as California ground squirrels, rabbits, or black-tailed deer until trees grow above the browse line.
- Reducing the biomass of understory herbaceous vegetation around seed trees or seedlings to reduce competition for water and nutrients through livestock grazing, mowing, prescribed burning, or other techniques (see Conservation Measure 2.4).
- Population control of exotic herbivores such as wild pigs to reduce damage to oak seedlings.

At sites where the understory of oak savanna and oak woodland in preserves is dominated by annual grassland, the understory will be managed according to the principles and guidelines outlined in Conservation Measure 2.4, except that the health and recruitment of overstory trees will also be considered. Oak savannas and woodlands within preserves will be reevaluated periodically as described in

Chapter 7. More intensive management actions will be conducted if a sudden decline in oak woodland or oak savanna stands is observed.

Wild pigs may be a serious threat to oak regeneration in the inventory area. A recent study of the effects of wild pigs in California showed that they can disturb up to 35–65% of the ground annually where they occur in high densities, and that they significantly reduce acorn survival (Sweitzer and Van Vuren 2002).

Many factors may influence the population dynamics of oaks (Pavlik et al. 1991). Accordingly, a site-specific assessment is required to determine the factors most important in stands within preserves. Based on the assessment of oaks in the Kellogg Creek watershed (Jones & Stokes Associates 1995), the factor that may be most limiting oaks in the inventory area is a lack of oak regeneration due to a high density of invasive weeds and nonnative plants in the understory. Some studies have found browsing by deer or livestock to be an important factor negatively impacting recruitment (Bartolome et al. 2002), while others have found that grazing by small mammals (Tyler et al. 2002) or large mammals (Borchert et al. 1989) is very detrimental. Fire may have negative or no effects on oak recruitment, depending on the timing, frequency, and intensity of the fire (Griffin 1977; Bartolome et al. 2002). Recruitment in many tree species, particularly oaks, can be highly cyclical and dependent on long-term rainfall patterns. Management techniques should be applied in the context of these long-term environmental factors.

Sudden oak death (SOD), caused by the pathogen *Phytophthora ramorum*, is a serious threat to oak woodlands and mixed evergreen forests in northern California. Several dominant and important trees in the inventory area have been identified as hosts to this pathogen: coast live oak, California black oak, bay laurel, madrone, California buckeye, and big-leaf maple (Davidson et al. 2003). The pathogen can kill adults of the oaks and madrone; bay laurel, buckeye, and maple host the pathogen without being killed by it. With the exception of coast live oak, these species are restricted to the mixed evergreen forest at higher elevations of the inventory area. Dominant oaks in the oak woodland and oak savanna, blue oak and valley oak, have not shown symptoms of the pathogen. As of December 6, 2004, there have been no confirmed cases of SOD in the inventory area (see the web site at http://kellylab.berkeley.edu/SODmonitoring/ for the latest data); however, recent occurrences have been documented in Alameda and Contra Costa Counties west of the inventory area. It is unknown if climatic or other factors will limit the spread of SOD into the inventory area. Because of the seriousness of this potential threat, oaks and other trees susceptible to the pathogen will be monitored regularly. Management under this measure may need to be adjusted to account for the effects of the pathogen if it spreads into the inventory area. See Chapter 7, *Monitoring and Adaptive Management Program*, for more details.

Conservation Measure 2.7. Compensate for Loss of Oak Savanna

To compensate for impacts on oak savanna, up to 162 acres of oak savanna will be restored within preserves on annual grassland or ruderal land-cover types with suitable site conditions for oak savanna establishment (Tables 5-16 and 5-7). Mitigation of impacts on oak savanna vegetation alliances will be accomplished in kind. For example, impacts on blue oak savanna will be mitigated by restoration of blue oak savanna, and impacts on valley oak savanna will be mitigated by restoration of valley oak savanna. Restoration of oak savanna under this measure is in addition to oak savanna preservation (see Conservation Measure 1.1). The biological goal and objectives specifically for oak woodland are as follows:

Goal: Restore oak savanna to compensate for its loss from covered activities

- **Replace oak savanna vegetation alliances (in kind) that are lost to covered activities at a ratio of 1:1**
- **Establish within 50 years of initiating restoration a sufficient number of blue or valley oak trees to provide a percent tree canopy cover equal to or up to 10% greater than the percent canopy cover in oak savanna stands removed by covered activities**

The time period for restoration establishment extends beyond the permit duration (30 years) to allow for oak growth and canopy development.

Guidelines for Selecting Restoration Sites

Potential restoration sites will be evaluated on the basis of criteria including but not limited to those listed below, which are based on the procedures used in the mitigation program for the Los Vaqueros Reservoir project (Jones & Stokes 1991, 1993a) and modified by recommendations in recent monitoring reports (Contra Costa Water District 2001c). See these documents for additional details.

- Topographic, soil, groundwater, and surface water conditions suitable for the target oak savanna alliance (e.g., blue oak savanna, valley oak savanna).
- Existing ecological functions and values that could be adversely affected by restoration.
- Proximity to existing oak savanna stands.
- Areas with evidence of historic occurrences of oak savanna (e.g., historic photographic analysis or other records, tree stumps, evidence of clearance along property lines).
- Distance to the impact area.
- Parcel size (among parcels with similar restoration potential, preference will be afforded to larger parcels) and the ability to continue long-term management, maintenance, and monitoring.

- Proximity to other enhancement or restoration sites within preserves.
- Areas not used or rarely used by San Joaquin kit fox (to avoid reduction in suitable habitat for this species).
- Proximity to existing, approved, and proposed developments or other adjacent land uses that may degrade the intended values of mitigation stands.
- The amount and cost of site preparation needed, all else being equal (restoration costs should be weighed against the conservation benefits of restoring the subject site as opposed to other sites).

Site Restoration Plans

Once restoration sites are selected, the Implementing Entity will prepare a site restoration plan that describes the following components.

- Percent canopy cover objectives to be reached in 5, 10, and 25 years in order to reach to the overall goal at year 50 described above. These objectives will be determined on the basis of initial plant height, site conditions, and expected growth rates of plantings.
- Restoration techniques (e.g., type, quantity, and density of planting material; weed and herbivory control methods and schedule; irrigation methods and schedule) required to achieve the objective.
- Monitoring program and performance objectives.
- Potential remedial measures that could be undertaken if performance objectives are not achieved.

Based on the restoration plans for each restoration site, construction specifications and drawings will be prepared to guide contractors who will implement restoration (e.g., Jones & Stokes Associates 1995, 1998).

Restoration Principles and Techniques

To the extent practicable, restoration designs and specifications will adhere to the following principles and techniques in addition to the guidelines and techniques in Conservation Measure 2.6:

- Restoration projects will use water only as necessary to ensure successful establishment of oak seedlings.
- Source material for plantings will be collected from adjacent or nearby stands of oaks in different years and from as many different individual trees as is practical to ensure a wide representation of the local gene pool.
- Soil supporting the same tree species and a high density of mycorrhizal fungi will be collected to inoculate planting sites with the fungi.
- Mitigation plantings will be protected from native and exotic herbivores such as black-tailed deer, cattle, feral pigs, and rodents, by using heavy welded-wire cages or similar material.

- Mitigation plantings will be irregularly spaced to avoid creating orchard-like groves of oaks and to increase the structural diversity of the mitigation sites.

Rationale

Compensation for loss of oak savanna is required to mitigate impacts on wildlife supported by this diverse natural community. Compensation will be achieved through preservation of oak savanna (see Conservation Measure 1.1) and restoration of oak savanna acreage at a 1:1 ratio to ensure no net loss of oak savanna.

The approach to oak savanna restoration described above is based largely on the approach to restoration used for the Los Vaqueros Reservoir project. The Los Vaqueros Reservoir project has been successful at establishing valley oaks in the Kellogg Creek watershed. Of 858 seedlings planted in 1995 in the Los Vaqueros Watershed, 695 (81%) survived to 2001 with an average height of 5.3 feet, average canopy diameter of 1.7 feet, and good vigor. Of 1,739 seedlings planted in 1998, 1,516 (87%) survived to 2001 with an average height of 3.6 feet, average canopy diameter of 2.0 feet, and good vigor (Contra Costa Water District 2001c). Restoration of oak savanna will provide habitat values for many species of wildlife that use preserve lands. Restored oak trees will provide food (e.g., acorns, catkins, leaves, buds, insects) used by many species of wildlife, such as woodpeckers, plain titmouse, wrens, western bluebird, towhees, white-breasted nuthatch, and black-tailed deer. Oak trees also provide perches for resting and foraging birds (e.g., hawks, owls) and nest sites for many species of songbirds and raptors, including cavity-nesting species (e.g., titmice and wrens).

Chaparral/Scrub

Conservation Measure 2.8. Manage Chaparral/Scrub

As described in Chapter 3, chaparral/scrub in the inventory area is dependent on periodic fires for regeneration and the maintenance of biological diversity. However, the natural fire frequency and intensity in chaparral/scrub in the inventory area is unknown. There is also uncertainty with regard to the efficacy of prescribed burning as a management tool in northern California chaparral and its effect on endangered animals such as Alameda whipsnake. Management of chaparral/scrub will seek to address these uncertainties through an adaptive management approach and through the monitoring program described in Chapter 7. The biological goal and objectives specifically for chaparral/scrub are as follows:

Goal: Enhance chaparral/scrub to promote native biological diversity and habitat heterogeneity

- **Maintain or mimic the natural fire regime**
- **Maintain a mosaic of stand ages and species composition across the landscape**

- **Promote canopy gaps within chaparral/scrub patches**

Establish Baseline Conditions

The historic extent, current environmental condition, and natural disturbance frequency of chaparral and coastal sage scrub stands within preserves will be assessed through vegetation sampling, interpretation of aerial photographs, and further analysis of historic records of fire in the area. The results of this study will be used to determine whether active management is required to maintain these stands in their current extent and condition.

Guidelines for and Uncertainties in Applying Management Techniques

Appropriate management techniques will be determined on a site-specific basis and may include those listed below:

- Prescribed burning,
- Mechanical or hand clearing,
- Livestock grazing or trampling,
- Limiting or restricting public access through chaparral/scrub patches.

Management of chaparral and coastal sage scrub in the last decade, including within the inventory area, has focused on the use of prescribed burning to enhance this community, restore the historic fire regime, and reduce the unnatural buildup of fuel. Mount Diablo State Park has been implementing a prescribed burn program in chaparral and other fire-dependent vegetation types since 1986 (Nielson 2001). This management technique is based on three key assumptions: (1) the current fire-return interval in chaparral is longer than historic levels due to modern fire suppression, (2) vegetation density has increased as a result, and (3) this increase in vegetation density has increased the risk of fire.

Many land management plans recommend rotational burning of chaparral and other shrublands to maintain a mosaic of stand ages, providing the maximum benefit to this community and to minimizing the chances of catastrophic wildfire. However, recent research suggests that the assumptions on which these policies are based are erroneous for chaparral communities in southern California (Keeley 2002b) and may also be wrong for chaparral communities in central and northern California[21]. The frequency of fire in southern California shrublands is as

[21] Most of the studies on the effects of burning and prescribed fires have been conducted in chaparral and coastal sage scrub in southern California, where these vegetation communities often dominate the landscape. It is therefore unclear if results from southern California apply to the chaparral and coastal sage scrub in the inventory area, where chaparral and coastal sage scrub form discrete, relatively small patches within large stands of annual grassland, oak woodland, or mixed evergreen forest. Management of chaparral and coastal sage scrub in the inventory area will be conducted using a cautious and adaptive approach. Prescribed burning will be used sparingly and only when necessary to reduce extreme fire hazards or obvious signs of stand decadence from fire suppression activities. If future research

frequent or more frequent in the twentieth century than it was in the nineteenth century (prior to fire suppression activities) partly because fire suppression activities have been ineffective at reducing fire frequency in shrublands (Keeley et al. 1999; Keeley and Fotheringham 2001). Fire hazard in chaparral habitat appears to be either independent of or only weakly dependent on stand age for the first 20 years after fire (Moritz 1999; Schoenberg et al. 2003). The frequency of severe weather conditions (e.g., low humidity, high winds, and drought) and the number of people with access to stands (providing an ignition source) appear to play much more important roles than do vegetation conditions in determining fire risk. A recent survey of major fires in the East Bay shows that the majority of the inventory area has not burned since at least 1951 (based on fire data from 1951–1996; U.S. Fish and Wildlife Service 2002b). It is not clear, however, if this is due to successful fire suppression activities or the fact that the natural fire interval is more than 50 years.

Because we do not know if the natural fire regime in the inventory has been altered, prescribed burns should be used sparingly and strategically in this vegetation community. Prescribed burns will be used only when necessary to reduce extreme fire hazards in areas of likely fire risk or to enhance unoccupied habitat for Alameda whipsnake or habitat occupied by Mount Diablo manzanita. New trail construction will be prohibited within and directly adjacent to chaparral/scrub patches to reduce the chance of wildfire ignitions and to minimize disturbance to and mortality of Alameda whipsnakes (see Conservation Measure 1.5). Prescribed fires, if determined to be necessary, will be carefully planned and implemented with the cooperation of the California Department of Forestry and Fire Protection and local fire agencies. A burn plan will be prepared for each prescribed fire event.

Prescribed burning in chaparral may reduce wildfire risk at some sites but this should be balanced with consequences of fires that are too frequent. Fires that occur too frequently in chaparral may reduce chaparral biological diversity by eliminating species not adapted to frequent burning (Zedler et al. 1983). Chaparral that experiences frequent fires is exposed to high rates of erosion and potential watershed damage. It has also been assumed that prescribed fires are effective at reducing or controlling exotic plants. Prescribed fires in chaparral should be conducted in late fall or winter when weather conditions maximize the ability of fire crews to control the fire. Burns conducted at that time will exert little effect on the seed banks or reproductive capability of exotic plants.

The effects of prescribed fire on Alameda whipsnake are largely unknown. However, USFWS considers fire suppression one factor in the decline of Alameda whipsnakes because it may reduce the extent of early to mid-successional stages of this vegetation community, which whipsnakes prefer, and because it may increase the risk of catastrophic wildfire (U.S. Fish and Wildlife

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demonstrates the benefits of prescribed burning (or another active management technique), then management in preserves can be adjusted.

Service 1997, 2000). Moreover, the closed canopy that results from fire suppression can reduce the prey base for whipsnakes. Because of the uncertainty in the effects of prescribed fire on this species, its use will be limited to unoccupied habitat for whipsnake where practicable. Ongoing research within the inventory area includes experimental burns to determine the effects of prescribed burning on Alameda whipsnake (Swaim pers. comm.). Monitoring will be used to determine the status of habitat function for Alameda whipsnake and the need for active management measures in chaparral and scrub vegetation.

With little evidence that prescribed burning is effective at enhancing chaparral communities in the inventory area, this technique should be used only to reduce extreme fire risk or to enhance small areas for specific reasons (e.g., to create habitat for Alameda whipsnake) unless future research or adaptive management shows otherwise.

Streams and Riparian Woodland/Scrub

Conservation Measure 2.9. Manage Streams and Riparian Woodland/Scrub

All degraded streams and riparian woodland/scrub within the preserves will be improved to increase overall ecological functions and values (i.e., species richness and diversity, vegetative cover, wildlife habitat function) and to enhance the ability of these habitats to support existing and new populations of covered species.

The biological goals and objectives for streams and riparian woodland/scrub are as follows:

Goal: Enhance riparian woodland/scrub to promote native biological diversity and habitat heterogeneity

- **Maintain or increase the cover, width, and connectivity of existing riparian vegetation consistent with current stream and habitat function**
- **Reduce the biomass, cover, and extent of exotic (i.e., non-native invasive) plants in the Preserve System**

Goal: Maintain and enhance instream aquatic habitat for covered species and native fish

- **Promote the natural disturbance regime (e.g., flooding, sediment deposition and scour)**
- **Reduce water temperature and temperature variation**
- **Increase inputs of organic matter where appropriate**
- **Reduce sediment input and downstream sediment transport/deposition, where appropriate**

- **Maintain and enhance instream structural diversity, where appropriate**
- **Improve stream flow and connectivity for native aquatic wildlife**
- **Control or reduce invasive, exotic animals including bullfrogs and fish**

Establish Baseline Conditions

The Implementing Entity will map riparian corridors within the preserves to identify stream segments suitable for enhancement measures.

Guidelines for and Uncertainties in Applying Management Techniques

Techniques that could be used to enhance streams and riparian woodland/scrub include but are not limited to those listed below:

Exclude Livestock

- Install livestock exclusion fencing along designated stream segments and provide alternative water supplies for livestock.

Control Exotics

- Remove invasive nonnative plant species mechanically, by hand, or through application of herbicides (e.g., Arundo donax).
- Use nursery-grown plant material that is free of invasive exotic pests such as Argentine ants.

Plant Native Vegetation

- Plant appropriate native riparian woodland/scrub vegetation in gaps in existing riparian corridors or in sparse vegetation using locally collected material, as determined by the Implementing Entity land managers (planting in gaps larger than one tree canopy length is considered riparian restoration; see Conservation Measure 2.10).
- Plant riparian woodland/scrub vegetation along stream banks to expand the width existing riparian vegetation.
- Install willow cuttings along the edge of the low-flow channel to increase overhead cover where it is lacking.
- Plant riparian woodland/scrub understory species in existing riparian corridors in areas where the understory has been denuded.

Recreate Natural Structures, Processes, and Flow

- Remove non-vegetative debris such as trash, garbage, or dumped fill material (e.g., concrete, asphalt) from the stream channel to facilitate stream flow.
- Install biotechnical bank-stabilization structures to arrest bank erosion and provide opportunities for planting native riparian woodland/scrub vegetation.

- Remove and/or modify barriers (e.g., culverts, low-flow crossings, diversion structures) to up- and downsteam fish migration as long as nonnative species (e.g., bullfrogs, exotic fish) do not benefit.
- Where appropriate, install instream woody material, boulders, or rock structures (e.g., cross or V weirs) to create pools and/or narrow the low-flow channel.
- Where severely incised streams are degraded (resulting in erosion and high sediment loads, floodplain disconnection, bank destabilization, or groundwater subsidence), geomorphically appropriate check dams may be placed to stabilize the channel's longitudinal profile, reduce erosive flow velocities, arrest further channel incision, and encourage in-channel sediment storage.
- Where possible, reestablish the natural disturbance regime (e.g., flooding, sediment deposition and scour) to facilitate natural regeneration of riparian woodland/scrub and promote habitat diversity (Mount 1995).

Riparian enhancement measures will be integrated into the preserve management plans (see Conservation Measure 1.2).

Potential enhancement sites will be evaluated and management actions identified in coordination with the other local agencies or organizations active in riparian restoration in the inventory area (e.g., Contra Costa County Resource Conservation District, Contra Costa County Watershed Forum). Detailed techniques will be developed for individual sites or steam reaches based on specific geomorphic, hydraulic, and hydrologic conditions; extent and quality of existing habitats (e.g., percent native vegetation and presence/absence of exotic wildlife such as bullfrogs or cowbirds); existing wildlife use; and the potential for adverse effects (e.g., disturbance and/or removal of existing wetland habitat). These management actions will include descriptions of plant material requirements (e.g., collected and propagated from local sources); planting and construction methods; and adaptive management and monitoring requirements.

Rationale

Covered species that will benefit from the riparian enhancement program include California red-legged frog, California tiger salamander, foothill yellow-legged frog, and Swainson's hawk. The program will also benefit other wildlife, including raptors, migratory and resident songbirds, and native insects (Warner and Hendrix 1984; National Research Council 2002).

Riparian areas can be impacted by uncontrolled livestock access. Invasive exotics can outcompete native plant species and decrease overall species diversity Therefore animal exclosures and riparian plantings are two techniques that will contribute to stream and riparian enhancement. Planting riparian woodland and scrub vegetation where it will have a high likelihood of success within existing riparian corridors will increase the width, length, connectivity, and overall species diversity of existing habitat patches.

Installing bank stabilization structures in areas of actively eroding stream banks reduces sediment input and downstream sediment transport/deposition, and reduces adverse effects on instream habitat and water quality. In limited cases, installing instream structures will create pools and overhead cover, increase inputs of organic material, and enhance aquatic habitat for covered species. Removing barriers and/or constructing passage structures will facilitate up- and downstream migration of fish and enhance habitat for covered aquatic species as long as exotic invasive species such as bullfrogs and exotic fish are controlled.

Conservation Measure 2.10. Restore Streams and Riparian Woodland/Scrub to Compensate for Habitat Loss and to Increase Biodiversity

The Implementing Entity will restore riparian woodland and scrub habitats within preserves according to the ratios listed in Tables 5-16 and 5-17 for the initial and maximum urban development areas, respectively. Impacts on riparian woodland/scrub will be compensated through the restoration riparian woodland/scrub habitat types at a ratio of 1:1. The Implementing Entity will also restore 20 acres of riparian woodland/scrub to enhance overall native biological diversity and to contribute to the recovery of covered species. All or most impacts on slough/channel are expected to be mitigated through restoration of up to 37 acres of additional riparian woodland/scrub (see Conservation Measure 2.3).

The biological goal and objectives are as follows:

Goal: Restore streams and riparian woodland/scrub to compensate for their loss from covered activities

- **Restore at least 20 acres of riparian woodland/scrub in addition to that required above as compensation for habitat loss**
- **Replace riparian woodland/scrub at a ratio of 1:1 in the Preserve System (estimated to be 30 acres with maximum urban development area)**
- **Restore species richness and diversity, vegetative cover, wildlife habitat function and hydrologic function**

Potential impacts on streams will be avoided and/or minimized through implementation of Conservation Measures 1.7 and 2.12 (Chapter 6). Where impacts on streams are unavoidable, mitigation will focus on restoration of streams within preserves. Where mitigation within preserves is infeasible, stream restoration within existing protected areas (e.g., East Bay Regional Park District) may be allowed. Impacts on streams without riparian woodland/scrub cover can be compensated through either restoration of riparian woodland/scrub vegetation on existing streams or restoration of seasonal or permanent wetlands on an acre-for-acre basis to replace some stream functions (see Conservation Measure 2.3). Stream restoration should be prioritized. Where stream restoration is not feasible, riparian woodland/scrub will be restored. If sites for riparian woodland/scrub are

not available, seasonal/perennial wetlands can be restored. Impacts on streams with riparian woodland/scrub vegetation will be compensated at a ratio of 1:1 through a combination of stream restoration and restoration of riparian woodland/scrub vegetation. Stream restoration will be accomplished in kind where possible (i.e., impacts on perennial streams will be mitigated through restoration of perennial streams). Restoration principles and rationales for the stream types that occur in the inventory area are described below.

Perennial Streams. Restoration will occur along perennial streams that have been degraded by past land use activities and that historically supported riparian woodland/scrub vegetation. Restoration of perennial streams will likely focus on the implementation of intensive measures such as excavating stream banks and floodplain surfaces because of the ecological benefits to covered species associated with permanent water. Combined with restoration of riparian woodland/scrub, implementation of these activities will provide shade and cover, reduce water temperatures, increase channel complexity, and enhance instream aquatic habitat for fish and other aquatic organisms.

Intermittent Streams. Compensation for the loss of intermittent streams can be accomplished through restoration of intermittent or perennial streams. Restoration will occur along intermittent streams that have been degraded by past land use activities and that historically supported riparian woodland/scrub vegetation. Restoration of intermittent streams will likely involve measures similar to those implemented for perennial streams (e.g., stream bank and floodplain excavation, planting).

Ephemeral Streams. Restoration along ephemeral streams will primarily focus on planting upper terrace riparian species (e.g., oaks, bay laurel, California buckeye) that can tolerate drier site conditions. However, because there is some evidence that California red-legged frog may be adversely affected by bay laurel (Bobzien pers. comm.),, which will be used sparingly. If the restoration of ephemeral streams is not feasible because of site conditions or other considerations, the Implementing Entity will be required to restore riparian woodland/scrub or seasonal or permanent wetland habitats on an acre-for-acre basis to replace lost stream functions.

Guidelines for Selecting Restoration Sites

Potential restoration sites in the inventory area (e.g., Robins and Cain 2002; Walking et al. 2002) will be evaluated and measures identified in coordination with the other local agencies or organizations active in riparian restoration in the inventory area (e.g., Contra Costa County Resource Conservation District, Contra Costa County Watershed Forum). As described in Conservation Measure 2.1, the Implementing Entity will likely be conducting most riparian restoration along Marsh Creek, Kellogg Creek, and in and adjacent to Dutch Slough (Figure 5-2 and 5-3). Restoration sites will be selected according to the presence of important criteria including but not limited to those listed below:

- The potential success of restoration activities, based on site-specific conditions (e.g., hydrology, soils).

- The ability of the site to support covered species after restoration.
- The proximity of the site to the area in which streams or riparian woodland/scrub were lost to covered activities.
- The proximity of the site to other intact riparian corridors that support, or are likely to support, covered species.
- The ability of the restored stream and/or riparian woodland/scrub to contribute to the conservation goals of habitat connectivity in this plan.

Site Restoration Plans

Detailed restoration plans, including plans and specifications, will be developed for individual sites or steam reaches based on specific geomorphic, hydraulic, and hydrologic conditions; extent and quality of existing habitats; existing wildlife use; and the potential for adverse effects (e.g., disturbance and/or removal of existing habitat or wetlands). Restoration plans will accomplish the following:

- Define restoration goals and objectives, performance indicators, and success criteria.
- Collect and analyze baseline data (e.g., soil type and suitability for riparian planting, low-flow conditions, past land use history/alterations).
- Identify suitable/feasible restoration measures.
- Develop conceptual restoration designs.
- Develop detailed restoration designs (plans and specifications) that identify and describe construction methods, planting areas and methods, planting species (including collection and propagation methods), and maintenance requirements.
- Prepare an adaptive management and monitoring plan that includes descriptions of responsible parties; monitoring methods and schedule; indicators (e.g., vegetative cover); success criteria (e.g., 20% cover by year 5); and adaptive management measures (e.g., replanting with different species).

Restoration Principles and Techniques

Management actions that could be implemented to restore streams and riparian woodland/scrub include but are not limited to those listed below (U.S. Department of Agriculture 1999).

- Replacing existing hardscape bank protection structures (e.g., riprap, concrete, sakrete) with biotechnical bank stabilization structures, consistent with flood protection purposes.
- Excavating and grading existing stream banks and/or floodplain surfaces to create suitable planting sites for riparian woodland/scrub vegetation, provide opportunities for the deposition of fine-grain materials and native seed stock, and enhance existing flood capacity (if needed to offset the loss of flood capacity from plantings).

- Planting riparian woodland/scrub vegetation in some stream reaches of newly excavated channel banks and floodplain surfaces to increase overhead cover and shaded bank/stream surface, thereby reducing water temperatures to improve aquatic habitat for covered amphibians.
- Planting appropriate native riparian woodland/scrub vegetation within large gaps in riparian corridors (planting in gaps smaller than a typical tree canopy diameter[22] is considered riparian enhancement; see Conservation Measure 2.9) to increase the width, length, connectivity, and overall species diversity of existing habitat patches.
- Shifting or realigning straightened stream channels to restore meanders (e.g., usually on agricultural lands) and increase instream habitat complexity and quality for covered aquatic species.
- Installing woody material, boulders, and/or instream structures to create pools, reduce the width of the low-flow channel, increase inputs of organic material, and improve habitat for covered aquatic species.
- All restoration actions will avoid take of migratory birds and their eggs and nests according to the restrictions of the Migratory Bird Treaty Act.

Cultivated Agriculture

Conservation Measure 2.11. Enhance Cultivated Agricultural Lands to Benefit Covered Species

The Implementing Entity will acquire conservation easements on at least 250 acres of cultivated agricultural land in Zone 6 from willing sellers (see Conservation Measure 1.1 and Table 5-11). Conservation easements will require landowners to modify existing agriculture-related practices to enhance the value of agricultural lands for covered species (see Conservation Measure 1.3).

Management measures that could be implemented on agricultural lands to benefit covered species are presented in Table 5-19. Specific management practices that may be required for a particular parcel will depend on its location within the Preserve System relative to the distribution and needs of covered species, as well as the types of management actions that can be reasonably undertaken while maintaining ongoing and profitable farming operations. The Implementing Entity will develop an agricultural management plan for each conservation easement that describes the management measures to be implemented by the landowner. Requirements and terms of agricultural management plans are described in Conservation Measure 1.3.

[22] A typical tree canopy diameter should be used to determine this distance, which will vary depending on the type of habitat and site conditions. Well-developed cottonwood trees may have canopy diameters of up to 30 feet.

Rationale

Cultivated agricultural lands are the dominant land-cover type in Zone 6 and provide the primary foraging habitat for Swainson's hawk, a key covered species. Croplands and pasture also provide secondary habitat for western burrowing owl (breeding and foraging) and tricolored blackbird (foraging). Consequently, the primary opportunity to enhance habitat for covered species in Zone 6 entails enhancing habitat on cultivated agricultural lands.

5.3.3 Species-Level Conservation Measures

Most species-specific conservation is accomplished by protecting, restoring, and managing habitat as described above. For some species, the management actions described in the natural-community conservation measures are sufficient to maintain and enhance the covered species in the preserve system. For those species, no additional conservation measures were developed. In other instances, additional measures have been created that are specific to individual covered species. These additional measures fill in small gaps in coverage in ways that were not specifically addressed at the natural-community level.

If specific biological goals and objectives were developed, they are listed at the beginning of each species narrative. Not all covered-species have species-level goals and objectives. Subsequently, a description of the overall landscape- and community-level conservation measures is provided to describe the benefits of these larger-scale measures on individual species.

Townsend's Western Big-Eared Bat

The biological goals and objectives for Townsend's western big-eared bat are listed below.

Goal: maintain or increase population size and distribution of Townsend's western big-eared bat in the Preserve System

- **Preserve hibernacula and maternity roosts of Townsend's western big-eared bat**
- **Enhance roosting habitat by protecting any abandoned mine, cave, or building in the Preserve System and, if feasible, creating artificial hibernacula**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit Townsend's western big-eared bat. Planning surveys will ensure that most impacts on this species from covered activities are avoided or minimized. The conservation strategy will preserve at least 15,600 acres of terrestrial vegetation, including alkali grassland, annual grassland, chaparral, oak savanna, and oak woodland (Table 5-7) that are expected to include suitable

microhabitats for roosting bats, such as caves, mines, or other structures. Preserve management will also benefit Townsend's western big-eared bat. For example, several measures will increase watering habitat by restoring streams, wetlands, and associated riparian habitat in habitat preserves and increase prey base by controlling the use of insecticides in preserves (see Conservation Measures 1.8, 2.12, 2.2, 2.3, and 2.9). Acquisition of lands containing large trees that provide cave-like conditions may provide night-roosting habitat (Fellers and Pierson 2002).

Conservation Measure 3.1. Protect and Enhance Roosting Habitat for Townsend's Western Big-Eared Bat

Planning surveys for land acquisition and baseline surveys following acquisition will use bat detectors near suitable roosting sites to attempt to locate colonies of Townsend's western big-eared bat. Lands containing maternity roosts or hibernacula will be prioritized for acquisition. Any roost locations within the Preserve System will be documented and mapped; the results will be shared with USFWS and CDFG but otherwise kept confidential. Abandoned mines within the Preserve System will be stabilized, if feasible, and gated, when practicable, to enhance roosting habitat for these bats. Recreational access to caves within the Preserve System will be prohibited. In addition, the creation of artificial hibernacula will be investigated and implemented, if appropriate, in an adaptive management context.

Rationale

Townsend's big-eared bat is highly sensitive to disturbance at roost sites, and surveys in coastal California indicate that the species is roost limited (Pierson 1988). Although Townsend's big-eared bat is generally a cave-dwelling species, the western subspecies is usually found in buildings and mine shafts. Protection from human disturbance and enhancement of roosting sites are the most promising means of protecting populations of this species.

San Joaquin Kit Fox

The biological goals and objectives for San Joaquin Kit Fox are listed below:

Goal: Preserve the most important movement routes and core habitat for San Joaquin kit fox

- **Preserve 3,200 acres in Horse, Lone Tree, and Deer Valleys (Subzones 2e, 2f, 2g, and 2h) to protect the two most important movement routes for San Joaquin kit fox between Black Diamond Mines Regional Preserve and Cowell Ranch State Park**
- **Preserve an important movement route for San Joaquin kit fox between Alameda County and Contra Costa County by protecting habitat in**

Zone 5 between the County line, the Byron Airport Habitat Mitigation Lands, and the Los Vaqueros Watershed

- **Preserve 4,300 acres of annual grassland and 750 acres of alkali grassland in Subzones 5a and 5d as suitable core habitat**

Goal: Increase the prey base for San Joaquin kit fox

- **Increase California ground squirrel and other small mammal populations within suitable core habitat**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures are designed specifically to benefit and contribute to the recovery of San Joaquin kit fox. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (Conservation Measures 1.6 and 1.9). The conservation strategy will protect an estimated 17,164 acres of suitable core habitat and 1,820 acres of suitable low-use habitat for San Joaquin kit fox in the inventory area with the initial urban development area (Table 5-13). A network of core preserves will protect a critical linkage for San Joaquin kit fox between its range outside Contra Costa County and most known locations in Contra Costa County. For example, habitat linkages will be acquired and protected to ensure that kit foxes can continue to move between the Contra Costa–Alameda County line and Detachment Concord at the northwestern corner of the species' range. This important regional connection will be made by connecting the existing large protected areas listed below that are known or suspected to support San Joaquin kit fox.

- Brushy Peak Regional Preserve and Bethany Reservoir State Recreation Area (Alameda County) with Vasco Caves Regional Preserve.
- Byron Airport conservation easements and the Los Vaqueros Watershed.
- Cowell Ranch/Los Vaqueros Watershed and Black Diamond Mines Regional Preserve.
- Black Diamond Regional Preserve and Detachment Concord.

There are four possible movement routes through annual grassland between Black Diamond Regional Preserve and Cowell Ranch/Los Vaqueros Watershed. The southernmost linkage is the narrowest (approximately 0.2 mile at its narrowest point), and its viability may be compromised by the planned expansion of the Los Vaqueros Reservoir. Two linkages of annual grassland between Black Diamond Regional Preserve and Cowell Ranch/Los Vaqueros Watershed will be created out of the other three possible routes to ensure that movement between these core protected areas can continue. Annual grassland within preserves will be managed to enhance small mammal populations (a prey base for kit fox) (Conservation Measure 2.5).

Tricolored Blackbird

The biological goals and objectives for tricolored blackbird are listed below.

Goal: Enhance habitat for tricolored blackbird in the Preserve System

- **Restore perennial wetlands so that at least 25% will provide breeding habitat**
- **Restore perennial wetlands to provide breeding habitat at least 1 mile from black-crowned night heron colonies and within flight distance of blackbird foraging habitat**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures are designed specifically to benefit tricolored blackbird. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (see Conservation Measures 1.6, 1.9, and 1.10). The Preserve System will protect approximately 126 acres of modeled core habitat, 16,747 acres of primary foraging habitat, and 242 acres of secondary foraging habitat with the initial urban development area (Table 5-13) (Conservation Measure 1.1). Surveys will be conducted to confirm habitat suitability and identify habitat occupied by tricolored blackbird in potential preserve lands; results of these surveys will be used to guide acquisition of preserves to include occupied habitat to the maximum extent practicable. Planning surveys for tricolored blackbird are not required for covered activities, although if tricolored blackbird is present, project proponents must comply with the Migratory Bird Treaty Act.

Land Acquisition. Agricultural conservation easements acquired in Zone 6 (Conservation Measure 1.1) may benefit tricolored blackbird by providing foraging habitat. The Implementing Entity will acquire at least 250 acres of cropland or pasture in Zone 6 or the ULL with the initial urban development area (Table 5-11). Land acquired in Zone 6 may provide suitable foraging habitat for tricolored blackbird. If conservation easements are used, they may require landowners to modify existing agriculture-related practices to enhance the value of agricultural lands for tricolored blackbird (Conservation Measures 1.3 and 2.11). Because tricolored blackbirds require nesting habitat near suitable foraging habitat, areas preserved as breeding habitat will include both elements.

Restoration and Enhancement. Conservation Measures 2.2 and 2.3 will benefit tricolored blackbird by enhancing, restoring, and creating suitable breeding habitat for this species adjacent to suitable foraging habitat (annual grassland).

Preserve Management. Several preserve management measures will benefit tricolored blackbird. Agricultural lands will be managed to maintain or enhance suitable foraging habitat for tricolored blackbird when close to breeding colonies (Conservation Measures 1.3, 1.4, and 2.11). Habitat enhancement on agricultural

lands (e.g., planting blackberries or other vegetation along ditches and canals to provide suitable nesting sites) will also benefit tricolored blackbird.

Conservation Measure 3.2. Minimize Predation on Tricolored Blackbird Colonies

At least 25% of the estimated 85 acres of wetland and pond created or enhanced will be designed to support breeding tricolored blackbirds (see Conservation Measure 2.3). To reduce predation risk to tricolored blackbird colonies, some sites will be located at least 1 mile from black-crowned night-heron rookeries. Aerial photos will be used to assess the potential presence of heron rookeries within 5 miles and surveys for heron rookeries will be conducted near wetland and pond sites under consideration for tricolored blackbird habitat creation.

Rationale

Predation is a major cause of complete nesting failure at some tricolored blackbird colonies in the Central Valley. Historical accounts documented the destruction of nesting colonies by a diversity of avian, mammalian, and reptilian predators. Recently, especially in permanent freshwater marshes of the Central Valley, entire colonies have been lost to black-crowned night-herons, common ravens, coyotes, and other predators (Beedy and Hamilton 1999). Night-herons generally do not forage on tricolored blackbird colonies in upland sites (i.e., sites comprised of Himalayan blackberry, thistle, or nettle). By locating wetland restoration sites designed to support tricolored blackbirds away from black-crowned night-heron rookeries, predation by these native birds can be minimized. There are no known empirical data on how predation rates at colony sites vary with distance from night-heron rookeries; moreover, predation rates may be driven more by habitat (e.g., upland versus wetland as previously described) than by distance. Although black-crowned night-herons will fly several miles between nesting and foraging areas, most incidences of predation by night-herons on Tricolored Blackbirds appear to have occurred when night-herons nest within or adjacent to tricolored blackbird colonies in freshwater marshes (Beedy pers. comm. 2003). Therefore, it is assumed that a 1-mile minimum distance is adequate.

Golden Eagle

The biological goals and objectives for golden eagle are listed below.

Goal: Maintain or increase population size and distribution of golden eagles in the inventory area

- **Acquire land in the Preserve System that includes occupied nests and suitable nest sites**
- **Retire wind turbine leases within the Preserve System, when feasible**

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will benefit golden eagle. For example, Conservation Measures 1.6 and 1.9 will ensure that impacts on this species from covered activities are avoided. (However, this Plan does not cover wind farms.) Conservation Measure 1.11 prohibits the take of individual golden eagles. The Preserve System will protect an estimated 24,321 or 29,267 acres of modeled foraging habitat for golden eagle under the initial urban development area or maximum urban development area, respectively (Table 5-13), including a network of large blocks of high-quality grassland habitat. Nearly the entire Preserve System will provide suitable foraging and breeding habitat for golden eagles. New preserves will be linked to existing protected land, which will result in large areas of contiguous foraging habitat for golden eagles. Acquisition of at least 250 acres of agricultural conservation easements in cropland or pasture (Zone 6) will benefit the species by providing additional foraging habitat.

Several preserve management measures will benefit golden eagles. Preserves will be managed to enhance the prey base for raptors, including golden eagles (Conservation Measure 2.5). Annual grassland that is managed to decrease the cover and extent of exotic plants (Conservation Measure 1.4) and to increase the cover and extent of native grasslands (Conservation Measures 1.2 and 2.4) will benefit golden eagles by decreasing escape cover in grasslands. Management of agricultural lands will be designed to enhance and increase foraging and nesting habitat for covered species, including golden eagle (Conservation Measures 1.3 and 2.11). These measures contain specific techniques and goals that will be incorporated into agricultural management plans and conditions of the conservation easements purchased on agricultural lands.

Conservation Measure 3.3. Protect Golden Eagle Nest Sites within Preserve System

Surveys in potential preserve lands will be conducted to determine habitat suitability and identify occupied and suitable golden eagle nest sites. Results of these surveys will be used to guide acquisition of occupied nesting habitat to the maximum extent practicable. The Implementing Entity will evaluate ongoing land uses in or adjacent to occupied habitat relative to future threats to nests or habitat. Occupied habitat that is considered threatened will be a high priority for acquisition and management.

Rationale

Although foraging habitat for golden eagle is common in the inventory area, occupied nest sites are rare. To contribute to the recovery of golden eagle, active or potential nest sites should be acquired within preserves to protect these important sites.

Western Burrowing Owl

The biological goals and objectives for western burrowing owl are listed below.

Goal: Maintain or increase population size and distribution of western burrowing owl

- **Install artificial burrows and perches as temporary attractants, where appropriate**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures are designed specifically to benefit western burrowing owl. Development guidelines ensure that impacts on this species from covered activities are avoided or minimized (Conservation Measures 1.6 and 1.9). The conservation strategy will protect an estimated 16,675 or 19,844 acres of modeled suitable habitat for western burrowing owl under the initial urban development area or the maximum urban development area, respectively (Table 5-13). A network of core preserves will protect large blocks of grassland habitat. New linkages will be created in blocks of habitat suitable for western burrowing owl to facilitate dispersal and colonization throughout the Preserve System, colonization of the inventory area from adjacent areas, and dispersal from inside to outside the inventory area. New preserves will be established adjacent to or near existing protected land. This approach will result in large areas of contiguous habitat. Large areas of contiguous habitat are likely to provide greater opportunities to meet the conservation objectives for this species. Planning and pre-acquisition surveys (see Chapter 6, *Conditions on Covered Activities*) will be conducted to identify suitable habitat. Results of these surveys will be used to minimize impacts and guide acquisition of occupied habitat to the maximum extent practicable.

Several preserve management and community-level measures will benefit western burrowing owl. For example, Conservation Measures 1.2, 1.3, 1.4, and 2.5 will enhance habitat quality for western burrowing owl in preserves by increasing nesting habitat and prey base.

Conservation Measure 3.4. Temporarily Create Artificial Burrows in Grasslands to Attract and Retain Burrowing Owls

Under certain circumstances preserved grasslands may be enhanced for western burrowing owls by installing artificial burrows. Where natural burrows are limited in number in otherwise suitable habitat, the Implementing Entity may create artificial burrows. Artificial burrows may encourage western burrowing owls to use sites where natural burrows are absent or scarce, particularly when the artificial burrow is constructed close to a source population or occurrence (Trulio 1995). Artificial burrows should be used as a temporary measure to

encourage use by western burrowing owls while long-term measures such as ground squirrel population enhancement are being developed (if these long-term measures are successful, the artificial burrows should be removed). Although it is unclear whether artificial burrows can directly enhance long-term productivity of burrowing owls (Haug et al. 1993), this technique has been successful in attracting burrowing owls to certain sites in northern California (Trulio 1995; Jones pers. comm.).

The effects of artificial nest burrows on reproductive success have not been well studied. Techniques for creating artificial burrows will be improved over time through the Monitoring and Adaptive Management Program. In addition, artificial burrows may be installed to attract owls from areas that are scheduled for development into preserved habitat. Periodic maintenance of artificial burrows will be required to ensure that the burrows provide suitable nest sites for burrowing owls. Maintenance activities will include removing vegetation around burrow entrances and unplugging and repairing burrow entrances, tunnels, and chambers as needed. Maintenance activities will occur before the nesting season.

Rationale

Burrow availability limits the extent of year-round habitat available to burrowing owls in some areas. Because burrowing owls need other animals to dig their burrows, the loss of fossorial rodents (e.g., ground squirrels) from much of historical burrowing owl habitat and the ensuing reduction in burrow availability has reduced suitable habitat for this species.

Conservation Measure 3.5. Install Temporary Artificial Perches to Attract and Retain Burrowing Owls

Under certain circumstances the Implementing Entity may install artificial perches in preserves that lack burrowing owl perch sites but that otherwise support suitable habitat to increase the probability of colonization by owls. The benefit of artificial perches in attracting and encouraging residency by owls, as well as conditions under which this management tool is appropriate, will be tested and improved through the adaptive management process. Initially, perches will be no more than 3 feet high to reduce their attractiveness to large raptors.

Rationale

In addition to artificial-burrow installation, if burrow availability is limited, burrowing owls can often be enticed to remain at a set of burrows if suitable perches are erected to increase their vantage of their surroundings (Johnson pers. comm.).

Swainson's Hawk

The biological goals and objectives for Swainson's hawk are listed below.

Goal: Maintain or increase population size and distribution of Swainson's hawk in the inventory area

- **Acquire land in the Preserve System that includes occupied nests and suitable nest sites**
- **Acquire 250 acres of cropland or pasture for Swainson's hawk foraging along Kellog Creek, Marsh Creek, or adjacent to Dutch Slough that is suitable for riparian restoration within 1 mile of the Zone-6 boundary**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will benefit Swainson's hawk. The development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (Conservation Measures 1.6 and 1.9). The Preserve System will protect an estimated 12 acres of modeled breeding habitat and 2,096 acres of modeled foraging habitat with the initial urban development area (Table 5-13). Under the maximum urban development area scenario, the extent of preserved modeled foraging habitat increases to 2,757 acres.

Prior to acquisition of preserve lands, surveys (see Chapter 6, *Conditions on Covered Activities*) will determine nesting habitat suitability and identify Swainson's hawk nest sites. Nesting habitat will be a priority for acquisition. The loss of riparian woodland/scrub, all of which is considered suitable nesting habitat for Swainson's hawk, will be mitigated through in-kind protection of riparian woodland (Conservation Measure 1.1) and enhancement and restoration of riparian woodland/scrub within preserves (Conservation Measures 2.9 and 2.10). Prior to submission of an application package, planning surveys will identify Swainson's hawk nest sites.

The Implementing Entity will acquire an estimated 12 to 16 acres of riparian woodland/scrub within preserves (Table 5-13) that provide suitable breeding habitat for Swainson's hawk. Up to 55 additional acres of riparian woodland/scrub will be restored within the preserves within the range of Swainson's hawk[23] (Table 5-16), providing additional high-quality breeding habitat for the species.

In addition to habitat acquisition and restoration, several preserve management measures will benefit Swainson's hawk. Preserves will be managed to enhance the prey base for raptors (Conservation Measure 2.5). Annual grassland that is managed to decrease the cover and extent of exotic plants (Conservation Measure 1.4) and to increase the cover and extent of native grasslands (Conservation Measures 1.2 and 2.4) will benefit Swainson's hawks by reducing overall vegetative cover and decreasing escape cover for prey. Management of agricultural lands will be designed to enhance and increase foraging and nesting

[23] Most riparian restoration is expected to occur within the range of the Swainson's hawk; restoration that occurs in upper Marsh Creek (e.g., Subzone 4c) or along small drainages in the Willow Creek watershed near Pittsburg would not be within the range of Swainson's hawk.

habitat for Swainson's hawks (Conservation Measures 1.3 and 2.11). These measures contain specific techniques and goals that will be incorporated into agricultural management plans and conditions of the agricultural conservation easements purchased on these lands.

Silvery Legless Lizard

The biological goals and objectives for silvery legless lizard are listed below.

Goal: Protect and maintain populations of silvery legless lizard

- **Preserve habitat for silvery legless lizard in Subzones 2a, 2e, and 2h if pre-acquisition surveys confirm their suitability**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will benefit silvery legless lizard. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (see Conservation Measures 1.6, 1.9, and 1.10). The conservation strategy will protect an estimated 153 acres of modeled habitat for silvery legless lizard in the inventory area under the initial urban development area (Table 5-13), including all modeled suitable habitat for silvery legless lizard in Subzones 2a and 2e. However, the suitability of modeled habitat for silvery legless lizard has not been verified in the field. Prior to acquisition of preserve lands, surveys (see Chapter 6) will be conducted to assess habitat suitability and identify occupied habitat. Results of these surveys will be used to guide acquisition of occupied or suitable habitat to the maximum extent practicable.

Several preserve, vegetation, and recreation management measures will be implemented to avoid or minimize impacts on silvery legless lizards and suitable habitat (particularly soils) in preserves. For example, restrictions on recreation in protected habitat will be implemented (Conservation Measure 1.5). These measures include limiting or prohibiting vehicle traffic in lizard habitat; limiting recreational activities allowed in protected habitat to hiking, bicycling, and horseback riding; and minimizing the number of trails in suitable habitat. Also, pesticide use, which threatens this species by affecting its insect prey base, will be controlled in preserves (Conservation Measure 1.2). Buffers between protected habitat and the urban edge will benefit silvery legless lizard by discouraging intrusion by domestic predators (Conservation Measures 1.8 and 1.9).

Existing landscape-level and community-level measures are sufficient to meet the biological goals and objectives for silvery legless lizard. No additional species-level measures are proposed for this species.

Alameda Whipsnake

The biological goals and objectives for Alameda whipsnake are listed below.

Goal: Contribute substantially to the recovery of Alameda whipsnake in the inventory area by protecting and enhancing chaparral/scrub

- **Preserve an average of 70% of currently unprotected core and perimeter whipsnake habitat in Subzones 2a, 2b, 2c, 3a, and Zone 4**
- **Preserve whipsnake movement habitat between patches of whipsnake core habitat, including the linkage in Zone 2 and Subzone 3a between Black Diamond Mines Regional Preserve and Mount Diablo State Park**
- **Maintain diverse canopy-coverage stages**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures are designed specifically to benefit and contribute substantially to the recovery of Alameda whipsnake in the inventory area. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (Conservation Measures 1.6 and 1.9). The Preserve System will protect an estimated 1,690 acres of core and perimeter habitat, 10,564 acres of upland movement habitat, and 46 miles of stream movement habitat for Alameda whipsnake under the initial urban development area (Table 5-13).

The Plan requires land acquisition in Zones 2a, 2b, 2c, 3, and 4 to preserve an average of 70% of unprotected suitable habitat for Alameda whipsnake. For example, in Subzone 3a the Implementing Entity will acquire at least 90% of the suitable core habitat for Alameda whipsnake to protect the largest block of chaparral/scrub in the inventory area outside public lands. Protecting 90% of this block and protecting movement habitat surrounding it will provide a key linkage between existing, protected Alameda whipsnake habitat in Mount Diablo State Park and Black Diamond Mines Regional Park. Land acquired in Subzones 2a, 2b, 2c, and 3a will contribute to the recovery of Alameda whipsnake by protecting important movement habitat between known populations and among patches of core habitat. Land acquisition requirements will result in the preservation of 90% of all core and perimeter habitat for this species in the inventory area (including existing public lands).

Several preserve management measures will benefit and/or minimize impacts to Alameda whipsnake. For example, movement habitat for Alameda whipsnake will be enhanced through better management of oak woodland, oak savanna, and annual grassland (Conservation Measures 1.2, 2.4, and 2.6). Control of exotic plants (Conservation Measure 1.4) and recreational uses (Conservation Measure 1.5) may also benefit or minimize impacts to Alameda whipsnake. Recreational controls include limiting vehicle and bicycle traffic in whipsnake habitat and

minimizing the number of trails in suitable habitat[24]. Wildfire management measures such as vegetation management, fuel breaks, or prescribed burns will be designed to minimize impacts on and enhance habitat for Alameda whipsnake (see Conservation Measure 1.2).

Management of chaparral/scrub (Conservation Measure 2.8) will be conducted to minimize impacts on Alameda whipsnake but still provide the diversity of successional stages that are likely necessary to support the species. Alameda whipsnakes require canopy gaps in which to thermoregulate; these gaps will be maintained within core habitat to the maximum extent practicable through management of this land-cover type.

Giant Garter Snake

The biological goals and objectives for giant garter snake are listed below.

Goal: Compensate for temporary and permanent loss of giant garter snake habitat

- **Replace suitable upland and aquatic habitat at a ratio of 1:1 to 3:1 according to USFWS guidelines**
- **Emphasize the restoration of suitable habitat for giant garter snake on Dutch Slough**

Benefits of Landscape- and Community-Level Conservation Measures

Some of the landscape-level and community-level conservation measures will benefit giant garter snake. Development guidelines will ensure that some impacts on this species from covered activities are avoided or minimized (Conservation Measures 1.6, 1.9, and 1.10). No records of giant garter snake have been documented within the inventory area[25]. However, suitable habitat occurs in the sloughs and drainage network associated with agricultural fields in the northeast and eastern section of the County (U.S. Fish and Wildlife Service 1999). Modeled foraging, movement, and core habitat occurs in agricultural lands in Zone 6; modeled habitat also occurs north of Zone 6 outside of Acquisition Analysis Zones. However, the suitability of modeled habitat for giant garter snake has not been verified in the field. Giant garter snake habitat suitability in these areas will be determined and mapped during planning and preconstruction surveys (see Chapter 6, *Conditions on Covered Activities*).

The Implementing Entity will acquire conservation easements on at least 250 acres of cropland or pasture within Zone 6. Land acquired near Dutch Slough will include sloughs and ditches that may provide suitable habitat for giant garter

[24] Little is known about recreation impacts on Alameda whipsnake. Conservation Measure 1.5 is intended to prevent possible impacts on this species.

[25] The lack of records from the inventory area may be due to a lack of survey effort.

snake. Restoration activities are also prioritized for Dutch Slough and adjacent to Dutch Slough to benefit giant garter snake. The amount of restoration in these areas is undetermined, but up to 73 acres of slough/channel restoration could occur in the inventory area if suitable restoration sites are found. Much of this restoration would benefit giant garter snake.

Several preserve management measures may benefit giant garter snake. For example, Conservation Measures 1.2, 1.3, and 1.5 may enhance movement or dispersal habitat for giant garter snake in preserves. The following conservation measure is required to meet the biological goals and objectives for this species.

Conservation Measure 3.6. Compensate for Loss of Giant Garter Snake Habitat

If impacts on giant garter snake habitat as a result of covered activities cannot be avoided, compensation for temporary and permanent losses of suitable habitat will be achieved using the standard USFWS compensation formula as specified in the USFWS guidelines (U.S. Fish and Wildlife Service 1999). Replacement ratios vary from 1:1 to 3:1, depending on the duration of the impact (i.e., number of seasons the site is affected by construction); whether the affected habitat is aquatic or upland habitat; and whether the impact is temporary or permanent. There are two options for implementing this compensation requirement: (1) by selecting, acquiring, and managing in perpetuity a local mitigation site that is approved by USFWS for the sole purpose of compensating project impacts on giant garter snake, or (2) by participating in a pre-existing, USFWS-approved mitigation bank with a service area that includes Contra Costa County. If a local mitigation site is selected, the site will be incorporated into the HCP/NCCP Preserve System and managed by the Implementing Entity to support or enhance habitat for giant garter snake.

Western Pond Turtle

The biological goals and objectives for western pond turtle are listed below.

Goal: Maintain or increase the population and distribution of western pond turtle

- **Increase number and distribution of basking sites and underwater refugia in ponds**

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will benefit western pond turtle. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized to the maximum extent practicable (Conservation Measures 1.6 and 1.10). The Preserve System

will protect an estimated 675 or 873 acres of non-stream core habitat under the initial urban development area or maximum urban development area, respectively (Table 5-13). In addition, the Preserve System will protect an estimated 1,715or 1,956 acres of upland movement habitat (Table 5-13). Six or 7 miles of core stream habitat and 80or 92 miles of stream movement habitat will also be protected. Pre-acquisition surveys will be conducted to identify areas of suitable and/or occupied habitat for western pond turtle in potential preserve lands. Results of these surveys will be used to guide acquisition of occupied habitat.

To mitigate impacts on habitat for western pond turtle and other aquatic species, the Implementing Entity will acquire aquatic habitats in kind within preserves at the ratios in Table 5-5. Many of the acquired ponds are expected to be suitable habitat for western pond turtle. Mitigation will also include creation, restoration, or enhancement of aquatic land-cover types, including creation of habitat for juvenile turtles, as described in Conservation Measures 2.2 and 2.3. Because western pond turtle requires both aquatic and upland habitats, enhancement of wetlands or ponds to compensate for loss of habitat will occur adjacent to suitable and accessible upland habitat (extending at least 300 feet from the edge of wetlands or ponds), which will also be protected.

Because population viability is largely tied to the quality and quantity of suitable and linked breeding habitat, the preservation of large areas of contiguous habitat helps meet the conservation objectives for this species. A network of core preserves will protect large blocks of upland breeding and migration habitat for western pond turtle. New preserves will be established adjacent to existing protected land to maintain contiguous wetland-upland complexes.

The following measure for western pond turtles will also be implemented to conserve this species.

Conservation Measure 3.7. Enhance Habitat for Western Pond Turtle

The Implementing Entity will install artificial basking substrate and add woody debris to ponds that otherwise lack suitable basking sites to enhance habitat for western pond turtles. The artificial basking platforms are easily constructed and deployed and are being used successfully in the Los Vaqueros Watershed to attract and retain pond turtles in ponds. Woody debris and artificial basking substrate enhance habitat by providing areas for turtles to thermoregulate, an essential biological function. The platforms will be anchored to the pond bottom by nylon cord and a concrete weight and will float at an angle on the surface, rising and falling with the level of water (Alvarez in press). Basking platforms differ from woody debris in that they can be anchored, are durable, and will not be submerged by rising water levels. The basking platforms and added woody debris will also facilitate species-level monitoring by providing a consistent and stable point at which to count pond turtles.

Rationale

Western pond turtles bask to thermoregulate, and safe basking sites within aquatic areas are a key habitat requirement. Woody debris and basking platforms provide a safe and semi-permanent habitat feature for turtles to use. In addition to improving habitat for western pond turtle, the woody debris and basking platforms can provide an easy means for monitoring the turtles and can attract nonnative species of emydid turtles for subsequent removal (Alvarez in press.).

California Tiger Salamander

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures are designed specifically to benefit California tiger salamander. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized to the maximum extent practicable (Conservation Measures 1.6 and 1.10). The Preserve System will protect an estimated 96 or 111 acres of modeled breeding habitat under the initial or maximum urban development areas, respectively (Table 5-13). In addition, the Preserve System will protect an estimated 24,047 or 28,751 acres of migration/aestivation habitat under each permit scenario (Table 5-13). Pre-acquisition surveys will be conducted to identify areas of suitable and occupied habitat for California tiger salamanders in potential preserve lands. Results of these surveys will be used to guide acquisition of occupied habitat to the maximum extent practicable. Planning surveys for suitable breeding habitat will be conducted prior to submission of application packages for covered activities.

To compensate for loss of habitat for California tiger salamander and other aquatic species, the Implementing Entity will acquire aquatic habitats in kind within preserves at the ratios in Table 5-5. Many of the acquired ponds are expected to be suitable habitat for California tiger salamander. Mitigation will also include creation, restoration, or enhancement of aquatic land-cover types as described in Conservation Measures 2.2 and 2.3. Creation, restoration, and enhancement will be designed to support the life-history requirements of California tiger salamander. In order to contribute to the recovery of covered aquatic species, the Implementing Entity will also create or restore key aquatic land-cover types within preserves above and beyond the compensation requirements. These requirements are also described in Tables 5-16 and 5-17.

Because California tiger salamanders require habitat complexes that include both suitable breeding and upland habitat, areas preserved to achieve the biological goals and objectives for tiger salamander will include both habitat elements. For example, preservation, restoration, creation, or enhancement of wetlands or ponds to compensate for loss of breeding habitat will occur adjacent to suitable and accessible upland habitat that will also be protected. Likewise, upland habitat targeted for tiger salamander conservation must occur adjacent to a protected suitable breeding site.

A network of core preserves will protect large blocks of aestivation/migration habitat. New linkages will be created in blocks of suitable habitat to facilitate dispersal and colonization throughout the inventory area. New preserves will be established adjacent to existing protected land to maintain contiguous wetland-upland complexes. Because population viability is largely tied to the quality and quantity of suitable habitat, the preservation of large areas of contiguous habitat helps meet the conservation objectives for this species.

Several preserve management and community-level measures were designed to benefit California tiger salamander. For example, Conservation Measures 1.4, 1.8, 1.7, 2.1, 2.2, 2.3, 2.4, 2.5, and 2.12 will enhance habitat quality for California tiger salamander in preserves.

California Red-Legged Frog

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures are designed specifically to benefit and contribute to the recovery of California red-legged frog. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (see Conservation Measures 1.6 and 1.10). The Preserve System will protect an estimated 27 or 34 acres of modeled breeding habitat with the initial or maximum urban development areas, respectively (Table 5-13; also see Conservation Measure 1.1). In addition, the Preserve System will protect up to 29,222 acres of migration/aestivation habitat. Surveys (see Chapter 6) will be conducted to confirm habitat suitability and identify habitat occupied by California red-legged frogs in potential preserve lands. Results of these surveys will be used to guide acquisition of preserves to include occupied habitat to the maximum extent practicable. Planning surveys will be conducted prior to submission of application packages for covered activities.

To mitigate impacts on aquatic habitat types, the Implementing Entity will acquire aquatic habitats in-kind within preserves at the ratios specified in Table 5-5. Many of the acquired ponds are expected to be suitable habitat for California red-legged frog. Mitigation will also include creation, restoration, or enhancement of aquatic land-cover types as described in Conservation Measures 2.2 and 2.3. Creation, restoration, and enhancement will be designed to support the life-history requirements of California red-legged frog. Because red-legged frogs require habitat complexes that include both suitable breeding and upland habitat, areas preserved to achieve the biological goals and objectives for California red-legged frog will include both habitat elements. For example, preservation, restoration, creation, or enhancement of wetlands or ponds to compensate for loss of breeding habitat will occur adjacent to suitable and accessible upland habitat that will also be protected. A network of core preserves will protect large blocks of aestivation/migration habitat. New linkages will be created in blocks of suitable habitat to facilitate dispersal and colonization throughout Zones 2 and 5 of the Preserve System. New preserves will be

established adjacent to or near existing protected land and linked to such land. This approach will result in large areas of contiguous habitat and the potential to maintain contiguous wetland-upland complexes. Because population viability is tied to the extent and quality of habitat and connectivity among aquatic breeding sites, large areas of contiguous habitat will better meet the biological objectives for this species.

Several preserve-management measures were designed to benefit California red-legged frog. For example, Conservation Measures 1.4, 1.7, 1.8, 2.1, 2.2, 2.4, 2.5, and 2.12 will enhance habitat quality for California red-legged frog in preserves.

Foothill Yellow-Legged Frog

The biological goals and objectives for foothill yellow-legged frog are listed below.

Goal: Protect, maintain, or increase populations of foothill yellow-legged frog

- **Acquire land in Zone 4 along the upper reaches of Marsh Creek where high-quality breeding and dispersal habitat for foothill yellow-legged frog exists**

Benefits of Landscape- and Community-level Conservation Measures

The landscape-level and community-level conservation measures will benefit foothill yellow-legged frog and achieve the biological goals and objectives for this species. Development guidelines will ensure that impacts on this species from covered activities are avoided or minimized (see Conservation Measures 1.6 and 1.10). Surveys (see Chapter 6) will be conducted to assess habitat suitability and identify habitat occupied by foothill yellow-legged frogs in potential preserve lands; results of these surveys will be used to guide acquisition of preserves to include occupied habitat to the maximum extent practicable. Planning surveys for foothill yellow-legged frog are not required for covered activities.

Preservation of streams will be accomplished according to stream type. Impacts on perennial streams, including suitable foothill yellow-legged frog habitat, will be mitigated at a preservation ratio of 2:1 (Table 5-5). Mitigation will also entail stream restoration. Stream restoration will be attempted through the restoration of existing streams (e.g., creating meanders in channelized streams, removing concrete lining) but may be accomplished out of kind (see Conservation Measures 2.3 and 2.10). Maintaining natural stream flows is also important for yellow-legged frog populations. Restoration compliance for impacts on perennial streams can be accomplished through enhancement of riparian woodland/scrub; such restoration will be designed to support the life-history requirements of covered aquatic species, including foothill yellow-legged frog.

In all cases, the Implementing Entity will restore more streams than strictly required for mitigation in order to enhance habitat for and prevent the future listing of foothill yellow-legged frog. Importantly, land acquisition in Zone 4 will be focused along Marsh Creek, especially in the upper reaches, where modeled suitable breeding and dispersal habitat for yellow-legged frog is present. As much of the creek bed as possible and an adequate buffer zone will be acquired. The buffer zone acquired will be consistent with the requirements discussed in Chapter 6.

Several preserve-management measures will benefit foothill yellow-legged frog. For example, Conservation Measures 1.2, 1.4, 1.5, 1.7, 2.1, and 2.3 will enhance habitat for foothill yellow-legged frogs in preserves.

Longhorn Fairy Shrimp, Vernal Pool Fairy Shrimp, Midvalley Fairy Shrimp, and Vernal Pool Tadpole Shrimp

The biological goals and objectives for covered shrimp species are listed below.

Goal: Compensate for loss of occupied covered shrimp habitat

- **Preserve occupied habitat within the Preserve System at a ratio of 3:1 or dedicate an equivalent number of mitigation bank credits**
- **Restore suitable habitat within the Preserve System at a ratio of 2:1 or dedicate an equivalent number of mitigation bank credits**

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape- and community-level conservation measures will benefit and contribute to recovery of longhorn fairy shrimp, vernal pool fairy shrimp, midvalley fairy shrimp, and vernal pool tadpole shrimp. Impacts on these species from covered activities are avoided or minimized (see Conservation Measure 2.12). The Preserve System will protect up to an estimated 177 acres of seasonal wetland complexes in the inventory area (Table 5-5b), much of which is likely suitable for covered invertebrates. Priority will be given to acquiring sites with suitable habitat for vernal pool invertebrates, including rock outcrops and basins that provide habitat for longhorn fairy shrimp and vernal pool fairy shrimp. Information used to develop species-habitat models was not sufficiently detailed to determine the distribution and quality of vernal pool and other suitable habitat on lands considered for development or for preservation. Consequently, pre-acquisition surveys will be conducted to identify suitable habitat for covered shrimp species in potential preserve lands. Results of these surveys will be used to guide acquisition of suitable habitat to the maximum extent practicable. Prior to submission of an application package, planning surveys for suitable habitat for covered shrimp species will be conducted.

The Implementing Entity will attempt to restore up to an estimated 138 acres of seasonal wetland complexes in preserves (see Table 5-17 and Conservation Measure 2.2). Wherever feasible, seasonal wetland restoration will be designed to support one or more covered invertebrates. Restored vernal pools will be evaluated to determine if covered vernal pool crustaceans are present at frequencies similar to those in natural vernal pool complexes. If not, the Implementing Entity will assess the feasibility of transplanting inoculant species samples from occupied pools to restored pools to establish new populations. Such efforts will be conducted in the context of cautious experimental management and will utilize the best scientific information available.

The landscape-level and community-level measures are expected to protect some existing suitable habitat for covered shrimp species, as well as to minimize and compensate for impacts on all seasonal wetlands. However, the following measure is necessary to supplement those measures.

Conservation Measure 3.8. Compensate for Loss of Occupied Covered Shrimp Habitat

Applicants who fill vernal pools must determine if the pools provide suitable habitat for covered shrimp. If surveys show absence of covered shrimp (see Section 6.3.3), applicants will mitigate for impacts according to Conservation Measure 2.3 for seasonal wetlands. If vernal pools are occupied by covered shrimp, applicants must compensate for impacts to these vernal pools according to this measure. Applicants have the option of assuming presence of covered shrimp in lieu of conducting presence/absence surveys. Compensation for loss of occupied habitat will be achieved by implementing the following actions.

- Preserve 3 acres of occupied habitat within the Preserve System or dedicate an equivalent amount of vernal pool credits in a USFWS-approved mitigation bank for each acre affected.
- Restore 2 acres of suitable habitat within the Preserve System or dedicate an equivalent amount of vernal pool credit in a USFWS-approved mitigation bank for each acre affected[26].

The habitat restoration component may be achieved by restoring suitable vernal pool habitat in the Preserve System or participating in a USFWS-approved mitigation bank[27]. If habitat is restored within the Preserve System, the vernal pool acreage can be credited to the requirement for seasonal wetland creation in Conservation Measure 2.2 (and vernal pool restoration, if applicable). Soils

[26] Note that fill of jurisdictional wetlands will also require permits from USACE and RWQCB. Those permits may require mitigation beyond that required by the HCP/NCCP.

[27] There are currently no USFWS-approved mitigation banks for vernal pool invertebrates in the inventory area, so mitigation for these species will either occur in new banks created in the inventory area or outside the inventory area (in banks with approved service areas that include the project site).

collected as described in Chapter 6 will be used to inoculate newly created seasonal wetlands on preserve lands with cysts of covered shrimp species.

Rationale
Impacts on covered shrimp habitat include disturbances to seasonal wetlands, including vernal pools, and their adjacent uplands by covered activities both directly through project implementation or indirectly through human intrusion, introduced species, or pollution caused by the project. Impacts on a single wetland or pool could affect the hydrology of an entire wetland complex. The specified compensation ratios are based on existing mitigation standards (U.S. Fish and Wildlife Service 1996a).

Conservation Measures for Multiple Plant Species

The following conservation measures apply to all plant species or to subsets of plant species. Species-specific measures are listed after these general plant measures.

Conservation Measure 3.9. Conduct Experimental Management to Maintain or Enhance Covered Plant Populations

The Implementing Entity will initiate a program within the Preserve System to experiment with different management techniques to benefit covered plants; this program will be conducted as part of the Adaptive Management Program. A pilot study will be designed and implemented for each covered plant to determine the best methods to either maintain or enhance its populations. Management techniques will be selected for application and manipulation based on the ecological requirements of the species and hypotheses about which ecological factors may be most important to the species. For example, conceptual ecological models could be developed for each species to identify ecological relationships, potential effects (positive or negative) of management techniques on each plant life stage, and gaps in current knowledge (Elzinga et al. 1998). This information will help guide the design of the pilot studies. Management treatments may include the following:

- Prescribed burning;
- Livestock grazing (e.g., continue existing grazing regime, reduce or eliminate grazing using an exclosure, change grazing patterns, or change type of grazing animals);
- Mechanical clearing of vegetation;
- Herbicide application to reduce the biomass of competitors.

Pilot studies will only be carried out on relatively large populations and treatments will be applied to only a portion of those populations to minimize

potential adverse effects of the treatments. The results of these pilot studies will be used to inform preserve management techniques to maintain and, if possible, enhance populations of covered plants. Pilot studies should focus on addressing *key management questions* (BMP Ecosciences 2002). That is, studies should focus on addressing the issues of highest importance to the conservation of the species. The general questions below apply to all of the covered plants:

- What is a suitable microsite for the species?
- What is the abundance and distribution of these sites, and are they limiting population size? If so, can these microsites be created? If so, how?
- If unoccupied microsites are available, will the species colonize these sites naturally? If not, what techniques are available to facilitate colonization?
- What other factors may be limiting population size (e.g., disease, herbivory by native species or livestock, poor seed dispersal, low reproductive output, competition from exotic species) and what management techniques can be used to reduce or control these factors?

The Preserve Manager will work with local colleges and universities to encourage students and professors to conduct research on preserve lands to address key management questions. Money in this HCP/NCCP budget earmarked for directed research can be used to help fund the collection of this information.

Rationale

An important set of objectives of this HCP/NCCP directs that populations of covered plants within HCP/NCCP preserves will be maintained or enhanced to increase the long-term probability of survival of these species so that listing is unnecessary. However, as described in the species profiles, little is known about the ecological requirements of many covered plants. Furthermore, the effects of most proposed management techniques on these species are also unknown.

Experimentation is necessary to determine the best techniques to enhance covered plants within preserves. For example, intensive studies of one of the no-take species, *Amsinckia grandiflora*, have revealed many of the habitat requirements and several effective management techniques to enhance populations of this extremely rare plant (e.g., Pavlik et al. 1993; Carlsen et al. 2000). Alternatively, experimental results may indicate that covered plant populations are relatively stable and enhancement measures are not needed or not effective. Because the rarity characteristics of the covered plants are not understood (Rabinowitz 1981), further information on the abundance and distribution will be necessary before appropriate management techniques can be designed and implemented, if needed. Additional research and monitoring is necessary to better understand these species' ecological and management needs.

Livestock grazing is currently widespread in the inventory area, but its effects on covered plant populations are unknown. Some species or populations may benefit, while others may be harmed. Because livestock grazing will be one of the primary tools used to manage grassland vegetation communities, it is

important to determine the effects of grazing on herbaceous plants so that the grazing program can be adjusted to maintain and benefit the covered species.

Creating new populations of rare plants in an experimental setting is very time consuming, expensive, and often unsuccessful (e.g., Pavlik et al. 1993). Well-designed pilot studies of existing populations of covered plants may yield results more quickly and more cost effectively than creating new populations, but limits must be placed on such pilot studies to minimize adverse effects.

A complementary strategy is to expand and enhance suitable habitat for covered plants. Increasing the availability of suitable habitat will allow plant populations to expand or at least to be maintained. Such an approach, however, presumes a body of knowledge regarding the physical and biological characteristics of suitable habitat for covered species that does not currently exist. The landscape-level and community-level conservation measures in this conservation strategy will likely increase suitable habitat for some covered plants (see species-specific discussions below), but additional research in protected areas (including HCP/NCCP preserves) will be necessary to determine the precise habitat requirements of covered species so that their long-term viability can be assured.

Mount Diablo Manzanita

The biological objective for Mount Diablo Manzanita is listed below.

Goal: Protect at least two occurrences of Mt. Diablo manzanita outside currently protected public lands

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit Mount Diablo manzanita. No impacts on known occurrences[28] of Mount Diablo manzanita are expected to result from covered activities. However, if a new population[29] is found that is expected to be removed by covered activities, the Implementing Entity, through the planning surveys discussed in Chapter 6, will ensure that a population as healthy as or healthier[30] than the one proposed for removal will be protected within HCP/NCCP preserves. The two known occurrences of Mount Diablo manzanita in the

[28] A plant occurrence is defined in the same way as an *element occurrence* is defined by CDFG: a location record of a plant in the CNDDB that is a population or group of populations within 0.25 mile and not separated by significant habitat discontinuities.

[29] A population is defined as a group of individuals that are separated biologically from other groups of individuals by topographic barriers, habitat barriers, or other important ecological features. Populations may be less than 0.25 mile apart, so they may or may not be the same as an occurrence. Known occurrences can be evaluated in the field as to whether they constitute one or more populations.

[30] See Conservation Measure 1.1 for definition of a "healthy" population.

inventory area outside public lands will be protected by the Preserve System (Table 5-20 and Conservation Measure 1.1). Moreover, an estimated 414 acres of the modeled suitable range[31] for Mount Diablo manzanita will be protected within the Preserve System under the initial urban development area or the maximum urban development area (Table 5-12). This protected land constitutes 61% of the remaining species range that is available for preservation.

Management of HCP/NCCP preserves will also benefit Mount Diablo manzanita. Conservation Measures 1.4 and 1.5 ensure that exotic plants and recreational use will be controlled within preserves. For example, visitors to parks within the EBRPD system may illegally harvest branches of manzanitas for decorative purposes (Olson pers. comm.). Public access to known populations of Mount Diablo manzanita within preserves will be controlled to avoid such illegal collection. Vegetation management actions, including prescribed burning (Conservation Measures 1.2 and 2.8), will ensure that the condition of the chaparral vegetation community that supports Mount Diablo manzanita will be maintained. Management in other areas has shown Mount Diablo manzanita produces high densities of seedlings following prescribed burning in late summer or fall (M. A. Showers, pers. comm.). If necessary, experimental management techniques will be applied to populations of this species within preserves to determine the best means to enhance population health and viability (Conservation Measure 3.9).

The biological objective for Mount Diablo manzanita is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

Brittlescale

The biological objective for brittlescale is listed below.

Goal: Protect at least two occurrences of brittlescale outside currently protected public lands

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit brittlescale. Impacts on one known population of brittlescale are expected from covered activities. The Implementing Entity, through the planning surveys discussed in Chapter 6, will ensure that populations as healthy

[31] For covered plants, the species distribution models represent the potential range of the species within the inventory area, not necessarily the amount of suitable habitat present. Plants, especially rare plants, tend to occur in distinctive microhabitats (characterized, for example, by slope, aspect, plant association, soil type) that cannot be mapped at a regional scale. These variables were not incorporated into the species distribution models, so the models should be viewed as an estimate of the plant species' potential range in the inventory area within which suitable habitat and plant populations would likely be found.

as or healthier than the populations removed will be protected within HCP/NCCP preserves. (If populations as healthy or healthier cannot be identified impacts are not allowed under the terms of the plan) It is likely that one known population of brittlescale will be affected by covered activities. The remaining four known occurrences of brittlescale in the inventory area that are presently not in protected lands will be brought under protection by the Preserve System (Table 5-20 and Conservation Measure 1.1). In addition, an estimated 577 or 697 acres of the modeled species range for brittlescale will be protected within the Preserve System under the initial urban development area and the maximum urban development area, respectively (Table 5-12). This protected land constitutes from 52% to 63%, respectively, of the species range in the inventory area that is available for preservation.

Management of HCP/NCCP preserves will benefit brittlescale. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within alkali grassland and alkali wetlands (Conservation Measures 2.1, 2.2, 2.4, and 2.12) will benefit brittlescale by maintaining or enhancing suitable habitat for this species. Approximately 63 to 69 acres of alkali wetlands will be restored within preserves (Tables 5-16 and 5-17). One objective of alkali wetland restoration is to restore suitable habitat for brittlescale (e.g., in alkali meadows).

The biological objective for brittlescale is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

San Joaquin Spearscale

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit San Joaquin spearscale. The only known population of San Joaquin spearscale outside public lands was recently found in Antioch during development of the Sand Creek Specific Plan (Mundie & Associates and City of Antioch 2002). This population may be extirpated by activities not covered by the plan. All remaining 31 known occurrences of this species are within the Los Vaqueros Watershed (Table 5-20). Although rare in California, the species is relatively common in the Los Vaqueros Watershed, where extensive surveys have been conducted (Jones & Stokes Associates 1989). It is expected that other populations will be found within the inventory area, particularly on alkali soils in Zone 5.

No species distribution model was developed for San Joaquin spearscale because of the difficulty in predicting the species' occurrence relative to conditions that could be mapped at a regional scale. This species often co-occurs with brittlescale, so it is anticipated that protection of suitable habitat for the species

will be largely coincidental with protection of habitat suitable to support brittlescale.

Management of HCP/NCCP preserves will benefit San Joaquin spearscale. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within alkali grassland and alkali wetlands (Conservation Measures 2.1, 2.4, 2.2, and 2.12) will benefit San Joaquin spearscale by maintaining or enhancing suitable habitat for this species. Approximately 63–69 acres of alkali wetlands will be restored within preserves (Tables 5-16 and 5-17). One objective of alkali wetland protection is to protect additional suitable habitat for San Joaquin spearscale (e.g., in alkali meadows).

Conservation and management for San Joaquin spearscale are addressed through landscape- and community-level measures and the one measure that applies to all covered plants. No additional species-specific conservation measures are required.

Big Tarplant

The biological objective for big tarplant is listed below.

Goal: Protect at least five occurrences of big tarplant outside currently protected public lands

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit big tarplant. One population of big tarplant is expected to be lost to covered activities. However, the remaining five known occurrences of big tarplant in the inventory area outside public lands will be protected by the Preserve System (Table 5-20) (Conservation Measure 1.1). In addition, an estimated 9,300 or 11,395 acres of the modeled species range will be protected within the Preserve System under the initial urban development area and the maximum urban development area, respectively (Table 5-12). This protected land constitutes from 49% to 61%, respectively, of the species range in the inventory area available for preservation.

Management of HCP/NCCP Preserves will benefit big tarplant. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves to minimize adverse impacts.

The biological objective for big tarplant is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

Mount Diablo Fairy Lantern

The biological objective for Mount Diablo fairy lantern is listed below.

Goal: Protect at least one occurrence of Mount Diablo fairy lantern outside currently protected public lands

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit Mount Diablo fairy lantern. No known populations of Mount Diablo fairy lantern are expected to be lost to covered activities. The one known occurrence of Mount Diablo fairy lantern in the inventory area outside public lands will be protected by the Preserve System, if this occurrence is still extant (Table 5-20) (Conservation Measure 1.1). If this population (in Subzone 4b) has been extirpated, completion of planning surveys will ensure that no other population will be removed until a new population is found within the preserves that is as healthy or healthier than the population lost (see Conservation Measure 1.1 for a definition of "healthy"). Moreover, an estimated 11,178 or 13,360 acres of the modeled species range will be protected within the Preserve System under the initial urban development area and the maximum urban development area, respectively (Table 5-12). This protected land constitutes from 46% to 55%, respectively, of the species range in the inventory area available for preservation.

Management of HCP/NCCP preserves will benefit Mount Diablo fairy lantern. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves to minimize possible competition with this species. Conservation Measure 1.5 ensures that public access will be controlled and monitored so that the species is not collected by visitors. Vegetation management and enhancement within native grassland (Conservation Measures 2.1 and 2.4), oak savanna/woodland (Conservation Measures 2.1 and 2.6), and chaparral (Conservation Measures 2.1 and 2.8) will benefit Mount Diablo fairy lantern by maintaining or enhancing suitable habitat for this species. Approximately 54–177 acres of oak savanna will be restored within preserves (Table 5-16 and 5-17 and Conservation Measure 2.7). One objective of oak savanna restoration is to provide additional suitable habitat for Mount Diablo fairy lantern.

The biological objective for Mount Diablo fairy lantern is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

Recurved Larkspur

The biological objective for recurved larkspur is listed below.

Goal: Protect at least two occurrences of recurved larkspur outside currently protected public lands

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit recurved larkspur. Impacts on one known population of recurved larkspur are expected from covered activities. The Implementing Entity, through the planning surveys described in Chapter 6, will ensure that a population as healthy as or healthier than the population removed will be protected within HCP/NCCP preserves. The two remaining known occurrences of recurved larkspur in the inventory area outside public lands will be brought under protection by the Preserve System (Table 5-20) (Conservation Measure 1.1). Moreover, an estimated 389 or 1,064 acres of the modeled range for this species will be protected within the Preserve System under the initial urban development area and the maximum urban development area, respectively (Table 5-12). This protected land constitutes from 21% to 59%, respectively, of the species range available for preservation.

Management of HCP/NCCP Preserves will benefit recurved larkspur. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within alkali grassland and alkali wetlands (Conservation Measures 2.1, 2.4, 2.2, and 2.12) will benefit recurved larkspur by maintaining or enhancing suitable habitat for this species. Approximately 63–69 acres of oak savanna will be restored within preserves (Table 5-16 and 5-17 and Conservation Measure 2.7). One objective of alkali wetland restoration is to restore additional suitable habitat for recurved larkspur (e.g., in alkali meadows).

The biological objective for recurved larkspur is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

Round-Leaved Filaree

The biological objective for round-leaved filaree is listed below.

Goal: Protect at least two occurrences of round-leaved filaree outside currently protected public lands

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit round-leaved filaree. Impacts on two known occurrences of round-leaved filaree are expected from covered activities. Completion of planning surveys will help the Implementing Entity to ensure that a population as healthy as or healthier than the two occurrences removed will be protected within

HCP/NCCP preserves. Two of the five known occurrences of round-leaved filaree in the inventory area outside public lands will be brought under protection by the Preserve System (Table 5-20; Conservation Measure 1.1). Because the location of several of the seven documented occurrences are not well known and there have been few surveys for this species in the area, it is expected that more than two occurrences would be protected in the Preserve System. An estimated 2,877 or 2,997 acres of the primary habitat for this species will be protected within the Preserve System under the initial urban development area and the maximum urban development area, respectively (Table 5-12). This protected land constitutes from 51% to 53%, respectively, of the primary habitat in the inventory area available for preservation.

Management of HCP/NCCP Preserves will benefit round-leaved filaree. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves; increases in the cover of exotic grasses may have contributed to the decline of round-leaved filaree. Vegetation management and enhancement within grasslands (Conservation Measure 2.4) will benefit round-leaved filaree by maintaining or enhancing suitable habitat for this species.

The biological objective for and conservation needs of round-leaved filaree are addressed through landscape- and community- level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species objective.

Diablo Helianthella

The biological objective for Diablo Helianthella is listed below.

Goal: Protect at least two occurrences of Diablo helianthella outside currently protected public lands

Benefits of Landscape- and Community-Level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit Diablo helianthella. No impacts on known populations of Diablo helianthella are expected from covered activities. However, the Implementing Entity, through the planning surveys, will ensure that if a population is discovered within impact areas, a population as healthy as or healthier than that removed will be protected within HCP/NCCP preserves.(If a population as healthy or healthier cannot be identified, impacts will not proceed under the terms of the plan). Both known occurrences of Diablo helianthella in the inventory area outside public lands will be brought under protection by the Preserve System (Table 5-20) (Conservation Measure 1.1). Moreover, the Preserve System will protect an estimated 6,168 acres of the modeled suitable range for this species under the initial urban development area (Table 5-12). This protected land constitutes 46% of the species range in the inventory area available for preservation (Table 5-12).

Management of HCP/NCCP preserves will benefit Diablo helianthella. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within oak savanna/woodland (Conservation Measures 2.1 and 2.6) and chaparral (Conservation Measures 2.1 and 2.8) will benefit Diablo helianthella by maintaining or enhancing suitable habitat for this species. Approximately 54–177 acres of oak savanna will be created or restored in the Preserve System (Tables 5-16 and 5-17). One objective of oak savanna restoration is to provide additional suitable habitat for Diablo helianthella.

The biological objective for Diablo helianthella is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

Brewer's Dwarf Flax

The biological objective for Brewer's dwarf flax is listed below.

Goal: Protect at least three occurrences of Brewer's dwarf flax outside currently protected public lands

Benefits of Landscape- and Community-level Conservation Measures

Many of the landscape-level and community-level conservation measures will directly benefit Brewer's dwarf flax. No impacts on known populations of Brewer's dwarf flax are expected from covered activities (Table 5-20). The Implementing Entity, through the planning surveys, will ensure that if a population is discovered within impact areas, a population as healthy as or healthier than that removed will be protected within HCP/NCCP preserves. All three known occurrences of Brewer's dwarf flax in the inventory area outside public lands will be brought under protection by the Preserve System (Table 5-20) (Conservation Measure 1.1). Approximately 9,337 acres of the modeled suitable range for this species will be protected within the Preserve System under the initial permit area (Table 5-12). This protected land constitutes 49% of the species range available for preservation.

Management of HCP/NCCP Preserves will also benefit Brewer's dwarf flax. For example, Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within native grassland (Conservation Measures 2.1 and 2.4), oak savanna/woodland (Conservation Measures 2.1 and 2.6), and chaparral (Conservation Measures 2.1 and 2.8) will benefit Brewer's dwarf flax by maintaining or enhancing suitable habitat for this species. Approximately 54–177 acres of oak savanna will be created or restored in the preserve system (Tables 5-16 and 5-17). (Conservation Measure 2.7). One objective of oak savanna restoration is to provide additional suitable habitat for Brewer's dwarf flax.

The biological objectives for Brewer's dwarf flax is addressed through landscape- and community-level measures and measures that apply to all covered plants. No additional species-specific measures are required to meet the species goals and objectives.

Showy Madia

The goals and objectives for showy madia are listed below.

Goal: Protect populations of showy madia within oak woodland

- **Identify and maintain or increase populations of showy madia in the inventory area**

Benefits of Landscape- and Community-level Conservation Measures

Showy madia is not currently known to occur in the inventory area (Table 5-20), but suitable habitat exists. A historic occurrence of showy madia in Antioch was not relocated during recent surveys (Mundie & Associates and City of Antioch 2002). This species was considered for no-take status. The inventory area represents the northernmost edge of a fairly wide distributional range in California (see the species profile in Appendix D). Within its entire range, 32 occurrences have been documented, although the current status of these occurrences is unknown. Because the inventory area represents a relatively small portion of the species' range, impacts on new occurrences of this species could occur as long as an equal number of populations were preserved in the HCP/NCCP Preserve System. As for other plants, the preserved populations must be as healthy or healthier than the population lost. Until a population is found and protected in an HCP/NCCP preserve, no impacts on this species will be allowed. No species distribution model was developed for showy madia because of the difficulty in predicting its occurrence relative to conditions that could be mapped at a regional scale.

Many of the landscape-level and community-level conservation measures will directly benefit showy madia if the species is found within HCP/NCCP preserves. Development conditions will ensure that impacts on this species from covered activities are avoided or minimized (see Chapter 6). Completion of planning surveys will ensure that botanical surveys will be conducted in potential impact areas and that high-quality populations will be avoided. Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within native grassland (Conservation Measures 2.1 and 2.4) and oak savanna (Conservation Measures 2.1 and 2.6) may also benefit showy madia by maintaining or enhancing suitable habitat for this species. Approximately 54–177 acres of oak savanna will be created or restored in the preserve system (Tables 5-16 and 5-17 and Conservation Measure 2.7). Oak savanna restoration may provide additional suitable habitat for showy madia.

Conservation and management for showy madia are addressed through landscape- and community-level measures and the one measure that applies to all covered plants. No additional species-specific conservation measures are required to meet the species goal and objective.

Adobe Navarretia

The goals and objectives for adobe navarretia are listed below.

Goal: proTect populations of adobe navarretia within wetlands

- **Identify, protect, and maintain populations of adobe navarretia in the inventory area**

Benefits of Landscape- and Community-Level Conservation Measures

The only known records of this species in the inventory area are two historic collections in and near Antioch from 1888 and 1907 (Jepson Herbarium 2003). These populations are assumed to have been extirpated. This species was considered for no-take status. The inventory area is a small portion of a broad distributional range throughout the Central Valley (see the species profile in Appendix D). Within this range, 12 occurrences have been documented (Table 5-20), although the current status of these occurrences is unknown. Because the inventory area represents a relatively small portion of the species' range, it was determined that some impacts on the species could occur as long as the highest-quality populations were preserved if any are found. Until the historic populations are relocated or more populations are found and protected in HCP/NCCP preserves, no impacts on this species will be allowed (see Chapter 6). No species distribution model was developed for adobe navarretia because the suitable habitat of this species is poorly known.

Many of the landscape-level and community-level conservation measures will directly benefit adobe navarretia, if it is found in HCP/NCCP preserves. For example, development conditions will ensure that impacts on this species from covered activities are avoided or minimized (see Chapter 6). Completion of planning surveys will ensure that botanical surveys will be conducted in potential impact areas and that high-quality populations will be avoided. Conservation Measure 1.4 ensures that exotic plants will be controlled within preserves. Vegetation management and enhancement within native grassland (Conservation Measures 2.1 and 2.4) may benefit adobe navarretia by maintaining or enhancing suitable habitat for this species.

Conservation and management for adobe navarretia are addressed through landscape- and community-level measures and the one measure that applies to all covered plants. No additional species-specific conservation measures are required to meet the species goal and objective.

Chapter 5
Tables

Table 5-1. Natural Community-level and Additional Species-specific Biological Goals and Objectives and Associated Conservation Measures

Covered Species Expected to Benefit from Wetlands (and other Aquatic) Biological Goals and Objectives:

Tricolored blackbird	Vernal pool tadpole shrimp
California red-legged frog	Longhorn fairy shrimp
California tiger salamander	Midvalley fairy shrimp
Giant garter snake	Adobe navarretia
Western pond turtle	Brittlescale [Grassland]
Vernal pool fairy shrimp	

Notes:

- Goals and objectives are organized by natural community type. Community-level goals and objectives that support multiple covered species are presented first within each section. Species-specific goals and objectives are developed and presented only when the community-level goals do not adequately address the species' needs.
- Habitat shown in brackets is the habitat with which the species is primarily associated; any specific Biological Goals and Objectives pertaining to this species are addressed in their primary habitat.

Wetlands (and other Aquatic) Biological Goals and Objectives	Conservation Measures
Goal 1: Preserve wetlands and ponds in the inventory area	
Objective 1.1. Acquire perennial wetlands at a ratio of 1:1 of wetted acres (estimated to be 75 wetted acres with the maximum urban development area) and protect as part of the Preserve System	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 1.2. Acquire seasonal wetlands at a ratio of 3:1 of wetted acres (estimated to be 177 acres of seasonal wetland complex with the maximum urban development area) and protect as part of the Preserve System	**Conservation Measure 1.3.** Prepare and Implement Agricultural Management Plans for Cultivated Agricultural Lands
Objective 1.3. Acquire alkali wetlands at a ratio of 3:1 of wetted acres (estimated to be 96 acres of alkali wetland complex with the maximum urban development area) and protect as part of the Preserve System in Zones 2, 5, and 6	
Objective 1.4. Acquire ponds at a ratio of 2:1 of wetted acres (estimated to be 16 wetted acres with the maximum urban development area) and protect as part of the Preserve System	
Objective 1.5. Acquire at least seven of the 13 ponds in Subzone 2c to provide suitable breeding habitat for tricolored blackbird, California tiger salamander, California red-legged frog, and/or western pond turtle	
Objective 1.6. Acquire slough/channel at a ratio of 0.5:1 of wetted acres (estimated to be 36 wetted acres with the maximum urban development area) and protect as part of the Preserve System	
Objective 1.7. Acquire aquatic (open water) at a ratio of 1:1 of wetted acres (estimated to be 17 wetted acres with the maximum urban development area) and protect as part of the Preserve System	
Objective 1.8. Preserve and maintain contiguous wetland-upland complexes	

Wetlands (and other Aquatic) Biological Goals and Objectives	Conservation Measures
Goal 2: Maintain and enhance hydrogeomorphic and ecological function of wetlands and ponds to promote covered species, native biological diversity, and habitat heterogeneity	
Objective 2.1. Maintain or increase native emergent vegetation where appropriate	**Conservation Measure 1.2.** Prepare and Implement an Exotic Plant Control Program for the Preserve System
Objective 2.2. Reduce sediment deposition and transport where appropriate	
Objective 2.3. Maintain or increase wetland and pond capacity and water duration as appropriate.	**Conservation Measure 1.3.** Prepare and Implement Management Plans for Cultivated Agricultural Lands
Objective 2.4. Maintain or increase flows to and connectivity among wetlands and wetland complexes as appropriate	**Conservation Measure 2.2.** Manage Wetlands and Ponds
Objective 2.5. Eliminate or reduce non-native animals	
Objective 2.6. Eliminate or reduce exotic plants	
Objective 2.7. Maintain or enhance upland habitat in close proximity to wetlands and ponds to support the life-history requirements of wetland-dependent covered species	
Goal 3: Restore wetlands and create ponds in Preserve System to compensate for permanent loss of these habitats	
Objective 3.1. Restore perennial wetlands in-kind at a ratio of 1:1 of wetted acres (estimated to be 75 wetted acres with the maximum urban development area)	**Conservation Measure 2.3.** Restore Wetlands and Create Ponds
Objective 3.2. Restore alkali wetlands in-kind at a ratio of 2:1 of wetted acres (estimated to be 64 acres of alkali wetland complex with the maximum urban development area)	
Objective 3.3. Restore seasonal wetlands in-kind at a ratio of 2:1 of wetted acres (estimated to be 118 acres of seasonal wetland complex with the maximum urban development area)	
Objective 3.4. Create ponds in-kind at a ratio of 1:1 (estimated to be 8 acres with the maximum urban development area) to support California tiger salamander, California red-legged, and/or western pond turtle	
Objective 3.5. Compensate for loss of slough/channel by either restoring slough/channel at a ratio of 1:1 where feasible or restoring riparian woodland/scrub in Zone 6 at a ratio of 0.5:1	
Objective 3.6. Compensate for loss of aquatic (open water) by creating ponds at a ratio of 0.5:1 (estimated to be 9 acres of ponds with the maximum urban development area) to support California tiger salamander, California red-legged, and/or western pond turtle	
Objective 3.7. Compensate for loss of aquatic (open water) by creating ponds at a ratio of 0.5:1 (estimated to be 9 acres of ponds with the maximum urban development area) to support California tiger salamander, California red-legged, and/or western pond turtle	

Wetlands (and other Aquatic) Biological Goals and Objectives	Conservation Measures
Goal 4: Restore wetlands and create ponds in the Preserve System to contribute to recovery of covered species	
Objective 4.1. Restore 10 wetted acres of perennial wetlands	**Conservation Measure 2.3.** Restore Wetlands and Create Ponds
Objective 4.2. Restore 5 wetted acres of alkali wetlands	
Objective 4.3. Restore 20 wetted acres of seasonal wetlands	
Objective 4.4. Create 8 acres of ponds to support California tiger salamander, California red-legged, and/or western pond turtle	
Goal 5: Enhance habitat for tricolored blackbird in the Preserve System	
Objective 5.1. Restore perennial wetlands so that at least 25% will provide breeding habitat	**Conservation Measure 2.2.** Manage Wetlands and Ponds
Objective 5.2. Restore perennial wetlands to provide breeding habitat at least 1 mile from black-crowned night heron colonies and within flight distance of blackbird foraging habitat	**Conservation Measure 2.3.** Restore Wetlands and Create Ponds **Conservation Measure 3.2.** Minimize Predation on Tricolored Blackbird Colonies
Goal 6: Compensate for temporary and permanent loss of giant garter snake habitat	
Objective 6.1. Replace suitable upland and aquatic habitat at a ratio of 1:1 to 3:1 according to USFWS guidelines	**Conservation Measure 3.6.** Compensate for Loss of Giant Garter Snake Habitat
Objective 6.2. Emphasize the restoration of suitable habitat for giant garter snake on Dutch Slough	
Goal 7: Maintain or increase the population and distribution of western pond turtle	
Objective 7.1. Increase number and distribution of basking sites and underwater refugia in ponds	**Conservation Measure 3.7.** Enhance Habitat for Western Pond Turtle
Goal 8: Compensate for loss of occupied covered shrimp habitat	
Objective 8.1. Preserve occupied habitat within the Preserve System at a ratio of 3:1 or dedicate an equivalent number of mitigation bank credits	**Conservation Measure 3.8.** Compensate for Loss of Occupied Covered Shrimp Habitat
Objective 8.2. Restore suitable habitat within the Preserve System at a ratio of 2:1 or dedicate an equivalent number of mitigation bank credits	
Goal 9: Protect populations of adobe navarretia within wetlands	
Objective 9.1. Identify, protect, and maintain populations of adobe navarretia in the inventory area	**Conservation Measure 1.1.** Acquire Lands for Preserve System

Covered Species Expected to Benefit from Grassland Biological Goals and Objectives	
San Joaquin kit fox	Recurved larkspur
Townsend's big-eared bat	Round-leaved filaree
Western burrowing owl	Swainson's hawk [Streams and Riparian woodland/scrub]
Golden eagle	Tricolored blackbird [Wetlands]
Silvery legless lizard	Alameda whipsnake [Chaparral/scrub]
Big tarplant	Western pond turtle [Wetlands]
San Joaquin spearscale	California tiger salamander [Wetlands]
Brittlescale	California red-legged frog [Wetlands]

Grassland Biological Goals and Objectives	Conservation Measures
Goal 10: Preserve sufficient habitat in the inventory area to maintain viable populations of grassland-dependent covered species	
Objective 10.1. Preserve 13,000 acres of annual grassland and 900 acres of alkali grassland	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 10.2. Protect native grassland alliances within the Preserve System	
Goal 11: Enhance grassland to promote native biological diversity and habitat heterogeneity	
Objective 11.1. Increase the relative cover of native grasses and forbs in native grassland vegetation alliances and other grassland types	**Conservation Measure 1.4.** Prepare and Implement an Exotic Plant Control Program for the Preserve System
Objective 11.2. Increase structural diversity by creating and maintaining a mosaic of grassland types and conditions	**Conservation Measure 2.4.** Manage Grassland
Objective 11.3. Reduce the biomass, cover, and extent of exotic plants (i.e., non-native invasive plants) in the Preserve System	
Goal 12: Increase availability of burrows within grassland for San Joaquin kit fox, California tiger salamander, California red-legged frog, and western burrowing owl	
Objective 12.1. Increase the number and distribution of California ground squirrel burrows	**Conservation Measure 2.5.** Manage Natural Burrow Availability and Prey Base in Grasslands

Grassland Biological Goals and Objectives	Conservation Measures
Goal 13: Preserve the most important movement routes and core habitat for San Joaquin kit fox	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 13.1. Preserve 3,200 acres in Horse, Lone Tree, and Deer Valleys (Subzones 2e, 2f, 2g, and 2h) to protect the two most important movement routes for San Joaquin kit fox between Black Diamond Mines Regional Preserve and Cowell Ranch State Park	
Objective 13.2. Preserve an important movement route for San Joaquin kit fox between Alameda County and Contra Costa County by protecting habitat in Zone 5 between the County line, the Byron Airport Habitat Mitigation Lands, and the Los Vaqueros Watershed	
Objective 13.3. Preserve 4,300 acres of annual grassland and 750 acres of alkali grassland in Subzones 5a and 5d as suitable core habitat	
Goal 14: Maintain or increase population size and distribution of Townsend's western big-eared bat in the Preserve System	
Objective 14.1. Preserve hibernacula and maternity roosts of Townsend's western big-eared bat	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 14.2. Enhance roosting habitat by protecting any abandoned mine, cave, or building in the Preserve System and, if feasible, creating artificial hibernacula	**Conservation Measure 1.5.** Prepare and Implement a System-wide Recreation Plan for the Preserve System
	Conservation Measure 3.1. Protect and Enhance Roosting Habitat for Townsend's Western Big-Eared Bat
Goal 15: Maintain or increase population size and distribution of golden eagles in the inventory area	
Objective 15.1. Acquire land in the Preserve System that includes occupied nests and suitable nest sites	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 15.2. Retire wind turbine leases within the Preserve System, when feasible	**Conservation Measure 3.3.** Protect Golden Eagle Nest Sites within Preserve System
Goal 16: Maintain or increase population size and distribution of western burrowing owl	
Objective 16.1. Install artificial burrows and perches as temporary attractants, where appropriate	**Conservation Measure 1.1.** Acquire Lands for Preserve System
	Conservation Measure 3.4. Temporarily Create Artificial Burrows in Grasslands to Attract and Retain Burrowing Owls
	Conservation Measure 3.5. Install Temporary Artificial Perches to Attract and Retain Burrowing Owls

Grassland Biological Goals and Objectives	Conservation Measures
Goal 17: Protect in the Preserve System at least 11 unprotected occurrences of grassland-dependent covered plants	
Objective 17.1. Protect populations of covered plants that are at least as large and as healthy* as populations lost to covered activities	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 17.2. Protect at least two occurrences of brittlescale outside currently protected public lands	
Objective 17.3. Protect at least five occurrences of big tarplant outside currently protected public lands	
Objective 17.4. Protect at least two occurrences of recurved larkspur outside currently protected public lands	
Objective 17.5. Protect at least two occurrences of round-leaved filaree outside currently protected public lands	
Goal 18: Enhance populations of grassland-dependent covered plants	
Objective 18.1. Increase population size and distribution of grassland-dependent covered plants, where feasible and biologically desirable	**Conservation Measure 3.9.** Conduct Experimental Management to Enhance Covered Plant Populations

Covered Species Expected to Benefit from Oak Woodland Biological Goals and Objectives:

Showy madia	California tiger salamander [Wetlands]
San Joaquin kit fox [Grassland]	Western pond turtle [Wetlands]
Golden eagle [Grassland]	Mt. Diable fairy lantern [Chaparral/scrub]
Silvery legless lizard [Grassland]	Diablo helianthella [Chaparral/scrub]
California red-legged frog [Wetlands]	Brewer's dwarf flax [Chaparral/scrub]

Oak Woodland Biological Goals and Objectives	Conservation Measures
Goal 19: Preserve oak woodland and oak savanna in the inventory area.	
Objective 19.1. Protect 900 acres of oak woodland and oak savanna	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Goal 20: Maintain the current canopy coverage of oaks and other native overstory trees within oak woodland and oak savanna land-cover types	
Objective 20.1. Ensure tree recruitment and age structure are adequate to replace lost trees and maintain canopy coverage	**Conservation Measure 1.4.** Prepare and Implement an Exotic Plant Control Program for the Preserve System
Objective 20.2. Reduce competition between tree seedlings and other plants to enhance survival rates of tree seedlings and saplings	**Conservation Measure 2.6.** Manage Oak Woodland and Oak Savanna

Oak Woodland Biological Goals and Objectives	Conservation Measures
Goal 21: Enhance oak woodland and oak savanna to promote biological diversity and habitat heterogeneity	
Objective 21.1. Increase the proportion of native species in oak woodland and oak savanna understories	**Conservation Measure 2.6.** Manage Oak Woodland and Oak Savanna
Objective 21.2. Leave in place snags, dead trees, and downed wood	
Goal 22: Restore oak savanna to compensate for its loss from covered activities	
Objective 22.1. Replace oak savanna vegetation alliances (in kind) that are lost to covered activities at a ratio of 1:1	**Conservation Measure 1.1.** Acquire Lands for Preserve System
	Conservation Measure 2.7. Compensate for loss of Oak Savanna
Objective 22.2 Establish within 50 years of initiating restoration a sufficient number of blue or valley oak trees to provide a percent tree canopy cover equal to or up to 10% greater than the percent canopy cover in oak savanna stands removed by covered activities	
Goal 23: Protect populations of showy madia within oak woodland	
Objective 23.1. Identify and maintain or increase populations of showy madia in the inventory area	**Conservation Measure 1.1.** Acquire Lands for Preserve System
	Conservation Measure 3.9. Conduct Experimental Management to Enhance Covered Plant Populations

Covered Species Expected to Benefit from Chaparral/Scrub Biological Goals and Objectives	
Alameda whipsnake	Diablo helianthella
Mount Diablo manzanita	Brewer's dwarf flax
Mount Diablo fairy lantern	

Chaparral/Scrub Biological Goals and Objectives	Conservation Measures
Goal 24: Preserve chaparral/scrub in the inventory area	
Objective 24.1. Protect 550 acres of chaparral/scrub that support a diversity of native plant alliances including chaparral, California sage scrub, and black sage scrub	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Goal 25: Enhance chaparral/scrub to promote native biological diversity and habitat heterogeneity	
Objective 25.1. Maintain or mimic the natural fire regime	**Conservation Measure 2.8.** Manage Chaparral/Scrub
Objective 25.2. Maintain a mosaic of stand ages and species composition across the landscape	
Objective 25.3. Promote canopy gaps within chaparral/scrub patches	

Chaparral/Scrub Biological Goals and Objectives	Conservation Measures
Goal 26: Contribute substantially to the recovery of Alameda whipsnake in the inventory area by protecting and enhancing chaparral/scrub	
Objective 26.1. Preserve an average of 70% of currently unprotected core and perimeter whipsnake habitat in Subzones 2a, 2b, 2c, 3a, and Zone 4	**Conservation Measure 1.1.** Acquire Lands for Preserve System **Conservation Measure 2.8.** Manage Chaparral/Scrub
Objective 26.2. Preserve whipsnake movement habitat between patches of core whipsnake habitat, including the linkage in Zone 2 and Subzone 3a between Black Diamond Mines Regional Preserve and Mount Diablo State Park	
Objective 26.3. Maintain diverse canopy-coverage stages	
Goal 27: Protect in the Preserve System at least eight occurrences of chaparral-dependent covered plants	
Objective 27.1. Protect populations of covered plants that are at least as large and as healthy* as populations lost to covered activities	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 27.2. Protect at least two occurrences of Mt. Diablo manzanita outside currently protected public lands	
Objective 27.3. Protect at least two occurrences of Diablo helianthella outside currently protected public lands	
Objective 27.4. Protect at least three occurrences of Brewer's dwarf flax outside currently protected public lands	
Objective 27.5. Protect at least one occurrence of Mount Diablo fairy lantern outside currently protected public lands	

Covered Species Expected to Benefit from Streams and Riparian Woodland/Scrub Biological Goals and Objectives	
Swainson's hawk	Western pond turtle [Wetlands]
Foothill yellow-legged frog	California red-legged frog [Wetlands]

Streams and Riparian Woodland/Scrub Biological Goals and Objectives	Conservation Measures
Goal 28: Preserve streams and riparian woodland /scrub in the inventory area	
Objective 28.1. Protect a minimum of 5 linear miles of stream to compensate for permanent loss of habitat.	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 28.2. Acquire riparian/scrub at a ratio of 2:1 (estimated to be 70 acres for maximum urban development area) and protect as part of the Preserve System	

Streams and Riparian Woodland/Scrub Biological Goals and Objectives	Conservation Measures
Goal 29: Enhance riparian woodland/scrub to promote native biological diversity and habitat heterogeneity	
Objective 29.1. Maintain or increase the cover, width, and connectivity of existing riparian vegetation consistent with current stream and habitat function	**Conservation Measure 1.4.** Prepare and Implement an Exotic Plant Control Program for the Preserve System
Objective 29.2. Reduce the biomass, cover, and extent of exotic plants in the Preserve System	**Conservation Measure 2.9.** Manage Streams and Riparian Woodland/Scrub **Conservation Measure 2.10.** Restore Streams and Riparian Woodland/Scrub to Compensate for Habitat Loss and to Increase Biodiversity
Goal 30: Maintain and enhance instream aquatic habitat for covered species and native fish	
Objective 30.1. Promote the natural disturbance regime (e.g., flooding, sediment deposition, and scour)	**Conservation Measure 2.9.** Manage Streams and Riparian Woodland/Scrub **Conservation Measure 2.10.** Restore Streams and Riparian Woodland/Scrub to Compensate for Habitat Loss and to Increase Biodiversity
Objective 30.2. Reduce water temperature and temperature variation	
Objective 30.3. Increase inputs of organic matter where appropriate	
Objective 30.4. Reduce sediment input and downstream sediment transport and deposition, where appropriate	
Objective 30.5. Maintain and enhance instream structural diversity, where appropriate	
Objective 30.6. Improve stream flow and connectivity for native aquatic wildlife	
Objective 30.7. Control or reduce non-native animals including bullfrogs and fish	
Goal 31: Restore streams and riparian woodland/scrub	
Objective 31.1. Restore at least 20 acres of riparian woodland/scrub in addition to that required above as compensation for habitat loss.	**Conservation Measure 2.9.** Manage Streams and Riparian Woodland/Scrub **Conservation Measure 2.10.** Restore Streams and Riparian Woodland/Scrub to Compensate for Habitat Loss and to Increase Biodiversity
Objective 31.2. Replace riparian woodland/scrub at a ratio of 1:1 in the Preserve System to compensate for its loss from covered activities (estimated to be 30 acres with maximum urban development area)	
Objective 31.3. Restore species richness and diversity, vegetative cover, wildlife habitat function and hydrologic function	
Goal 32: Maintain or increase population size and distribution of Swainson's hawk in the inventory area	
Objective 32.1. Acquire land in the Preserve System that includes occupied nests and suitable nest sites	**Conservation Measure 1.1.** Acquire Lands for Preserve System
Objective 32.2. Acquire 250 acres of cropland or pasture for Swainson's Hawk foraging along Kellogg Creek, Marsh Creek, or adjacent to Dutch Slough that is suitable for riparian restoration within 1 mile of the Zone 6 boundary	

Streams and Riparian Woodland/Scrub Biological Goals and Objectives	Conservation Measures
Goal 33: Protect, maintain, or increase populations of foothill yellow-legged frog	
Objective 33.1. Acquire land in Zone 4 along the upper reaches of Marsh Creek where high-quality breeding and dispersal habitat for foothill yellow-legged frog exists	**Conservation Measure 1.1.** Acquire Lands for Preserve System

* Healthy populations of plants are defined by physical condition, age structure, reproductive success, diversity and availability of suitable habitat, long-term observation of population.

Table 5-2. Relationship of Conservation Measure Type to Conservation Scale

	Scale of Conservation Measure		
Type of Conservation Measure	Landscape-level	Community-level	Species-level
Land Preservation	✓		
Habitat Enhancement	✓	✓	
Habitat Restoration		✓	
Habitat Creation		✓	
Population Enhancement			✓
Avoidance/Minimization Measures (see Chapter 6)	✓	✓	✓