Report of
Independent Science Advisors
for
Santa Clara Valley
Habitat Conservation Plan / Natural Community Conservation Plan (HCP/NCCP)

Prepared For
County of Santa Clara
Santa Clara Valley Water District
City of Gilroy
City of Morgan Hill
City of San Jose
Santa Clara Valley Transportation Authority
California Department of Fish and Game
United States Fish and Wildlife Service

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Executive Summary

This report summarizes recommendations from a group of independent science advisors for the Santa Clara Valley Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP). This scientific input is provided early in the planning process to help the plan proceed with best available science. The advisors operate independent of the entities involved in planning or implementing the HCP/NCCP. Our recommendations are advisory only and not binding on HCP/NCCP participants.

Our recommendations are organized by the following major topics: (1) scope of the plan, (2) review of existing information, (3) conservation design, (4) conservation analyses, and (5) adaptive management and monitoring.

Scope of the Plan

The scope of an HCP/NCCP includes its biological goals, geographic area, plan duration, species to be addressed, and actions to be permitted.

Biological Goals

The advisors recommend developing a hierarchical framework of goals and objectives that tiers off the overarching goals of the NCCP program, which are "to sustain and restore those species and their habitats… necessary to maintain the continued viability of… biological communities impacted by human changes to the landscape" and "to conserve, protect, restore, and enhance natural communities." Based on these broad goals, which go beyond obtaining permits to "take" covered species, we recommend defining measurable objectives tailored to the specific ecological setting, natural communities, and species of concern. These objectives should be used to develop resource-specific criteria to guide plan development and to define monitoring and management actions.

The advisors recommend that plan goals specifically address the maintenance of ecological processes, such as natural or semi-natural hydrological and fire regimes, rather than focusing narrowly on conserving locations and species. Goals should also include maintaining and enhancing ecological connectivity, including physical connectivity between habitat areas, hydrological connectivity along streams, and lateral connectivity from streams to floodplains to uplands.

The advisors discussed potential conflicts in goals for riparian communities, especially along Coyote Creek. The conflict arises between restoring a presumed historical condition (intermittent flows and associated sycamore alluvial woodland) versus contributing to recovery of sensitive species, especially threatened steelhead (*Oncorhynchus mykiss*), that depend on the more perennial flows and denser riparian vegetation now present below dams. We recommend carefully researching means of meeting both fisheries goals and historic ecological goals, for example by restoring sycamore alluvial woodlands along braided side channels or other locations that won't conflict with steelhead recovery actions.

Geographic Extent

The planning area is reasonable as delineated, but we recommend accounting for effects that transcend plan boundaries, such as downstream effects on aquatic resources, disruption of habitat connectivity into adjoining counties, or disruption of ecosystem processes that work at regional scales.

Plan Duration

The 50-year plan duration is reasonable for an HCP/NCCP, but we urge recognition that conservation, management, and monitoring actions must be continued in perpetuity. Habitat losses and species extinctions are (for all practical purposes) irreversible; and science-informed management intervention will be required to address changing conditions, including climate change, well beyond this 50-year horizon.

Species Addressed

The advisors concur with the process used to identify species to be covered by take authorizations (permits) and with the designation of certain "no-take" species. However, NCCPs are not strictly endangered-species permitting plans, but are required to sustain and enhance the state's *natural communities*. We therefore recommend supplementing the list of "covered" species with some "planning species" to help achieve the plan's broader biological goals.

<u>Covered Species</u>

The list of proposed covered species (Jones & Stokes 2006) is generally reasonable and defensible. However we recommend considering the following **additions**:

- Black rail (*Laterallus jamaicensis coturniculus*). The advisors recommend reconsidering this as a potentially covered species. We are not convinced that the study area is outside the species' range and has no suitable habitat, in light of recent discoveries of black rails in small, isolated wetlands elsewhere in California.

- Rare Plants. Consider adding at least some of these rare plant species, which may benefit from plan implementation: *Viburnum ellipticum, Ptelea crenulata*, *Arctostaphylos andersonii, Acanthomintha lanceolata, Helianthus exilis, Calandrinia breweri, Leptosiphon ambiguous, Clarkia breweri, Leptosiphon grandiflorus, Clarkia concinna* ssp*. automixa, Lessingia tennis, Erysimum franciscanum, Piperia michaelii, Fritillaria agrestis,* and *Galium andrewsii* ssp*. gatense.*

We also recommend the following **deletions** from the covered species list:

- Monterey roach (*Lavinia symmetricus subditus*). This subspecies is not threatened within the plan area and is not particularly useful as a planning species.

- Unsilvered fritillary (*Speyeria adiaste adiaste*). This species is unlikely to be found in the planning area or affected by plan actions.

- Kit fox (*Vulpes macrotis mutica*). Although kit fox are occasionally sighted in southern Santa Clara County, the plan area is not considered important to this species' conservation or recovery. Nevertheless, road-crossing improvements may benefit this and many other species by reducing roadkill.

- Bank swallow (*Riparia riparia*), purple martin (*Progne subis*), and saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*). We agree with consultants that these species are unlikely to be affected by the plan.

No-take Species

The advisors generally agree with the logic of designating a few "no-take" species due to their extreme rarity, but we caution that no-take provisions can sometimes conflict with biological goals due to constraints they may create for habitat management. We specifically discussed adding coyote ceanothus (*Ceanothus ferrisae*) to the no-take list, but decided this designation may interfere with rather than further species recovery by discouraging land owners from facilitating or allowing population expansions or reintroductions.

Planning Species

In addition to covered species, we recommend selecting some planning species to help guide plan development. Planning species may include indicators of healthy habitat or ecological processes that benefit many species, or they may be particularly sensitive to certain threats, such as roadkill, pollution, or habitat fragmentation (Lambeck 1997). We recommend reviewing the list of potentially covered species to see how well it represents the variety of communities and ecological threats of concern in the planning area, and then identifying additional planning species to address any gaps in this representation. We specifically recommend considering the following planning species to address threats to ecological connectivity and wildlife movement:

- American badger (*Taxidea taxis*). We strongly recommend using badger as a planning species, due to its sensitivity to habitat fragmentation and roadkill. If the reserve design and road-crossing improvements are adequate to sustain badger populations, many other species will benefit.
- Cougar (*Puma concolor*). This species contributes to ecosystem health via its role as a top carnivore, and there is a growing concern that cougars in the Santa Cruz Mountains are becoming genetically and demographically isolated from other populations—and could disappear if remaining movement corridors are severed. However, some advisors were concerned that explicitly recognizing cougar as a planning species may be misinterpreted as encouraging cougar use of urban-interface areas, and thus potential human-cougar interactions.

Covered Actions

The advisors reviewed the potential effects of development and other actions to be permitted via the plan. We focused our review on less obvious, indirect impacts that might otherwise be overlooked, rather than dwelling on obvious impacts like habitat loss that we assume the plan will fully address.

Urban Development

In addition to direct removal and fragmentation of natural habitats, urban development increases impervious surfaces and runoff, which adversely affects aquatic habitats and species via sedimentation, pollution, etc. The plan should analyze and mitigate for these effects.

Rural Development

Low-density rural development fragments habitats and introduces adverse "edge effects" into adjoining natural areas, such as weedy exotic species, house pets, irrigation runoff, pesticides, and fertilizers. The plan should account for these reductions in habitat value within a zone of influence around developments—based on the approximate distance the most detrimental effects are expected to penetrate habitat areas—and counter them with appropriate mitigation measures.

Increased ground-water pumping also often accompanies rural development (and vineyard conversion), which can reduce stream flows and affect aquatic communities. These potential adverse effects should also be estimated and mitigated by the plan. We note that commercial vineyard conversion was explicitly excluded from the plan's covered activities (Jones & Stokes, August 2006, Chapter 2), but we recommend analyzing the potential effects of vineyard conversions on covered resources and providing guidelines to minimize and mitigate them.

Where new roads or road improvements cross natural areas, we recommend incorporating Before-After-Control-Impact studies of wildlife movement and roadkill to identify where wildlife crossing structures (e.g., underpasses or overpasses coupled with wildlife fencing) will benefit ecological connectivity and reduce roadkill (Hardy et al. 2003, Orth and Riley 2005, Clevenger and Kociolek 2006).

<u>Operations and Maintenance within Streams, Ponds, and Lakes</u>

The plan should consider whether changes in reservoir operations are feasible as habitat enhancement or mitigation actions for aquatic species. Reservoirs block much of the former habitat of steelhead in area watersheds, and appropriately timed water releases are important to allowing access for fish and maintaining appropriate temperatures in the remaining, downstream habitat.

Both on-channel and off-channel percolation ponds can warm downstream waters, because the cooler inflows sink to the bottom and warmer surface waters flow out of the pond. Ponds also harbor non-native fish that harm native species. Percolation ponds should be located as far downstream as possible to minimize the affected stream length. Existing ponds that could be moved off-channel or otherwise modified to enhance biological conditions include Ogier Ponds, Metcalf Percolation Pond, Silveira Lake, and a pond created as a borrow pit near the mouth of Cedar Creek on Pacheco Creek.

On-channel ponds in headwater areas may actually benefit steelhead provided they do not warm waters too much, do not harbor abundant exotic species, and do not block fish migration. We recommend considering operation of Sprig Lake and Pickel Dam to enhance steelhead production in the Uvas Creek and Little Arthur Creek watersheds.

Review of Existing Information

The advisors reviewed various maps, reports, and other information provided by the plan consultants (Jones & Stokes 2006). We offer some recommendations for improving or supplementing this information.

Plan Documents

An HCP/NCCP must be as transparent and credible as possible, and should fully detail the methods used along with any uncertainties in findings, predictions, and policy decisions. Evaluating uncertainties is essential for assessing tradeoffs among alternatives and for structuring monitoring and management programs. All maps, data, and analyses should include detailed descriptions of the methods and uncertainties, for example by including error bars for statistical summaries. All predictions or model outcomes should at least be accompanied by qualitative assessments of uncertainty (e.g., high, medium, or low confidence in predicted outcomes).[1]

We also recommend providing a clear method for developing and selecting among plan alternatives *during plan development* rather than waiting to develop alternatives during the NEPA/CEQA process, which may result in overlooking viable alternatives until too late.

Maps

We recommend improving some map coverages, including with finer resolution mapping of wetland and serpentine soil communities and increased error checking.

- Wherever possible, show continuous map coverages beyond planning area boundaries to illustrate the plan's geographic context. Map coverages "clipped" to planning boundaries constrain judgment of how biotic communities, species distributions, or other features connect into adjoining areas.
- Consider incorporating the detailed mapping of vegetation alliances for Coyote Ridge prepared by the Santa Clara County Chapter of the California Native Plant Society (CNPS; Evans and San 2004; http://www.cnps.org/programs/vegetation/reports.htm).
- Consider using helicopter surveys, aerial photographs, or LIDAR images from wet months to maximize detection of small or seasonal wetlands and to error-check land-cover maps.
- Obtain outside review of vegetation maps by CNPS or other qualified individuals.
- Consider additional mapping of historic versus present vegetation to better inform restoration priorities.
- Develop a floodplain-channel system map that shows floodplains and their relation to stream courses, vegetation communities, and property boundaries to inform alternative approaches to flood hazard reduction.
- Map concentrations of exotic species, especially for riparian habitats, to assist with identifying restoration and management opportunities.
- Include waterways (rivers and streams) and their names on all maps.
- Map and characterize watersheds using criteria that reflect their ecological integrity and functionality, such as the nature and extent of aquatic communities, upland buffers, and human alterations.
- For aquatic habitat types, use the stream habitat map developed by Jerry Smith (July 2006; Potential Fisheries in Selected Santa Clara County Streams) for the Santa Clara Valley Water District (SCVWD).

Species Distribution Data

The advisors offer the following suggestions for ensuring the best available species location data are used.

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[1]Recognizing that plan documents are written for a broad audience, we recommend placing details of methods and analyses in appendices, and summarizing key findings and uncertainties in the body of the text.

- Use all reliable data sources, and especially museum records, which are increasingly available as georeferenced digital files and can be traced back to verifiable specimens.
- Recognize the limitations of species location data that may include misidentifications, imprecise locations, and sampling biases (e.g., greater sampling in areas near roads, towns, or flatter slopes).
- Incorporate additional rare plant species location data collected by Santa Clara County CNPS.
- Seek review of species distribution maps by other local experts, such as the local CNPS chapter for plants.

Species Habitat Suitability and Distribution Models

Since comprehensive survey coverage is not feasible for most species, we recommend judicious use of habitat suitability models. However, the GIS overlay models the consultants have used thus far are not the best available means of mapping habitat values or predicting species distributions. We recommend developing more rigorous statistical distribution models for those species where existing data are adequate, such as generalized additive models (GAM) or hierarchical regression models (see Scott et al. 2002, Guisan and Thuiller 2005, Beissinger et al. 2006 for recent reviews). Many statistical models produce continuous gradients of a species' probability of occurrence, or at least multiple categories of habitat value, which can be more revealing for conservation planning than discrete suitable/unsuitable habitat maps.

A number of sophisticated software packages for analyzing species distribution data are now freely available, such as:

- BioMapper (www.unil.ch/biomapper);
- MaxEnt (www.cs.princeton.edu/~schapire/maxent); or
- GARP (www.lifemapper.org/desktopgarp).

If the number of species observation points within the study area is too small to build robust statistical models, consider increasing the study area window to include more occurrences to build the model, and then apply the resultant model to the smaller planning area window. For species having too few observation points even with an expanded study window, expert-opinion models are acceptable, so long as the model structure and logic are appropriate to reasonably predict species distributions, and so long as model uncertainties are clearly articulated.

Regardless of which approach to distribution modeling is selected, recognize that there are a wider variety of environmental variables available than are often considered in simple GIS overlay approaches. These include continuous variables like elevation and annual precipitation, and derived landscape variables, such as habitat patch sizes, fragmentation indices, distance from water, primary productivity, insolation indices, and road density.

Conservation Design

The following recommendations should be refined once the biological goals are fully developed.

General Approach

[2]The opportunistic approach of identifying key lands that may be available for conservation is common and often unavoidable in conservation planning, due to time and cost constraints. However, the advisors recommend using formal reserve-selection algorithms (Margules and Pressey 2000) and the tenets of reserve design (Noss et al. 1997:73-110) to ensure a robust and defensible conservation design. Whether or not computer-aided reserve-selection algorithms are used (see below), the biological goals, decision rules, and assumptions for reserve design should be made as transparent and repeatable as possible, so that tradeoffs are explicit.

<u>Reliance on Existing Land-use Protections</u>

The advisors are concerned that resource protections in existing General Plans and local ordinances (e.g., community "green lines") may not be permanent—nor allow sufficient flexibility and access for biological monitoring and management—so that using these designations as starting points for reserve design may be misleading. We recommend a thorough analysis of the degree of protection afforded by existing designations and ordinances and comparing the degree of permanency, effectiveness, management responsibility, costs, and risks to covered resources amongst a range of conservation alternatives. Only those land-protection designations that permanently conserve habitat value, and allow for active biological management and monitoring, should be treated as truly conserved in the plan.

<u>Coordination with Other Plans and Studies</u>

The advisors strongly advise coordinating with other local conservation planning efforts:

- The Nature Conservancy's Mount Hamilton project.
- Relevant endangered species recovery plans, including those for serpentine soil species, California red-legged frog (*Rana aurora draytonii*), and central California and south central California steelhead (pending).
- Santa Clara County Parks Planning and Development Master Plan.
- The Riparian Restoration Action Plan for the City of San Jose (Jones & Stokes 2000).
- Studies on badgers and other carnivores being done by researchers at UC Davis and San Jose State University.
- Studies by Stuart Weiss on nitrogen deposition effects on sensitive serpentine soils species, and means of countering these effects.

[2] Note that during the drafting of this Science Advisors' report, the plan consultants issued a memorandum concerning the application of reserve-design principles to the planning process (Zippin 2006, in litt.). This memorandum may make some of the following discussion moot, although we include our recommendations for completeness.

- Serpentine grassland management and monitoring efforts conducted by Silicon Valley Land Trust, Kirby Canyon Butterfly Trust, Santa Clara County Open Space District, Santa Clara County Parks District, and the Environmental Trust of the Ranch at Silver Creek.

<u>Specific Geographic Areas of Concern</u>

The following locations that should receive high priority in designing the reserve system and defining restoration and enhancement actions:

- **Coyote Ridge**: Coyote Ridge is essential to the survival and recovery of the Bay checkerspot butterfly and numerous other species. We recommend adding to existing reserves there to better conserve, buffer, and connect butterfly and rare plant habitat.
- **Coyote Valley**. We recommend consolidating and restoring viable samples of historic vegetation communities on valley floors, especially sycamore alluvial woodlands in the floodplain of Coyote Creek.
- **Vicinity of Santa Teresa County Park and Tulare Hill Ecological Reserve**. This area seems the last remaining opportunity to maintain ecological connectivity between mountains on either side of Coyote Valley. Greater conservation here (in conjunction with Laguna Seca) and improved road crossings in the vicinity may be essential to sustaining populations of certain species, such as badgers and cougars, in the Santa Cruz Mountains.
- **Laguna Seca Wetland.** This degraded wetland adjacent to Tulare Hill should be a high priority for restoration and enhancement of wetland functions and values.
- **Serpentine habitat on the west-side of Santa Clara Valley**. At least one and preferably three serpentine grassland sites on the west side of Coyote Valley should be preserved and managed to reduce the risks of changing circumstances (e.g., climate change) that might adversely affect serpentine species on drier Coyote Ridge.
- **Sprig Lake in Mount Madonna County Park**. Regulated use of this headwater pond could substantially increase steelhead smolt production in the Uvas Creek watershed.

Use of Reserve-Selection Algorithms

To meet NCCP goals, the reserve system should be designed to include functional samples of all natural communities in the planning area in a reserve system that ensures sustainability for all covered resources. GIS based reserve-selection algorithms (such as the computer programs SITES and MARXAN) are useful tools for meeting these goals, because they can rapidly integrate complex goals and inputs to derive alternative reserve scenarios in an objective, efficient, and transparent manner. The goals, decision rules, and assumptions are made explicit, and therefore can be varied to compare tradeoffs between alternative designs. We recommend investigating use of formal reserve-selection algorithms (Margules and Pressey 2000) to assist in reserve design. However, please recognize that no reserve-selection algorithm can completely design a reserve system: They are decision-support tools that must be used in concert with the basic tenets of reserve design (see below) to ensure that the selected reserves are sufficiently large, connected, and buffered to sustain each covered (and planning) species, and to allow for the relatively natural function of ecological processes.

Conservation Design Principles for Terrestrial Habitats

We were pleased that, during the drafting of this report, the consultants issued a memorandum describing how conservation design principles will be applied to this plan (Zippin 2006, in litt.). We agree with the principles thus outlined, which represent a generally sound interpretation of the reserve-design literature (e.g., Noss et al. 1997:73-110). We add the following recommendations for further consideration and elaboration, recognizing that they are somewhat redundant with those in Zippin (2006, in litt.):

- Conserve large open-space systems that comprise a full range of environmental gradients and community types within contiguous areas, as opposed to scattered reserves each supporting a small sample of the available variation.
- Concentrate new reserves adjacent to existing reserves to increase the size, connectivity, and buffering of existing conservation investments.
- Connect reserves to one another *and to open spaces beyond planning boundaries* to allow for wildlife movement and shifting environmental conditions (e.g., with climate change).
- Minimize development incursions into large blocks of intact habitats. Concentrate development near existing development and roads. Maximize infill, densification, and community aggregation strategies to minimize habitat fragmentation.
- Avoid fragmenting large upland areas by roads or other developments, which can have severe effects on area-dependent species, like American badger. Internal fragmentation (e.g., by inholdings in reserve areas) may constrain management measures, such as prescribed fire.
- Maximally avoid impacts to rare communities that support narrow endemic species, such as serpentine soils.
- Avoid impacts to grasslands on or near the interface with oak woodlands and savannahs, which are valuable to a variety of declining bird species and other wildlife.
- Use larval-occurrence data and the habitat classification scheme devised by Stuart Weiss for Bay checkerspot butterfly to help prioritize additional conservation areas on Coyote Ridge. Conserve the full range of small-scale topographic variation on the Ridge and nearby areas.

Conservation Design for Riparian/Riverine Corridors

Conserving and recovering aquatic species requires accommodating or re-creating natural physical and ecological processes, such as floods, sediment transport, erosion, and deposition, which have been highly altered by dams, canals, and percolation ponds.

- Include stream corridors in biological reserves and use them as "backbones" to connect other (e.g., terrestrial) reserve areas. Make these corridors as broad as possible, and strive for continuity of riparian systems from headwaters to river mouths, as well as lateral continuity from aquatic habitats, through floodplains, to adjacent uplands.
- Manage stream flows below reservoirs to maintain favorable conditions for target resources. Flow management could substantially enhance habitat value and migration for native fish in the following streams: Guadalupe, Alamitos, Arroyo Calero, Upper Penitencia, Coyote, Uvas, Llagas, and Pacheco.

- Increase the amount of naturally inundated floodplain in the planning area by restoring natural topography, hydrology, and vegetation where possible. Restore and enhance native riparian vegetation and control exotic vegetation.
- Use pipeline screens or pressure differences to prevent transfers of aquatic animals between streams during inter-basin water transfers.
- Control runoff from man-modified landscapes, especially urban development and vineyards.
- Remove or alter on-channel ponds that adversely affect target species, including Ogier Ponds, Metcalf Pond, and Silveira Pond.
- Develop a steelhead enhancement program for four watersheds (two in each of the two distinct population segments in the planning area): Uvas and Pacheco Creeks in South County, and Coyote Creek and Guadalupe River in North County. This redundancy will help protect against catastrophic losses.

Conservation Analyses

Predicting effects of a conservation plan on target resources is one of the most important yet underdeveloped tasks in most HCP/NCCPs. At a minimum, the plan must fully analyze its likely effects on populations of covered species, which often requires assessing plan effects on physical or ecological processes. It also requires addressing such uncertainties as the effects of global climate change, or how land uses are likely to change over the permit duration (30 or 50 years), with or without plan implementation. The HCP/NCCP should comprehensively analyze the likely spatial patterns of future development and infrastructure, and how this will affect habitat fragmentation, wildlife movement, and ability of reserves to support covered species. The plan should also specifically analyze likely effects of future road improvements on wildlife movements, roadkill, and ecological connectivity. Finally, the plan should analyze how well the reserve system captures (or "represents") the range of environmental variability in the plan area.

Conservation and Take of Covered Species

The plan should predict, as best possible with available knowledge and models, whether plan implementation will increase, decrease, or have no measurable effect on the population size, sustainability, and recovery of each covered species. We don't advocate formal, quantitative, population viability analyses (PVA) for most covered species, because the necessary data are usually lacking. (One exception to this may be Bay checkerspot butterfly, for which a PVA incorporating metapopulation dynamics and considering climate change would be beneficial.)

For most species, we recommend using a systematic, limiting-factor analysis to predict plan effects. For each species (1) identify the key factors limiting its population size and recovery; (2) assess (quantitatively if possible) how each limiting factor will change with implementation of the plan or alternatives; (3) carefully weigh the relative contribution of each change to overall population size and recovery; (4) determine the likely net cumulative effect of all these changes, considered together, on population size and recovery.

For example, a slight decrease in habitat acreage may be more than compensated by increased carrying capacity of the remaining habitat, due to improved habitat management or restoration of some limiting factor (e.g., nesting sites, migration corridors, or water temperature). On the other hand, improvements in certain limiting factors may be moot if one or more other factors are lacking (e.g., enhancing habitat value for a species in an area it cannot reach due to movement barriers). The evidence used to make these decisions should be carefully documented, along with all key uncertainties. These uncertainties should become foci of the monitoring program.

Effects on Ecological Processes

In addition to species-by-species analyses, the plan should assess how implementation will affect important ecological processes that affect many species or natural communities in common, such as flooding, stream flows, fire, atmospheric nitrogen deposition, and exotic species invasions. We recommend analyzing changes in those ecological processes that are most influential in shaping and maintaining natural communities (for example, intermittent stream flows and periodic floods for sycamore alluvial woodlands; fire regimes for chaparral). For each natural community and process of interest, we recommend estimating the natural or historic range of variability (Landres et al. 1999) and assessing how the plan will likely affect this range (i.e., will plan implementation move the process closer to or farther from its natural range of variability?). These process analyses should also serve as inputs to the covered species analyses described above. Finally, these analyses should guide development of the adaptive management program, with monitoring designed to test the hypothesized changes and management actions to move processes closer to desired ranges.

Representation Analysis

A representation analysis evaluates how well a reserve system *represents*, or samples, the range of variation within an area of interest, such as whether it includes significant examples of all vegetation types, species habitats, or geological substrates in the plan area. We recommend a representation analysis of physical (abiotic) habitats and natural vegetation, assessing to what degree each type is represented in existing or potential reserves. Physical attributes to be evaluated include watershed attributes, climate variables, slope-aspect categories, and geological substrates.

In addition to univariate representation, we urge consideration of a multivariate representation analysis, which would help reveal how well joint occurrences of features of interest are represented in the reserve system. For example, whereas a univariate representation analysis may suggest that serpentine soils are well conserved, a multivariate analysis may reveal that existing reserves capture only a subset of the topographic and climatic conditions important to Bay checkerspot butterflies. We encourage applying some strategic multivariate representation analyses based on the quality of available data and what combinations of variables are most likely to be meaningful to covered species requirements.

Effects of Climate Change

Global climate change (Oreskes 2004) is projected to continue increasing temperatures in the study area, and will likely affect precipitation patterns, although the amount of change is uncertain. Warming temperatures may reduce the availability of water imported from the Delta (originating in the Sierra Nevada) and consequently may reduce the amount of water released into local streams for groundwater recharge and maintenance of stream flows for fish. Warmer (and possibly drier) conditions may also alter the length of the fire season and increase wildland fire risks, which will be especially problematic if development moves more into rural hillsides. Sea level rise will affect the San Francisco baylands and lower stream reaches.

Since the nature of these changes is somewhat predictable, they should be considered "changed circumstances" that are reasonably foreseeable over the plan duration and therefore accommodated by the adaptive management program. Effects on covered species should be considered in the conservation analysis, with management and monitoring contingencies built into the plan. Uncertainty about the magnitude of effects, and interactions between multiple effects, will require considerable attention in the adaptive management and monitoring program.

Adaptive Management and Monitoring

Adaptive management is a systematic process for continually improving management practices by learning from outcomes of previous actions. The adaptive management plan should contain feedback loops to inform land managers and those overseeing plan implementation. If possible, specific *a priori* management thresholds should be developed for each plan objective. Management thresholds tell managers when a change in management action is needed.

Management Recommendations for Select Natural Communities

Although it is too early in planning to identify all necessary and sufficient management guidelines, we offer some preliminary recommendations for select natural communities.

<u>Grasslands</u>

Grasslands management should be informed by the latest research on use of managed grazing and fire to counter the adverse effects of annual grasses and thatch buildup on native communities and species (Harrison et al 2003, Harrison et al 2006, Keeley 2002). Managed livestock grazing is an important grassland management tool for reducing thatch and maintaining short-statured native annual forbs, especially in serpentine grasslands. An adaptive grazing program should be designed to answer questions about the optimal timing, intensity, and species of grazers to use.

Controlling invasive exotic plants, such as barbed goatgrass (*Aegilops triuncialis*) and Italian ryegrass (*Lolium multiflorum*), is a major management concern. Fire has little long-term effect on degree of exotic dominance, unless carefully timed (late spring) to eliminate exotic seed input. Prescribed fire is controversial due to air quality concerns, and alternative control measures, such as pulsed grazing, hand-pulling, or herbicides may be necessary.

<u>Chaparral and Coastal Scrub</u>

Fire is a central concern for managing chaparral and coastal scrub habitats, but is not well studied in this region. We recommend that the plan include (1) post-fire monitoring strategies to learn more about the fire ecology of target resources; (2) small-scale experimental prescribed burns to stimulate reproduction of target species (e.g., *Malacothamnus*, *Ceanothus*); and (3) wildfire management plans that minimize adverse effects of fire-suppression activities (e.g., no wet-season prescribed burns, no fire lines through sensitive habitats).

<u>Oak Woodlands and Savannahs</u>

Management in oak woodlands and savannahs should strive to increase oak regeneration and control exotic species. Poor oak regeneration, especially in blue oaks (*Quercus douglassi*), is a major concern (Swiecki and Bernhardt 1998, Gordon and Rice 2000). Exotic annual grasses and forbs (e.g., yellow starthistle) may compete with oak seedlings or harm them indirectly by subsidizing high densities of small mammals. Exclusion of livestock also appears necessary but not sufficient to permit oak regeneration.

Riparian Forest and Scrub

Maintaining perennial flows downstream of reservoirs is important for maintaining and enhancing habitat for threatened steelhead and other native fishes; but maintaining perennial flows may preclude restoration of the presumed natural condition of intermittent flows and open sycamore alluvial woodlands along stream channels (especially Coyote Creek). We therefore recommend carefully researching where restoration and enhancement of historical sycamore alluvial riparian conditions is possible without compromising steelhead recovery—for example, along more braided side channels within the floodplain of Coyote Creek.

Aquatic Communities

Site-specific management directives should be developed for ponds, based on species-specific requirements. Permanent ponds provide habitat for certain covered species (e.g., western pond turtles), but may also harbor detrimental exotic species. Periodically draining ponds during late summer to control bullfrogs and other exotics can benefit some rare amphibians.

We recommend removing or altering conditions of some percolation ponds to improve conditions for native species: Ogier Ponds, Metcalf Percolation Pond, and Silviera Pond could be moved off channel, and the pond adjacent to Pacheco Creek near the mouth of Cedar Creek should remain off-channel. Sprig Lake and Pickel Reservoir could be managed to provide rearing habitat for steelhead.

We recommend managing stream flows below reservoirs to maximize the amount and quality of rearing habitat for steelhead and Chinook salmon by optimizing the mix of release volumes and release water temperatures for them. Releases should be managed to provide sufficient flows for adult access and smolt migration in late March through May. The following watersheds are high priorities for aquatic habitat enhancement: Coyote Creek, Guadalupe River, Uvas Creek, and Pacheco Creek.

Preliminary Monitoring Recommendations

We recommend using the conceptual-model approach presented in Atkinson et al. (2004) to guide development of the monitoring program. This dovetails well with the hierarchical approach to setting goals, objectives, and criteria. Development of management-oriented conceptual models is especially useful for relating plan goals to management actions within an adaptive management program.

Monitoring effort for each covered species should be sufficient to understand its relative population status and trends, threats to the population, and responses to management, with reasonable certainty. However, it is not essential to obtain precise, statistical estimates of population size for all species or all years. For most species, relative indices of distribution and abundance may suffice, such as those derived from presence-absence surveys conducted periodically throughout reserves and corrected using detection probabilities (Azuma et al. 1990, MacKenzie et al. 2002). For other species, especially plants, yearly population density estimates would be useful and appropriate, particularly when populations are large, although more precise counts of individuals may be necessary when populations are very small.

For rare plants, we recommend working closely with the Santa Clara County CNPS, which is developing a rare plant monitoring program and can provide a well-organized and skilled volunteer force. For serpentine grasslands, we recommend working closely with the agencies already involved in monitoring invasive species. For the Bay checkerspot butterfly, well-researched monitoring protocols already exist, involving transect counts of butterfly larvae and fixed-plot counts of larval host plants and nectar plants.

For fish, we recommend periodic sampling (i.e., using electrofishing) to determine distribution, abundance, and growth rates of juvenile steelhead. Late summer monitoring in rearing habitat can be used to assess restoration effectiveness. Periodic trapping during downstream smolt migration (every 5-10 years) can provide an index of watershed productivity and can be used to monitor smolt sizes and ages.

1 Introduction

This report summarizes recommendations from a group of independent science advisors for the Santa Clara Valley Habitat Conservation Plan/Natural Community Conservation Plan (HCP/NCCP). This statutorily required scientific input is provided early in the planning process, before preparation of a draft plan, to help ensure that the plan is developed using best available science. To ensure objectivity, the advisors operate independent of the plan applicants, their consultants, and other entities involved in the HCP/NCCP[3]. Appendix A provides brief biographies of the advisors.

Contents of this report reflect the advisors' review of information prepared by the HCP/NCCP consultants (Jones & Stokes 2006), results of a two-day science advisors' workshop, and subsequent research and discussions amongst the advisors. The science advisors met July 6–7, 2006, to review information gathered for the HCP/NCCP planning process, hear the concerns of plan participants and other stakeholders, tour portions of the planning area, and begin formulating recommendations for plan development and implementation (Appendices B and C). Advisors were also encouraged to seek expert input from other scientists.

General questions addressed by advisors during their deliberations are included in Appendix D. These questions served as guidance only, to ensure that advisors addressed the full scope of issues pertinent to an HCP/NCCP. No attempt was made to format this report to explicitly answer each question, although answers are implicit to the contents. Additional and more detailed questions that were asked by plan participants or that arose during the July workshop (Appendix C) were also addressed.

The Science Advisors recognize that our recommendations are advisory only and are not binding on HCP/NCCP participants. Nevertheless, advisors appreciate receiving feedback on which recommendations were followed or not, and why.

We also recommend that science advice be sought at appropriate plan milestones in the future. For example, further scientific input or review (whether from this or a different body of advisors) would be useful during the drafting of preferred or alternative reserve designs and during preparation of adaptive management and monitoring plans for reserves. Experience with previous HCP/NCCPs demonstrates that continued scientific guidance up to and during implementation is essential to plan success.

[3] Although advisors receive honoraria from the County for participating, payment is in no way contingent on the nature of their advice. Advisor honoraria and preparation of this document were funded from Cooperative Endangered Species Conservation Fund (Section 6) Planning Grants administered by the California Department of Fish and Game through Agreement #P0630005. The Agreement, which is for use of $448,305 of Federal funding, is for several work products, including this document.

2 Scope of the Plan

The scope of an HCP/NCCP includes its biological goals, geographic extent, plan duration, species to be addressed, and actions to be permitted.

2.1 Biological Goals

The delineation of clear objectives with measurable outcomes is central to the success of conservation planning. Objectives should guide the selection of conservation targets or goals, the structure of impact analyses, and the targets and measures selected for monitoring.

2.1.1 Approaches for Structuring Biological Goals

The NCCP Act (Sher 2001, Senate Bill No. 107) states that the purpose of NCCP planning is "to sustain and restore those species and their habitat… that are necessary to maintain the continued viability of those biological communities impacted by human changes to the landscape" and that "it is the policy of the state to conserve, protect, restore, and enhance natural communities." Thus, while one objective of NCCPs and HCPs is to obtain authorizations (or permits) to "take" some habitat or individuals of listed or otherwise sensitive species, the broader goals are to sustain, restore, and enhance biological diversity and ecological functionality in general.

To create a plan that meets the goals of the NCCP Act, the advisors recommend that the plan (1) include explicit, hierarchical goals for the maintenance of biological diversity and ecosystem function in addition to goals for listed or sensitive species intended for permit coverage; (2) evaluate the impact of various planning scenarios on those biodiversity and ecosystem function goals, in addition to evaluating impacts on covered species; and (3) choose conservation strategies and policies that best satisfy this suite of biological goals.

A hierarchical framework of goals and objectives should provide a transparent and logical format for planning, implementing, and monitoring an HCP/NCCP, as well as for adjusting management over time to reflect knowledge gained via monitoring (adaptive management). The commonly used "coarse filter - fine filter" approach has proven very useful for setting conservation goals (Noss 1987). It focuses on conserving representative samples of ecosystems or ecological communities (the coarse filter) as well as individual species or other resources (fine filter) that might fall through the cracks of coarse-filter protection.

2.1.2 Ecological Connectivity Goals

The advisors urge that ecological connectivity be specifically addressed as a conservation goal, including physical connectivity between habitat areas, longitudinal connectivity along streams (e.g., for upstream-downstream fish passage), and lateral connectivity from streams to floodplains to uplands (e.g., to accommodate flood pulses from stream channel to floodplain). We also recommend that the goals specifically address the need to manage and monitor ecological processes in perpetuity, rather than simply focusing on locations to be conserved. Many of the resources of concern in the planning area require the maintenance of specific environmental conditions or processes, such as stream flows or fire regimes, that cannot be taken for granted simply because lands are designated as reserves.

2.1.3 Dealing with Conflicting Goals for Riparian Systems

The advisors discussed in detail some potentially conflicting biological goals for riparian communities within the planning area, and especially along Coyote Creek. The conflict is between restoring presumed historic ecological conditions and communities associated with intermittent flows (especially sycamore alluvial woodland) versus contributing to recovery of a threatened species that depends on more perennial flows (steelhead, *Oncorhynchus mykiss*).

Before European settlement, the main stem of Coyote Creek is thought to have been an intermittent stream along most of its length, with a broad, braided floodplain that supported a relatively open mix of sycamore alluvial woodland, riparian scrub, and gravel bars (San Francisco Estuary Institute [SFEI] 2006; http://www.sfei.org/HEP/reports/coyotecreek1.htm; T. Keeler-Wolf, personal communications with Susan Harrison)[4]. The ecological community associated with this condition is thought to have included a distinct suite of native species, including fish assemblages associated with braided channels, a distinct flora including California sycamores (*Platanus racemosa*) and smooth-stem blazing star (*Mentzelia laevicaulis*), and nesting birds such as the lesser nighthawk (*Chordeiles acutipennis*).

Summer flows below Anderson Reservoir are now much higher than historically, with the increased flows used to recharge groundwater. The increased flows provide suitable steelhead habitat below the dam, which now blocks steelhead from reaching the upper two-thirds of the watershed, where suitable habitat for steelhead (and presently for resident rainbow trout) is widespread (Leidy et al. 2005). The density of riparian vegetation along Coyote Creek below the dam has also increased, with dense willow and cottonwood vegetation largely replacing the open sycamore alluvial woodland. This also benefits steelhead (and other species associated with dense riparian vegetation) by shading the stream (reducing water temperatures) and providing increased habitat structure and cover.

Sycamore alluvial woodland is now very rare in California (only about 2,000 acres remaining at about 17 sites). According to Todd Keeler-Wolf, Senior Vegetation Ecologist with CDFG (personal communications with Susan Harrison) this habitat should be recognized as a major historical component of Coyote Creek, with existing remnants being of high conservation significance. Restoration of sycamore alluvial woodland along Coyote Creek, involving among other actions, managing flows to more closely mimic historical patterns, has been proposed (SFEI 2006). However, decreasing summer flows and recreating the intermittent stream conditions would conflict with recovery goals for steelhead. Because steelhead is a listed species, enhancing steelhead conditions below the dam has been formally embraced as a goal by the wildlife agencies and the Fisheries Aquatic Habitat Collaborative Effort (FAHCE).

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[4] This view is not universal however. At least one advisor (Jerry Smith) believes that much of the main stem of Coyote Creek may have been perennial prior to European settlement, and that the open woodlands of the nineteenth century may have been largely a result of livestock grazing.

The Science Advisors agree that an important goal for the HCP/NCCP should be to preserve and enhance the sycamore alluvial riparian community wherever possible. However, we also recognize the importance of recovering steelhead as a listed species, and that existing dams and other alterations along streams greatly constrain potential recovery actions. We therefore recommend that the NCCP/HCP research this issue closely with input from experts on these systems, and develop site-specific goals for the Coyote Valley to attempt meeting both fisheries goals and historic ecological goals. As documented by SFEI (2006) there are locations in the Valley where riparian vegetation has not converted from sycamore alluvial woodland to denser willow and cottonwood forest, because they are off the main Coyote Creek channel and have more intermittent flow conditions. We recommend further research on where restoration and enhancement of historical sycamore alluvial riparian conditions is possible without compromising steelhead recovery actions. For example, it should be possible to restore sycamore alluvial woodlands along more braided side channels within the floodplain of Coyote Creek, perhaps aided by planting and irrigating sycamores until their roots reach the water table.

In addition to portions of Coyote Valley, maintaining and enhancing sycamore alluvial woodland should be a priority in the floodplain of Pacheco Creek. Pacheco Creek supports an extensive sycamore alluvial woodland from Casa de Fruta upstream to the reservoir, with smaller stands along its south fork, Cedar Creek, and upstream of North Fork Pacheco Reservoir to above Kaiser Aetna Road in Henry Coe Park. The woodland downstream of the reservoir appears to be declining in quality. Numerous old trees are dying of unknown causes, and regeneration in the floodplain is probably not occurring because of cattle grazing.

Llagas and Uvas creeks have limited opportunities for sycamore alluvial woodland restoration, because their riparian corridors have been extensively narrowed by suburban development, agriculture, and leveed channels. Sycamores are a part of the diverse riparian community at the edge of the wetted channel. On Uvas Creek, sycamore woodland could be expanded on the floodplain from about 1/2 mile upstream of Highway 152 downstream through the Uvas Preserve to Miller Ave.

2.2 Geographic Extent

The advisors generally agree with the rationale used to delineate the planning area (e.g., excluding the Baylands). However, we urge recognition that the plan must look beyond its boundaries to account for effects of landscape context and ecosystem processes that do not recognize boundaries. For example, actions along streams within the plan area (such as changing flow regimes) can affect conditions downstream of the planning area (e.g., downstream steelhead habitat in the Pajaro or salinity of marshes in the Baylands). Also, many species distributions straddle plan boundaries, and wide-ranging species and ecosystem processes require habitat connectivity beyond the planning area into adjoining jurisdictions.

These issues should be addressed by supplementing planning area maps with appropriate regional maps (e.g., showing complete watersheds and species ranges), and by considering regional context when analyzing plan effects. For example, assessing the importance of grasslands for badgers in the study area depends on how this area relates to badger habitat extending beyond the planning area.

2.3 Plan Duration

Plan participants have proposed a permit term of 50 years (Jones & Stokes 2006)[5]. This is a common permit term for regional conservation plans (Rahn et al. 2006) and it seems a reasonable and ecologically relevant period over which to implement this plan[6]. However, we urge recognition that environmental conditions can change dramatically over 50 years. We therefore stress the importance of an effective monitoring and adaptive management program to ensure that plan goals are being met within this permit duration. Science-informed management intervention will be required to address changing conditions, including climate change, within and beyond this 50-year horizon.

2.4 Species Addressed

The advisors generally agree with the process used to identify species intended to be covered by take authorizations (permits) and with the designation of certain "no-take" species. Note, however, that NCCPs are not strictly endangered-species permitting plans, but are required to sustain and enhance the state's natural communities and their constituent species. This may entail selecting "focal species" or "planning species" that may not be listed or likely to be listed as threatened or endangered, but that are sensitive indicators of habitat conditions, ecological processes, populations of more difficult to monitor species, or of biodiversity in general. Thus, we recommend supplementing the list of species to be analyzed for coverage under state and federal take authorizations (including listed or likely to be listed species) with a few additional planning species that may otherwise help achieve the plan's biological goals.

[5] We understand that a 30-year permit duration is also under consideration. Our recommendations would be similar with either duration.

[6] Note, however, that protections offered to biological resources by the plan (e.g., reserve areas and their management) are expected to continue in perpetuity.

2.4.1 Covered Species

The list of proposed covered species prepared by Jones and Stokes is generally reasonable and defensible. However, we recommend considering the following changes:

<u>Potential Additions</u>

- **Black rail (*Laterallus jamaicensis coturniculus*)**. In light of recent discoveries of black rails in small, isolated wetlands in foothill terrain elsewhere in California, the advisors are not convinced that the study area is outside the species' range and has no suitable habitat. The consultants have stated that they think the likelihood is low because most wetlands in the study area are stock ponds. However, before black rails were fortuitously discovered in the Sierra foothills in 1994, there was absolutely no expectation that they existed there. Since then, systematic surveys have found them in over 100 wetlands, including ditches, leaks from agricultural canals, and around pond edges—similar to the types of habitats observed in the Santa Clara Valley planning area. The advisors therefore continue recommending that this species be considered possible in the planning area, even if they are not treated as a covered species due to lack of sufficient information.
- **Rare Plants.** The advisors agree with the California Native Plant Society (CNPS) that the following species appear to meet the criteria listed by Jones & Stokes (2006) and should also be investigated and considered for coverage:
  - *Viburnum ellipticum* – This CNPS List 2[7] species has at least one known occurrence in the planning area along Little Uvas Rd.
  - *Ptelea crenulata* – The planning area encompasses the southern end of this locally rare species' range limit in the Coast Range.
  - *Arctostaphylos andersonii* – This CNPS List 1B species was considered for coverage by the plan, but rejected due to the occurrence of this species in adjacent Santa Cruz County; the Santa Clara County population is the species eastern range limit.

The advisors also agree with CNPS that the following List 4 species should be considered, as it is possible one or more could become listed within the permit term:

- *Acanthomintha lanceolata*
- *Helianthus exilis*
- *Calandrinia breweri*
- *Leptosiphon ambiguus*
- *Clarkia breweri*
- *Leptosiphon grandiflorus*
- *Clarkia concinna* ssp. *automixa*

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[7]CNPS has created five "lists" to categorize degrees of concern: List 1A: Plants Presumed Extinct in California; List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere; List 2: Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere; List 3: Plants About Which We Need More Information; List 4: Plants of Limited Distribution. For details: http://www.cnps.org/programs/Rare_Plant/inventory/names.htm.

- o *Lessingia tenis*
- o *Erysimum franciscanum*
- o *Piperia michaelii*
- o *Fritillaria agrestis*
- o *Galium andrewsii* ssp. *gatense*

Potential Deletions

The advisors urge caution when removing species from the list due to lack of recent observations in the study area. Survey coverage is too incomplete to prove absence for many species, and species distributions are dynamic over time. Therefore, and in light of shifting distributions with climate change, we urge reasonable caution in interpreting which species may occur within the study area over the next 50 years. Nevertheless, we recommend deleting the following species from the covered species list:

- **Monterey roach (*Lavinia symmetricus subditus*).** Consider deleting because it is not threatened in watersheds affected by this plan. California roach (*Lavinia symmetricus*) is a species of special concern in California because some subspecies, such as the Red Hills roach (*L. s*. ssp.) and Pit River roach (*L. s. mitrulus*), are scarce. However, the Monterey roach (*L. s. subditus*) is widespread and common within its native range (the San Lorenzo, Pajaro, and Salinas river watersheds). Monterey roach does not warrant coverage as a scarce or declining species, and is not a good umbrella for other species or habitat conditions. Additional information on this species, including its range within the planning area, is included in Appendix E.
- **Unsilvered Fritillary (*Speyeria adiaste adiaste*)**. Consider deleting this species due to insufficient distributional information and a lack of records and apparent suitable habitat within the HCP/NCCP area. Impacts of the plan on the species, including any proposed management actions, are therefore unpredictable. If populations of this species are found in the plan area in the future, they are unlikely to represent a significant fraction of the entire species' population. The known distribution of this species is in upper-elevation coniferous forests that are relatively far from development pressures in Santa Clara County.
- **San Joaquin kit fox (*Vulpes macrotis mutica*).** Based on available information and discussions with species experts (Brian Cypher and Rick Hopkins), most advisors[8] do not believe that the plan area is important to the conservation of this species. Although several individual kit foxes have been observed as roadkill in the southernmost portions of the planning area, and live individuals have occasionally been reported in the region, no breeding population has been demonstrated within Santa Clara County despite substantial survey efforts (over 1,500 survey days in the past 15 years; Rick Hopkins personal communications with Raymond White and Wayne Spencer). Moreover, the species experts believe that the planning area has little suitable habitat and that it is highly unlikely foxes are dispersing between or among source populations through southern Santa Clara County or northern San Benito County (Rick Hopkins, personal communication with Wayne Spencer). Individual kit

[8] Jerry Smith disagrees with this assessment, believing that there are substantial gaps in the survey efforts and that kit fox may live in the southeast portion of the plan area.

foxes may sometimes disperse into inhospitable terrain that is of little ecological value for supporting breeding populations and which therefore may be characterized as "sink" habitat (Pulliam and Danielson 1991). That said, improved wildlife crossing structures (e.g., wildlife overpasses or underpasses coupled with fencing) along highways in the planning area (especially Highway 152) may benefit kit fox, along with many other wildlife species, by reducing road kill. Likewise, restrictions on rodent poisoning (e.g., use of 1080 on ground squirrels) may benefit a suite of sensitive wildlife species. However, such actions could be done as general measures to benefit wildlife without the need to analyze plan effects or issue take authorizations for kit fox as a covered species.

- **Bank swallow (*Riparia riparia*), purple martin (*Progne subis*),** and **saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)**. The advisors agree with the consultants that these birds are unlikely to be affected by the plan, and can be deleted.

"No-Take" Considerations

The consultants listed some species that are so rare in the planning area that they are not currently being considered for authorized incidental take under the plan. The advisors generally agree with this logic, although we caution that in some cases "no-take" provisions have the potential to actually interfere with attaining biological goals. We specifically discussed whether at least one species, Coyote ceanothus, should be added to the no-take list, and decided not:

- **Coyote ceanothus (*Ceanothus ferrisae*)**. The advisors discussed whether this and perhaps other narrow endemic plant species should be shifted to the "no take" list due to extremely limited distributions. However, we concluded that such a policy may actually increase threats to the species by precluding adaptive management actions to benefit it. For example, opportunities for expanding the distribution of "no take" species via restoration or reintroduction may be constrained due to resistance by land managers to have "no take" species actively or passively introduced into new areas. Conflicts could also arise between other species that have to be managed and "no take" provisions. Most of the coyote ceanothus plants potentially subject to take were planted as mitigation by the Santa Clara Valley Water District (SCVWD) in a location where dam maintenance may be necessary. Field observers report excellent seedling response to recent fire events (personal communications to Raymond White).

2.4.2 Additional Planning Species

The advisors recommend supplementing the list of covered species with additional planning species that can assist with meeting plan goals. Specifically, we propose a method modified from Lambeck (1997), who suggested that conservationists identify groups of species whose vulnerability can be attributed to a common cause, such as loss of habitat area or alteration of a natural disturbance regime. Species in each group then can be ranked in terms of their vulnerability to those threats.

Lambeck identified four functional categories of focal species. For each group the focal species are those most demanding for the attribute that defines that group and which therefore serve as the umbrella species for that group. Together, these species tell us what patterns and processes in the landscape must be sustained in order to sustain biodiversity. Their collective needs define conditions and thresholds—such as patch size, connectivity, fire frequency, etc.—that must be met if the native biota is to be maintained (Lambeck 1997).

- *Area-limited species* have large home ranges, occur at low densities, or otherwise require large areas to maintain viable populations. Examples include large mammals (especially carnivores) and large raptors.
- *Dispersal-limited species* are limited in their dispersal capacity, sensitive to particular movement barriers such as highways, or are vulnerable to mortality when trying to move through a human-dominated landscape. Examples include amphibians (especially salamanders), turtles, large snakes, flightless insects, large-seeded herbaceous plants, and species sensitive to roadkill, human persecution, or collecting.
- *Resource-limited species* require resources that are at least occasionally in critically short supply. Classic examples are nectarivores, some frugivores, mast-dependent birds and mammals, cavity-nesting birds, cliff-nesting birds, and plants or burrowing animals dependent on particular substrates or soils, such as serpentine-soil endemics.
- *Process-limited species* are sensitive to details of the disturbance regime (e.g., the frequency, severity, or seasonality of floods or fires) or other manifestations of natural processes, such as hydroperiod, fire-return intervals, or the flow velocity of streams. Examples include fire-dependent animals and plants, stream fishes, and riparian plants like sycamores that establish following floods.

To this list we add one category:

- *Keystone species* are species that exert a disproportionately strong influence on community structure or function, such as the presence or abundance of other species (Power et al. 1996). Examples include top carnivores (like cougar) that may provide top-down regulation of food webs (Soulé and Terborgh 1999), and burrowing animals (like ground squirrels) that provide microhabitats and homes for numerous other species.

We suggest that the consultants review the list of potentially covered species to see whether they adequately represent this range of functional categories for the natural communities defined by the plan (grasslands, chaparral and sage scrub, oak woodland, riparian forest and scrub, conifer woodland, wetland, and open water). For categories or communities not adequately represented by the existing covered species list, consider supplementing the list with additional planning species to ensure that all communities and essential processes are addressed.

Regardless of whether the plan uses this approach to adding planning species, we recommend considering the needs of at least the following species during planning of the reserve system:

- **American badger (*Taxidea taxis*).** Although not likely to be listed as threatened or endangered, badgers are uncommon and declining indicators of grassland integrity in California. They require very large landscapes and are highly sensitive to habitat fragmentation and roadkill. Current field work on badgers within the planning area (by Tanya Diamond, MS Candidate at San Jose State University) is demonstrating the importance of habitat connectivity across the Coyote Valley (specifically at Tulare Hill/Santa Teresa County Park) to maintaining badger populations in the Santa Cruz Mountains (within and well beyond the plan area). Please see Appendix F for a map of badger and other carnivore sign in this area, along with a modeled least-cost corridor across the valley for badger. Note also that Jessica Quinn (UC Davis) is reviewing badger information statewide and performing a telemetry study of a badger population in Monterey County, which is providing valuable data on movements and roadkill incidence.

- **Cougar (*Puma concolor*).** The cougar is an area-limited and dispersal limited species thought to contribute to ecosystem health via its role as a top carnivore (Terborgh et al. 1999, Ripple and Beschta 2006). Consider adding cougar as a species to be considered in reserve design, to ensure adequate ecological connectivity among major habitat areas, and to plan for road-crossing improvements in appropriate locations as part of future road-improvement projects (e.g., wildlife fencing coupled with wildlife underpasses or overpasses). There is a growing concern that the cougar population in the Santa Cruz Mountains is becoming genetically and demographically isolated from others. If movements between the Santa Cruz Mountains and other cougar habitats are cut off, cougars will likely disappear from the Santa Cruz Mountains, with the potential for adverse ecological effects on other species. However, some advisors are concerned that explicit use of cougar as planning species may be misinterpreted as encouraging cougar use of urban-fringe areas and thus increasing the potential for human-cougar encounters. We therefore leave it to the discretion of the planning team whether adding cougar as a planning species will further plan goals, especially since planning for the American badger is likely to address similar connectivity issues. We further recommend contacting Rick Hopkins of Live Oak Associates for more specific information on cougar in the study area, including habitat connectivity and movement issues. Dr. Hopkins is a cougar expert who has been developing cougar movement models in California.

2.5 Covered Actions

Here we offer some preliminary observations on potential impacts and mitigation measures for the types of projects and other actions listed as likely to be covered by the plan (Chapter 2 of the Working Draft HCP/NCCP, Jones & Stokes Associates, August 2006). We focus on some effects that might otherwise be overlooked during the planning process, and do not address more obvious impacts that we assume will be adequately addressed in the plan, such as removal of terrestrial habitats by development.

2.5.1 Urban Development

It is common knowledge that urban development can remove and fragment terrestrial habitats required by covered species, which we assume will be analyzed in the plan. However, we point out that development can also substantially impact aquatic habitats and species, even if located away from the low-flow channel and floodplain. The impervious surfaces associated with urban development increase winter flood peaks and increase the likelihood that nests (redds) or even juveniles of aquatic species like Chinook salmon, steelhead, and lamprey will be damaged or flushed out of streams. Increased flood peaks can also enlarge the bankfull channel by incision and bank erosion, and may increase the need for flood-control measures that adversely effect species (including vegetation clearing, hardening banks, widening channels, and constructing and raising levees).

Urban development can also increase sediment discharge into aquatic habitats and remove riparian vegetation. Even when large riparian trees (and the shade they provide) are left, streamside landowners often "manicure" stream banks by removing downed trees, overhanging trees and shrubs, and undercut banks that provide escape cover for fish. This hiding cover is important for juvenile steelhead, salmon, and other native fishes (Smith 1982). "Messy" but important habitat features can also be lost by planting lawns or groundcover like ivy to the water's edge.

These adverse effects require substantial development setbacks to prevent impacts to stream and riparian habitat. Riparian setbacks should be at least large enough to accommodate the 100-year floodplain. Developments near streams should use detention basins as part of the storm drain system. Setback width should vary with floodplain slope (incised channels will require less than broad, flat channels), and should accommodate the increase in floodplain size that comes with the increase in impervious surfaces. Streamside parks with natural stream banks (such as along Uvas Creek from Santa Teresa Boulevard to Miller Avenue) are a logical land use for such development setbacks.

2.5.2 Rural Development

The advisors urge recognition that the impacts of rural developments, such as low-density or dispersed estate-style housing, generally extend well outside the actual development footprint (e.g., the area to be cleared, grubbed, or graded) due to habitat fragmentation and adverse edge effects, such as increases in weedy exotic species, house pets, irrigation runoff, pesticides, fertilizers, and traffic. The analysis of plan effects should therefore review the range of possible edge effects and appropriately account for reduced habitat value for covered species within a zone of influence around proposed rural developments, based on the approximate distance the most detrimental effects are expected to penetrate habitat areas. The size of this zone could vary with habitat type, the nature of the development, and other factors.

The plan should analyze possible effects of planned or potential road improvements on wildlife movements and incorporate restoration and enhancement actions as mitigation. These can include, for example, inclusion of wildlife underpasses (or overpasses) in strategic locations to accommodate movements by large mammals, reptiles, and amphibians with new or upgraded highways. Where new roads or road improvements are in areas of likely wildlife movement corridors, we recommend incorporating Before-After/Control-Impact studies of wildlife movement and roadkill to identify whether and where wildlife crossing structures will be beneficial to restoring ecological connectivity and to monitor success of the improvements (Forman et al. 2003, Hardy et al. 2003, Orth and Riley 2005, Clevenger and Kociolek 2006).

To the degree possible, the plan should also analyze likely effects of rural developments on ground and surface waters, and incorporate appropriate mitigation actions. Increased well pumping due to conversion of rural areas to home sites, and conversion of pasture to vineyards, can substantially reduce summer stream flows in headwater streams, which have naturally low summer flows. Streamside wells have especially severe effects on stream flow because the groundwater can be hydrologically connected to surface waters. Wells along streams downstream of reservoirs also reduce stream flow, but releases from reservoirs for groundwater percolation can offset the effects in this situation.

We note that commercial vineyards were explicitly excluded from covered activities (Jones & Stokes, August 2006, Chapter 2). However, we urge recognition that conversion of pasture or other land to vineyards (whether or not covered by the plan) can adversely affect covered resources, and these effects should therefore be considered in the plan, which could provide guidelines for vineyard conversion and mitigation. Vineyards are a special case of agricultural conversion, because they are the one irrigated crop likely to be planted in hilly areas. Vineyard erosion can be especially pronounced, compared to that from orchards or row crops on flat land. Erosion is also increased by the tendency to align the rows of grapes up and downhill rather than along the contours. This has already occurred in the Little Arthur Creek watershed, resulting in the drying and silting up of much of the accessible steelhead rearing habitat. Silt from the Little Arthur Creek watershed is also impacting Uvas Creek. This same silting and drying process will likely negatively impact summer stream flows in the Tar, Bodfish, upper Uvas, upper Llagas creek, Arroyo Calero, and Alamitos creek watersheds if pastureland is converted to vineyards.

2.5.3 Operations and Maintenance within Streams

The plan should consider whether changes in reservoir operations are feasible as habitat enhancement or mitigation actions for aquatic species. Here we discuss some existing effects of reservoirs in the planning area, with some recommendations for remedial actions.

Aquatic Migration Impacts

Reservoirs block much of the former habitat of steelhead in Santa Clara County (1/2 to 2/3 of the habitat is blocked in Guadalupe River watershed and Stevens, Coyote, Uvas and Llagas creeks watersheds). Water releases from reservoirs are important to allowing access to the remaining, downstream habitat. Migration upstream by adults in fall (salmon) and winter and spring (steelhead and lamprey), and migration downstream by juveniles in spring, requires that flows from the reservoirs be managed to provide for access to and from the ocean or San Francisco Bay. Smaller barriers may also have to be modified to provide for upstream passage. Special considerations to allow migration include:

- Adult migration can occur during episodic winter storms, with most of the adult fish moving during the storm or in the declining flows afterward. Continuous accessibility throughout the spawning season may not be necessary, although release of stored water from reservoirs may sometimes be necessary to allow access periods during drought years or years of delayed rainfall.
- The Chinook salmon present in Guadalupe River and Coyote Creek watersheds are "fall run" fish. They are adapted to Central Valley streams, where delayed snow melt conditions provide late summer and fall stream flows sufficient to allow access prior to the onset of winter precipitation. However, their migration timing is normally earlier than the usual winter rain and runoff that occurs in the Guadalupe and Coyote watersheds. Chinook access is therefore more likely than steelhead to be affected by stream flows. However, early season releases for Chinook may not be desirable because (1) water temperatures in fall may not be suitable for adult survival, spawning, or egg survival; and (2) releasing large amounts of stored water for early Chinook access would reduce water for other uses, including steelhead rearing and outmigration of smolts by both Chinook and steelhead.

- Downstream migration by steelhead and salmon smolts and juvenile lampreys occurs rather continuously during March through May or early June (Shapovalov and Taft 1954), when natural stream flows are declining or severely reduced. Downstream migration is a bigger population bottleneck than adult upstream migration and possibly a limiting factor for steelhead in Uvas, Llagas, Pacheco, and Coyote Creek watersheds (Smith 2006). Maintaining adequate flows during downstream migration should therefore receive a high management priority, especially in allotting scarce stored water to fisheries values. The generally continuous nature of juvenile migrations means that a few small time "windows" for suitable passage will be inadequate to allow most fish to pass (unlike the situation for adult access).
- Downstream migration problems vary substantially among watersheds, which should be considered when setting stream enhancement priorities. Presently, downstream migration is not a big problem in the Guadalupe River watershed, as perennial flows to the Bay are present year round (due to a full, perched water table along the lower Guadalupe River). Coyote Creek (and its tributary Upper Penitencia) and Uvas creeks probably have the next best spring passage conditions, with late spring flow cutoffs likely in most years, and with the timing of cutoffs affected by reservoir releases (or diversions on Penitencia Creek). Pacheco Creek used to have early-mid spring cutoffs and difficult passage in the majority of years, but conditions have improved with the importation of water and reduced groundwater pumping (Smith 2006); mid-late spring cutoffs are still likely, depending upon releases from North Fork Pacheco Reservoir. The worst stream for downstream migration is Llagas Creek, due to the extensive valley floor channel and heavy percolation rate. SCVWD Llagas Creek percolation operations normally allow water down ½ of the valley, so flow cutoffs to the Pajaro River would often occur during or prior to smolt outmigration. This severely limits steelhead potential in Llagas Creek.

Spawning and Rearing Impacts

Reservoir operations also affect spawning and rearing conditions for aquatic species. Spring–Fall releases from SCVWD reservoirs are used for groundwater percolation, usually increasing stream flow (with potentially cooler water temperatures) compared to natural conditions. Since much of the original steelhead habitat is no longer accessible upstream of reservoirs, these augmented flows and expanded perennial stream habitat downstream of the reservoirs offer the only chance to maintain and enhance populations of steelhead. However, to provide fisheries values, the amount and timing of releases requires a balancing of stream flow and temperature concerns. The amount of stored water in the reservoir and the amount of cooler water in and below the thermocline need to be considered in providing releases for fisheries. Some specific considerations in the plan area:

- Anderson Reservoir on Coyote Creek is relatively large and usually has a thick, cool bottom layer, so conflicts between amount of releases and release temperature are usually minor. However, Anderson Reservoir has multilevel release capability, so warmer mid-level water is often released to mitigate drinking water quality concerns. For the remaining (much smaller) reservoirs in the study area, the conflict between release size and release is substantial, as their cool bottom layers can be depleted by high summer releases.

- North Fork Pacheco Reservoir is operated by the small Pacheco Water District to provide agricultural water. Historically reservoir operations have involved little or no release in late spring (especially in wet years), resulting in much of the stream channel drying out (Smith et al. 1983, 1984; 2006). Releases during the summer irrigation season then maintain a more extensive live stream, which sometimes dries back in fall if the reservoir is completely drained. Altering the operation of Pacheco Reservoir has the potential to substantially improve conditions for steelhead in Pacheco Creek. However, the Pacheco Water District is not a party to the HCP process. If the SCVWD assumed responsibilities for maintenance and operation of the reservoir, there is substantial potential to provide mitigation for other SCVWD activities within the county.
- Stream flow and water temperature interact to provide summer habitat for juvenile steelhead downstream of reservoirs (Smith and Li 1983). Higher flow provides more fast-water feeding habitat for efficient feeding on drifting insects. Warmer water increases metabolism and food demands, reducing growth or starving fish. Therefore, both cooler water temperature and higher stream flow are generally desirable, but in smaller reservoirs, harmonizing these two desirable goals is a challenge. Releases from smaller reservoirs must balance the amount of the release and the effect of releases upon the temperature of the receiving waters. The FAHCE[9] program, a multi-agency fisheries plan to be implemented by the Santa Clara Valley Water District for the Stevens Creek, Coyote Creek, and Guadalupe River watersheds, emphasizes temperature of summer releases to the exclusion of stream flow rate, cutting back releases in an attempt to maintain a smaller, but cooler, summer stream (FAHCE 2003). Optimizing a combination of the two may provide more and better habitat for steelhead if the gains in fast-water feeding conditions are greater than the metabolic loss due to warmer stream temperatures (Smith and Li 1983).
- The location of habitat conditions within the channel may also affect release requirements. In general, stream temperatures increase downstream from a reservoir (due to heating by the sun and air) while stream flows decrease (due to groundwater percolation). Consequently, best conditions are expected closer to the dam. However, ongoing studies on Uvas Creek (Joel Casagrande, in preparation) have found that habitat quality in terms of substrate, light, and food availability are greater in downstream reaches. This appears to be due at least partially to substrate degradation by agricultural and residential development along Little Arthur and Uvas creeks. Steelhead growth rates are therefore actually greater in downstream reaches, contrary to expectations from stream flow and temperature considerations. Reduction in releases could eliminate these most productive downstream reaches.

2.5.4 Ponds and Lakes

In this section, we consider effects of existing or future ponds and lakes on biological resources and offer some recommendations for actions to mitigate adverse effects and restore biological values in aquatic systems.

Both on-channel and off-channel percolation ponds can warm downstream waters, because the cooler, denser inflows sink to the bottom and warmer surface waters flow out of the pond. They

[9] Fisheries and Aquatic Habitat Collaborative Effort. See http://www.scvwd.com/Water/Watersheds_-_streams_and_floods/Taking_care_of_streams/FAHCE/index.shtm

also harbor non-native predatory fish, like largemouth bass (*Micropterus salmoides*), that are detrimental to steelhead, salmon, and lamprey populations. Percolation ponds should be located as far downstream as possible to stretch the zone of high summer stream flow (e.g., the Church Avenue Ponds for Llagas Creek). Some specific considerations:

- The on-channel Ogier Ponds severely degrade steelhead conditions on Coyote Creek by warming an extensive reach of potential rearing habitat. The Metcalf Percolation Pond also results in stream heating, but is far downstream so the effect on steelhead potential is less. Both ponds have abundant predatory fish (including largemouth bass). These on-channel ponds could be moved off-channel as a mitigation action to increase steelhead rearing potential in Coyote Creek.
- Almaden Lake on Alamitos Creek has both temperature effects and potential predation effects. However, this large recreational lake is near the downstream end of suitable summer water temperatures, so the effect of the lake on summer rearing temperatures may be relatively small.
- Silveira Lake on Llagas Creek has both temperature and potential predation effects, although it is near the downstream end of suitable rearing habitat for steelhead (Smith 2006). The lake, which was illegally constructed[10], could be taken off-channel as a habitat improvement action (Harvey and Stanley and Associates 1988).
- A pond that was created as a borrow pit near the mouth of Cedar Creek on Pacheco Creek could result in heating of Pacheco Creek if the creek channel changes course during a flood and diverts through the pond.
- On-channel ponds in headwater areas can actually benefit steelhead under certain conditions, such as if (1) waters do not become too warm; (2) warm-water fish species are scarce or absent; (3) productivity within the pond is high enough to encourage fish growth; and (4) migration is not significantly affected by the dam or by pond operation. For example, Sprig Lake, an on-channel pond formerly operated in Mount Madonna County Park, has the potential to rear abundant, fast-growing (1 year to smolt size) steelhead. This pond formerly supplied a substantial portion of the smolts from the Bodfish Creek watershed (Smith et al. 1983, 1984 and Smith 2006). It could be put into operation again (with strict operating rules) to enhance steelhead production in the Uvas Creek watershed. On Little Arthur Creek (a Uvas Creek tributary) the Pickel Dam and Reservoir could similarly be operated to provide substantial steelhead rearing habitat. However, major modifications to the dam (installation of a slide gate closure system, similar to that at Sprig Lake) and its operation (timing of opening and closure) would be required (Smith 1993). We recommend that the HCP/NCCP consider the feasibility of operating Sprig Lake and Pickel Dam to enhance steelhead production. A feasibility study should estimate costs of modifying the dam and should include strict operating procedures to accomplish the habitat enhancement goal.

[10] The Department of Fish and Game intended to pursue action in the late 1980's (Harvey and Stanley and Associates 1988), but no action was ever taken due to personnel turnover.

3 Existing Information

The advisors reviewed a few partial draft chapters of the HCP/NCCP and various maps provided by the consultants. We offer a few comments on these preliminary materials.

3.1 Plan Documentation

It is important that an HCP/NCCP be as transparent and as credible as possible. We therefore recommend the following points for consideration in preparing plan documents:

- Please provide detailed and explicit methods sections or technical appendices for technical aspects of the plan, such as for data compilation, modeling, and analyses. The Science Advisors had some questions about data sources, mapping methods, model logic, etc., that could not be answered by the draft Plan text as written. Understanding that plan documents can become overlong and cumbersome if too much technical detail is packed into documents meant to reach wide audiences, such technical details can be assembled in appendices for review by scientists.
- Please explicitly assess and disclose uncertainties in all data sources, models, and analyses used in the plan. The accuracy and precision of all GIS data layers and other information sources should be listed. Uncertainties associated with model outputs or analyses of plan effects should be explicitly documented with error bars (for quantitative values) or at least qualitative assessments (e.g., high, medium, or low confidence in predicted outcomes). Evaluating uncertainties throughout the planning process is essential to informing policy decisions and to structuring a monitoring and management program that can reduce uncertainties over time and adjust actions appropriately to changing circumstances.
- Provide a clear method for developing and selecting among plan alternatives during plan development. Often, alternatives to a preferred HCP/NCCP plan are developed as afterthoughts, as part of the mandatory NEPA/CEQA process rather than as an integral part of plan development. This can result in overlooking viable alternatives to meeting plan goals until too late in the planning process.

3.2 Land-cover Mapping

The Science Advisors are concerned that the level of detail and accuracy in the mapping may not be sufficient to adequately prioritize conservation decisions for some resources or geographic areas of concern. We agree with the Santa Clara County chapter of CNPS that better vegetation mapping would be useful in some areas, and we endorse their offer to review and assist with ground-truthing of vegetation maps. We provide the following recommendations to improve the Plan's land-cover mapping:

- Although the advisors recognize the need for consistent mapping methods and resolution across the planning area (at least for certain purposes), we believe more detailed mapping is warranted for certain resources or geographic areas of concern. For example, we recommend using the more detailed mapping of vegetation alliances for Coyote Ridge prepared by the Santa Clara County Chapter of the California Native Plant Society (Evans and San 2004; available at http://www.cnps.org/programs/vegetation/reports.htm). Given that Coyote Ridge supports a high number of rare species and vegetation types, we recommend using the best available information. Fine-scale mapping of serpentine endemic species can help in prioritizing conservation areas and for informing management actions. CNPS has also volunteered to review vegetation maps for accuracy and to assist with field verification (personal communications to Susan Harrison).

- Vegetation mapping could be improved by analyses of historic versus present vegetation, in order to determine what has been lost and what is available to preserve or restore. It appears feasible to better interpret the vegetation history from aerial photos and other sources, and to carry out original alliance-level mapping of the entire project area. An example mapping protocol (for Western Riverside County NCCP) is found at the CNPS website[11]. Todd Keeler-Wolf, State Vegetation Ecologist, for the Department of Fish and Game, is available to show how these mapping techniques can be used as a dynamic planning tool (personal communications to Susan Harrison).
- Consider using helicopter surveys, aerial photographs, or LIDAR images taken during wet months to maximize detection of small marshes, seasonal wetlands, and riparian vegetation types. The consultants acknowledged that many smaller or seasonal wetlands may have been missed during mapping (due to private lands access constraints), which could underestimate distributions of covered species. Also, the advisors questioned the accuracy of some riparian community designations (such as the extent of sycamore alluvial woodlands in the Pacheco watershed).
- Consider additional ground-truthing of vegetation maps (e.g., by helicopter) and inviting an objective review of the final Plan land-cover mapping by a third-party, such as the local CNPS chapter.
- Bay checkerspot butterfly habitat can be mapped using both theoretical and empirical approaches. Empirical data (larval counts over a series of years) and slope designation (very warm, warm, moderate, cool, very cool) data are available for Coyote Ridge and should be used to prioritize butterfly habitat based on quality of existing habitat, restoration potential, and other factors. Use of similar data for the Waste Management reserve is documented in Weiss (2003).
- Develop a floodplain-channel system map that shows floodplains and their relation to stream courses and vegetation communities, and overlay a property ownership map to help plan alternative approaches to flood hazard reduction, including easements or land purchases to facilitate conservation and restoration of riparian systems.
- Map concentrations of exotic species, especially for riparian zones, to assist with identifying restoration and management opportunities. It should be possible to map concentrations of *Arundo donax* and other key exotics using remotely sensed imagery. Dr. Josh Viers at UC Davis can provide examples of similar mapping efforts along the Cosumnes River.
- All maps should show, to the degree possible, continuous coverage beyond planning area boundaries to illustrate the plan's geographic context. Map coverages "clipped" to planning area boundaries constrain the ability to judge how biotic communities, species distributions, or other features connect across boundaries into adjoining areas. Where comparable map

[11] http://www.cnps.org/programs/vegetation/PDFs/Integrated%20Classification-Mapping_WRiverside_Fremontia_2006.swf

layers are not available outside planning boundaries (e.g., detailed vegetation maps), other existing map layers may be substituted outside the boundaries to at least show the spatial context of the planning area.

- Include waterways (rivers and streams) and their names on all maps.

3.3 Watershed and Stream Habitat Mapping

We recommend mapping and characterizing watersheds in a manner that reflects their ecological integrity and functionality. These data could be used in species habitat suitability models as well as for identifying high-integrity and high-priority watersheds for conservation, evaluating restoration potential, and analyzing how well a reserve system captures the range of environmental variation. The following landscape-scale indicators of environmental status and quality should be developed for each CalWater watershed in the planning area:

- Area.
- Elevation range.
- Average annual precipitation.
- Mean and variation in runoff. Stream gages are present for Uvas, Llagas, Coyote, Guadalupe watersheds and were present until the last decade for Pacheco.
- Stream length within each stream order (Straler 1952), including ecologically sensitive "first order" headwater stream segments and the "zero order" colluvial basins that contribute water and sediment to downstream areas.
- Aquatic habitat types. For this we recommend reviewing and using the existing stream habitat map and associated data developed to support the SCVWD's[12] maintenance mitigation strategies, as updated in July 2006 by Jerry Smith ("Potential Fisheries in Selected Santa Clara County Streams"). The 2006 update reflects removals of stream barriers and incorporates new sampling results. The maps and GIS database use species composition and habitat conditions to delineate ten fish-habitat categories[13]. See Appendix E for details.
- Miles of free-flowing versus impounded streams.
- Fish passage barriers.[14]
- Levees, channelized or hardened reaches, and other artificial modifications to the natural flow regime (as part of floodplain mapping).
- Location of gravel mining and other instream or floodplain uses.
- Isolated springs, bogs, seeps, and ponds.

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[12] Joe Abel was the SCVWD contact.

[13] The ten fish-habitat categories are cold trout, cold steelhead, warm potential trout/steelhead, warm native, mixed/salmon, mixed native/introduced, fish scarce, no fish value, no data/probably no value, no data and estuarine)

[14] Absolute barriers are captured by the fish classification categories of cold trout versus cold steelhead (Appendix E). Other partial barriers are recognized by FAHCE and the 1983/4 Ambag studies and 2006 update by J. Smith.

3.4 Species Distribution Data

Species occurrence data is fundamental to conservation planning, and lack of sufficient data on the distribution and abundance of target species creates uncertainties for HCP/NCCPs. This can be further exacerbated by confounding effects of history (i.e., range expansions and contractions; extirpation) as well as spatial biases in survey coverage (e.g., due to lack of access on private lands). The advisors offer the following suggestions for ensuring the best available data are considered in the plan.

- Ensure that species distribution data utilizes all reliable sources, and especially museum records. Museum records are increasingly available as georeferenced digital files, and can be traced back to verifiable specimens. However, care must be taken to ensure that older location records are still relevant and do not paint misleading pictures of species' distribution patterns (e.g., records from areas subsequently removed by agriculture or development).
- Recognize the limitations of CNDDB data, which may include misidentifications or imprecise locations and are usually presence-only (not presence-absence) data. Also, a preponderance of data tends to come from biological surveys performed for CEQA or NEPA projects, which can create strong spatial biases in survey coverage. For example, since most development projects are proposed near existing development, survey data may misleadingly suggest that a particular species' range is concentrated near developing areas (because this is where most surveys have been performed).
- Additional rare plant species location data collected by the Santa Clara County CNPS should be incorporated into the Plan's species distribution maps and models. The CNPS also provided ecological data on 15 covered plant species (see Appendix G) which should be added to the plan's species accounts.
- For all location data, determine and consider the spatial precision of the data when using them for species models or for reserve planning. Points with poor spatial precision can add uncertainty to models based on them. CNDDB records, and most digital records of museum specimens, include estimates of spatial precision.
- Seek review of species distribution maps by other local experts, such as the local CNPS chapter for plants.

3.5 Species Habitat Suitability and Distribution Models

Modeling species distributions beyond known occurrence (presence) records based on habitat suitability is a powerful tool for conservation planning, especially where occurrence records are sparse and survey options limited (Section 3.4). Although the consultants clearly recognize the value of species distribution modeling, the simple GIS overlay models they have used thus far are not very reliable for mapping habitat values or predicting actual species distributions. Although commonly used, this approach usually results in significant errors of commission (false positives) and omission (false negatives) that add uncertainty to planning. Many more sophisticated modeling methods are available, such as generalized additive models (GAM), decision-tree models, neural network models, and hierarchical regression models, to name just a few (see Scott et al. 2002, Guisan and Thuiller 2005, Beissinger et al. 2006 for recent reviews).

Many of these approaches produce continuous gradients of a species' probability of occurrence, or at least multiple categories of habitat value, which can be more revealing for conservation planning than discrete suitable/unsuitable habitat maps.

We recommend the consultants review the recent habitat-modeling literature and develop statistical distribution models, at least for those species having sufficient data to build statistical models. A number of sophisticated software packages for analyzing species distribution data are now freely available and relatively easy to use. One promising method that makes good use of available GIS data is species-likelihood mapping using Ecological Niche Factor Analysis (ENFA) implemented using the freeware program BioMapper (downloadable from www.unil.ch/biomapper). ENFA is a multivariate statistical method that uses species presence data and GIS layers of environmental variables to map probabilities of species occurrence across a landscape (Hirzel et al. 2002). Other examples of freely available modeling packages worth exploring include MaxEnt (www.cs.princeton.edu/~schapire/maxent) and GARP (www.lifemapper.org/desktopgarp).

We recognize that the number of species observation points within the study area may be too limited to build robust statistical models for most species. One way to overcome this problem, at least for some species, is to judiciously include occurrences from outside the study area to increase sample sizes for model building. Models developed using a larger study area window can then be used to predict species occurrences within the smaller study area, as long as the larger model-building window is ecologically similar to the smaller planning area. For species having inadequate observation points even with an expanded study window, expert-opinion models are acceptable, so long as the model structure and logic are appropriate to reasonably predict species distributions, and as long as the resultant uncertainties are clearly articulated and considered in the plan.

Regardless of which approach to distribution modeling is selected, also recognize that there are a wider variety of environmental variables available than are often considered in simple GIS overlay approaches, which tend to rely heavily on categorical variables taken directly from available GIS layers (e.g., vegetation types and soil types). Other environmental variables that often prove useful in species distribution models include a variety of continuous variables (such as elevation or annual precipitation) or derived landscape variables, such as habitat patch sizes, distance from water, distance from human settlement, primary productivity, insolation indices, and road density (e.g., Carroll et al. 2001).

4 Conservation Design

This section recommends approaches for designing an ecological reserve network in the planning area to meet NCCP and HCP goals. These approaches should be refined once the biological goals for the plan are more fully developed. While traditional approaches to reserve design (such as reserve-selection algorithms and landscape design criteria) work well for terrestrial habitats, the focus for aquatic habitats must include accommodating processes (e.g., floods, sediment transport, erosion, and deposition that alter channel form, and vegetation succession) in addition to designating reserve areas.

4.1 General Approach

[15]We presume from information presented to advisors at the July 6-7, 2006 workshop that the approach for identifying reserve areas is not yet fully developed but is intended to identify a minimal set of strategically located lands that can best contribute to existing reserve lands (for example, by connecting them). It also appears that this approach relies to some degree on resource protections from existing land-use plans (e.g., General Plans) and ordinances (e.g., slope-protection ordinances and "green lines"). The advisors discussed several concerns with this approach to reserve design, and recommend using more formal, objective, and transparent decision-support tools to assist in meeting biological goals.

4.1.1 Reliance on Existing Land-use Protections

The advisors are concerned that resource protections in existing General Plans and local ordinances may not be permanent, and therefore relying on them as a starting point for reserve design could be misleading. We are further concerned that these existing tools do not necessarily guarantee the long-term health and management of resources in the areas apparently "conserved" by them. For example, in our experience many existing open-space easements or land set-asides for previous developments may not allow for active habitat management, or even access for resources agencies or others to perform biological monitoring during implementation of an HCP/NCCP. We therefore recommend a thorough analysis of the degree of protection afforded by these existing designations and ordinances, along with the risks and uncertainties of relying on them as permanent conservation areas. The relative level of permanency, effectiveness, management responsibility, costs, and risks to covered resources should be compared amongst a range of tools, including parcel acquisition, easements, permanent restrictive covenants, and land-use plans and ordinances. Only those tools that permanently conserve habitat value, and allow for active biological management and monitoring, should be treated as truly conserved by the plan. For land-use designations or restrictions that do not meet these criteria, the plan should explore means of increasing the protections to ensure they will permanently contribute to conservation value of the reserve system.

[15] Note that during the drafting of this Science Advisors' report, the plan consultants issued a memorandum concerning the application of reserve-design principles to the planning process (Zippin 2006, in litt.). This memorandum may make some of the following discussion moot, although we include our recommendations for completeness.

4.1.2 Transparency and Repeatability

The opportunistic approach of identifying key lands that may be available for conservation is common and often unavoidable in conservation planning, due to time and cost constraints. However, to the degree feasible, the advisors recommend using more formal reserve-selection algorithms (Margules and Pressey 2000) and the basic tenets of reserve design (Noss et al. 1997:73-110) to ensure a robust and defensible conservation design. We elaborate on these recommendations in Sections 4.2 (Use of Reserve-selection Algorithms for Terrestrial Habitats) 4.3 (Conservation Design Principles), and 4.4 (Conservation of Riparian/Riverine Corridors). Whether or not computer-aided reserve-selection algorithms are used, the biological goals, decision rules, and assumptions for how the reserve will be designed should be made as transparent and repeatable as possible, so that tradeoffs in meeting plan goals are explicit.

4.1.3 Coordination with Other Plans and Studies

The advisors strongly advise coordinating with other local and regional conservation planning efforts, including those outside but near the HCP/NCCP area. In particular, we recommend coordinating the plan with the following:

- The Nature Conservancy's Mount Hamilton project.
- Relevant endangered species recovery plans, including the Recovery Plan for Serpentine Soil Species of the San Francisco Bay Area (U.S. Fish and Wildlife Service 1998), the Recovery Plan for the California Red-legged Frog, *Rana aurora draytonii* [16] (U.S Fish and Wildlife Service, May 28, 2002) and the pending central California and south central California steelhead recovery plans (Federal Register: September 11, 2006 [Volume 71, Number 175][17]). Note that contributing to recovery actions, as identified in existing or developing recovery plans, should be included among the biological goals of the HCP/NCCP.
- Santa Clara County Parks Planning and Development Master Plan including efforts to develop and maintain riparian buffers.
- The Riparian Restoration Action Plan prepared for the City of San Jose (Jones & Stokes 2000).
- Studies on badgers and other carnivores being done by researchers at UC Davis and San Jose State University (Appendix F).
- Studies by Stuart Weiss on nitrogen deposition effects on sensitive serpentine soils species, and means of countering these effects.
- Serpentine grassland management and monitoring efforts conducted by the following organizations: Silicon Valley Land Trust, Kirby Canyon Butterfly Trust, Santa Clara County Open Space District, Santa Clara County Parks District, and the Environmental Trust of the Ranch at Silver Creek. We recommend that the consultants and plan proponents convene these parties to develop a serpentine grassland management and monitoring strategy for the NCCP. This strategy should be reviewed by independent scientists prior to adoption.

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[16]See the Recovery Plan at: http://ecos.fws.gov/docs/recovery_plans/2002/020528.pdf
[17]Federal Register Notice of Intent to prepare Recovery Plan for Steelhead is available at: http://www.epa.gov/fedrgstr/EPA-SPECIES/2006/September/Day-11/e14986.htm

4.1.4 Specific Geographic Locations of Concern

The Science Advisors offer the following comments concerning some locations of particular importance for conservation and/or restoration. These should receive high priority in design of the reserve system regardless of the approach used:

- **Coyote Ridge**: It is well known that the serpentine grasslands of Coyote Ridge are essential to the survival and recovery of the Bay checkerspot butterfly, along with numerous other species of concern. Coyote Ridge provides the only remaining mosaic of serpentine habitats that is large enough and topographically heterogeneous enough to buffer the checkerspot population through climatically variable years. We therefore recommend adding to existing reserves there to better conserve, buffer, and connect butterfly habitat. Details regarding methods to assess butterfly habitat are provided in Appendix H.
- **Coyote Valley**. Natural habitats on valley floors, especially in Coyote Valley, have become very uncommon, fragmented, and degraded. Given that representation of all natural communities is a priority of NCCPs, we recommend exploring opportunities for consolidating and restoring viable samples of historic vegetation communities on valley floors. In particular, sycamore alluvial woodlands have become extremely rare in California, and conservation and restoration of this unique community type should be pursued wherever feasible given the dramatic changes to hydrological processes that have already occurred.
- **Vicinity of Santa Teresa County Park and Tulare Hill Ecological Reserve**. This area deserves high priority for increased conservation and restoration to ensure functional connectivity across Coyote Valley (perhaps in conjunction with Laguna Seca). This area appears the last remaining opportunity to maintain ecological connectivity between mountains on either side of Coyote Valley. It is the best location to ensure that wide–ranging species, like badger and mountain lion, can reach habitats on either side of the valley, and it may be essential to sustaining their populations in the Santa Cruz Mountains (T. Diamond and J. Quinn, personal communications with Wayne Spencer; Appendix F). We recommend roadkill surveys and design of improved road crossings to ensure safe passage across major north-south roads in this vicinity.
- **Serpentine habitat on the west-side of Santa Clara Valley**. While Coyote Ridge is the center of Bay checkerspot butterfly populations and includes virtually all extant butterflies, at least one and preferably three serpentine grassland sites on the west side of the valley should be preserved and managed to spread the risk to cover unforeseen events that might adversely affect the east side.[18]
- **Laguna Seca Wetland.** This degraded wetland, adjacent to Tulare Hill, is recommended as a high priority for restoration and enhancement of wetland functions and values.
- **Sprig Lake in Mount Madonna County Park**. Regulated use of this headwater on-channel pond has the potential to substantially increase steelhead smolt production in the Uvas Creek watershed.

[18] Sites large enough to be of value include Santa Teresa County Park (plus adjacent serpentine grassland), Rancho San Vicente (aka "Calero"), and Hale Avenue-Falcon Crest (aka "north of Llagas Avenue"). These west-valley sites appear to average about 22 inches of annual precipitation, while Coyote Ridge and Tulare Hill average about 18 inches, suggesting that conserving the west-valley sites could decrease extinction risk for checkerspots as well as other serpentine-dependent species, by buffering against climatic uncertainties.

4.2 Use of Reserve-Selection Algorithms

Ideally, a reserve system will be designed (i.e., conservation sites will be selected) to *represent* (i.e., contain significant samples of) all features of interest (e.g., species or habitats) in a highly efficient manner (i.e., in the smallest area or without unnecessary redundancy; Margules and Pressey 2000). GIS based reserve selection algorithms (such as the computer programs SITES and MARXAN) are useful because they are more objective than approaches based purely on expert opinion, where subjective biases and preferences are known to influence results. Such models are being increasingly used in regional conservation plans because they can rapidly integrate complex goals and inputs to derive alternative reserve scenarios. Additionally, their use is transparent (the goals, decision rules, and assumptions are made explicit, and therefore can be varied interactively with input from stakeholders or others to compare tradeoffs between alternative designs). They are also more useful than site-scoring approaches because they are based on principles of efficiency and complementarity and therefore can ensure that all features are represented in a selected reserve network while attempting to minimize overall costs (where costs may be calculated in terms of acres, dollars, edge effects, or other appropriate currencies). In contrast, sites ranked highest in a scoring approach might contain many of the same features while missing many others.

4.3 Conservation Design Principles for Terrestrial Habitats

We were pleased that, during the drafting of this report, the consultants issued a draft memorandum describing how conservation design principles will be applied to this plan (Zippin 2006, in litt.). We agree with the principles thus outlined and believe they represent a sound interpretation of the reserve-design literature as it applies to this plan area. We add the following recommendations for further consideration and elaboration, recognizing that they are somewhat redundant with those in Zippin (2006, in litt.):

- Strive to conserve large open-space systems that comprise a full range of environmental gradients and community types within contiguous areas, as opposed to scattered reserves each supporting a small sample of the available variation.
- Concentrate new reserve areas adjacent to existing reserves to increase the size, connectivity, and buffering of existing conservation investments.
- Connect reserves to one another and to reserves outside the planning area to allow for wildlife movement and shifting environmental conditions (e.g., with climate change).
- Minimize development incursions into large blocks of intact upland habitats. Concentrate development near existing development and roads. Maximize infill, densification, and community aggregation strategies to reduce habitat fragmentation by exurban and low density housing.
- Avoid fragmenting large upland areas by roads or other developments, which can have severe effects on area-dependent species, like American badger, mountain lion, and golden eagle. Internal fragmentation, for example by "inholdings" within reserve areas, also constrains use of important management measures, such as prescribed fire.
- Maximally avoid impacts to rare communities that support narrow endemic species, such as serpentine soils.

- Avoid impacts to grasslands on or near the interface with oak woodlands and savannahs, which are valuable to a variety of declining bird species and other wildlife.
- Use larval-occurrence data and the habitat classification scheme using slope-exposure classes devised by Dr. Stuart Weiss for bay checkerspot butterfly to help prioritize additional conservation areas on Coyote Ridge. Long-term conservation of this species will require conserving the full range of small-scale topographic variation on the Ridge. Details are provided in Appendix H.

4.4 Conservation Design for Riparian/Riverine Corridors

Although designating reserve areas remains an important conservation tool for riparian and riverine communities, conserving aquatic habitats and species requires a strong focus on accommodating natural physical and ecological processes, such as floods, sediment transport, erosion, and deposition that alter channel form and vegetation succession. Major riparian systems in the planning area are highly impacted by human activities, which have severely altered the water-flow regimes that native organisms evolved with. Fish can no longer reach former portions of their habitat due to barriers and lowered flows during key portions of life cycles. High flows have been attenuated by reservoirs, allowing upstream movement of low gradient species, including non-natives. This is especially a problem where on-channel ponds provide habitat for these non-native species. On-channel ponds and other changes to hydrological regimes can also increase water temperatures, adding further stress to the system, especially for native cool-water species.

The advisors recommend a two-pronged approach to conserving and restoring biological values in riparian/riverine corridors:

- Include stream corridors within biological reserves and use them as "backbones" to connect other (e.g., terrestrial) reserve areas. Make these corridors as broad as possible, and strive for continuity of riparian systems from headwaters to river mouths, as well as lateral continuity from aquatic habitats, through floodplains, to adjacent uplands.
- Manage the hydrology of aquatic systems to maintain conditions as close as possible to conditions required by target resources, even where streams are not part of biological preserves.

We expand on recommendations for maintaining essential processes, along with some specific recommendations for steelhead conservation, in the following sections.

4.4.1 Maintaining Essential Processes

It is essential that the physical conditions of stream systems be maintained within a natural range of variability, or as close to natural as possible, for such characteristics as water temperature, flow regime, sediment transport, substrate condition, and water quality. Management of stream systems should strive for the following goals:

- Improve habitat connectivity, including aquatic continuity for fish passage, by removing physical barriers and regulating flows to allow fish passage during critical life stages. Low flow or dry stream sections in spring that affect fish migration include: Coyote Creek between Cottonwood Lake area downstream to Tully Road; Penitencia Creek between Mabury Road and the mouth; Uvas Creek downstream of Thomas Road; Llagas Creek downstream of Church Avenue; and Pacheco Creek from upstream of Casa de Fruta downstream to Highway 156.

- Flow management could substantially enhance habitat value for steelhead, Chinook salmon or Pacific lamprey migration, spawning, and rearing in the following streams, downstream from reservoirs:
  - Guadalupe, Alamitos, and Arroyo Calero creeks in the Guadalupe River watershed (partially covered by FAHCE).
  - Upper Penitencia and Coyote creeks in the Coyote Creek watershed (covered by FAHCE).
  - Uvas, Llagas, and Pacheco creeks in the Pajaro River watershed.
- Increase the amount of naturally inundated floodplain in the planning area by restoring natural topography, hydrology, and vegetation where possible. Restore and enhance riparian vegetation with appropriate composition of native trees and shrubs that help shade and cool aquatic habitats, and control exotic vegetation.
- Use pipeline screens or pressure differences to prevent unwanted transfers of aquatic animals between streams during inter-basin water transfers. Inter-basin water transfers can potentially mix native species from different drainages or spread exotics among drainages. For example, transfers from Coyote Creek to Llagas Creek should route towards seasonal dry channels such as Madrone Channel.
- Improve water quality by controlling runoff from man-modified landscapes, especially impervious landscapes associated with urbanization or altered hydrological conditions associated with vineyards. Watershed areas where rural development or conversion to vineyards is likely to affect stream flows or sedimentation include the following:
  - Tar, Bodfish, Little Arthur, Upper Uvas and Upper Llagas creeks in the Pajaro River watershed.
  - Arroyo Calero and Alamitos creeks in the Guadalupe River watershed.
- Remove or alter on-channel ponds that have adverse impacts on target species, including the following (see Appendix E for further details):
  - Ogier Ponds and Metcalf Pond on Coyote Creek
  - Silveira Pond on Llagas Creek
  - An off-channel pond near the mouth of Cedar Creek on Pacheco Creek, which could become a problem due to channel change during floods.

4.4.2 Steelhead Conservation and Management

The advisors recommend managing to maintain existing populations of steelhead in all five major watersheds within the Planning area. To guide steelhead management, a steelhead population-enhancement program for four of the watersheds should be prepared that considers the following:

- Substantial effort must be made to enhance the steelhead populations in both population segments present in the study area. The steelhead in Pacheco, Llagas and Uvas creeks in South County are in a separate distinct population segment (formerly a different evolutionarily significant unit [ESU]) than those in Coyote Creek and Guadalupe River.
- At least two watersheds should receive substantial habitat enhancement in both the north and south parts of the county. Redundancy of populations is desirable to protect against natural disasters (e.g., fires) or made-made disasters (e.g., toxic spills).
- Highest priority should be given to the watersheds with the highest steelhead potential, with the widest array of natural habitats, most diverse native fish communities, and fewest nonnative fish populations.

Based on these factors, we recommend the following priorities for steelhead enhancement (see Appendix E for details and rationale):

- South County: Uvas Creek and Pacheco Creek
- North County: Coyote Creek and Guadalupe River

5 Conservation Analyses

Predicting effects of a conservation plan on target resources is one of the most important yet underdeveloped tasks in most HCP/NCCPs. At a minimum, the plan must fully analyze its likely effects on populations of covered species, which often requires assessing plan effects on physical or ecological processes. It also requires addressing such uncertainties as the effects of global climate change, or how land uses are likely to change over the permit duration (30 or 50 years), with or without plan implementation.

The plan should comprehensively analyze the likely spatial patterns of future development and infrastructure, and how this will affect habitat fragmentation, wildlife movement, and ability of reserves to support covered species. The plan should specifically analyze effects of future road improvements on wildlife movements, roadkill, and ecological connectivity. Finally, the plan should analyze how well the reserve system captures (or "represents") the range of environmental variability in the plan area.

5.1 Conservation and Take of Covered Species

Analyzing effects on target species populations is required for any HCP or NCCP, yet "conservation and take" analyses remain weak and scientifically indefensible for many regional conservation plans. HCP and NCCP guidelines essentially require a plan to assess its *net effects* on *populations* of covered species. In other words, the plan should predict, as best possible with available knowledge and models, whether plan implementation will increase, decrease, or have no measurable effect on a species' population size, sustainability, or recovery.

This is not easy; and due to insufficient time, money, expertise, data, or precedence, many conservation plans have done little to analyze plan effects beyond tallying species location points or habitat acreages falling inside or outside of preserve boundaries. Recognize that these tallies are poor metrics for representing population sizes or effects on viability. Sometimes, vegetation community types are used as proxies to represent a species "habitat," which is a poor way to model habitat value for nearly any species. Clearly, the best possible habitat and distribution models that have been devised for a species should always be used in the quantitative analysis of conservation and take (refer to model discussion in Section 3.5). This quantification must be supplemented with a systematic assessment of plan effects on the physical and ecological processes affecting the species' habitat quality and population dynamics.

Ideally, an HCP/NCCP should perform quantitative Population Viability Analyses (PVA) on each covered species to determine the likely impacts of the plan on species populations. However, formal PVAs are not possible for most species due to insufficient data on species life histories, genetics, and other factors. Consequently, we do not recommend performing PVAs for this plan except, perhaps, for such well-studied species as Bay checkerspot butterfly).[19]

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[19] A preliminary PVA for Bay checkerspot has been conducted for the 100-hectare Kirby Canyon Butterfly Trust Leasehold (S. B. Weiss, personal communication with Raymond White). Results indicated less than a 95% likelihood of population persistence over 100 years within this area, due to observed variations in population size. Expanding the PVA to include the whole of Coyote Ridge would undoubtedly improve the likelihood of long term persistence.

For most species, we recommend applying a systematic, species-specific, limiting-factor analysis, as follows:

1. Identify the key factors limiting population size and recovery (e.g., available habitat area, availability of nest sites, competition from exotic species, or disruption of movement corridors).
2. Assess (quantitatively if possible) how each limiting factor will change with implementation of the plan or alternatives (increase, decrease, or no measurable effect).
3. Carefully weigh the relative contribution of each change to overall population size and recovery.
4. Determine the likely net cumulative effect of all these changes, considered together, on population size and recovery.

Although not fully quantitative, this approach forces thorough consideration of each known limiting factor and how the plan is likely to affect it (increase, decrease, or no measurable effect on its influence on the species' population). The relative strength of each factor should be weighed relative to the others in determining the overall, cumulative effects on species' populations. For example, a plan alternative may slightly decrease the acreage of potential habitat for a species, but with improved quality of that habitat to support the species (due to improved management or habitat connectivity, for example). The assessment should carefully weigh whether the combined effect of all positive and negative changes will most likely increase, decrease, or not measurably affect the species' population size and sustainability. The evidence used to make these decisions, and any accompanying uncertainties, should be carefully documented. The uncertainties should become monitoring targets in the adaptive management program to reduce uncertainty over time, to test whether the hypothesized net effect was correct, and to define management actions to counter adverse effects.

The following example demonstrates how the proposed analytical approach might work for hypothetical species and plan scenario. The consultants should adapt and modify this structure as needed to best reflect those threats, limiting processes, or other factors influencing a particular species (e.g., migration barriers, invasive exotics, limiting resources).

Hypothetical Example – Species Conservation Analysis		
Limiting Factors	**Net Effect**	**Explanation**
Habitat Area	Slight (10%) decline	The plan will reduce acreage of suitable habitat by about 10%. This decrease in habitat acreage will be at least partially offset by improved management and spatial configuration of the remaining habitat, such that the species' carrying capacity will be reduced by less than 10%.
Dispersal	Slight improvement	The plan will not degrade or remove existing movement corridors, and improved road-crossing structures may increase demographic and genetic connectivity across roads.
Resources	Slight improvement	Improved management, habitat restoration, and project-specific mitigation measures are expected to increase availability of favored prey and nest substrates.
Other Processes	Slight improvement	Plan implementation is expected to improve hydrological conditions for the species in at least some locations.
Threats	Slight improvement	Habitat management should decrease incidence of exotic plant species and thereby increase carrying capacity within reserves.
Uncertainties	Moderate	Current population size is unknown. Connectivity to populations outside planning area is uncertain. Whether habitat restoration efforts will increase prey availability is an untested hypothesis.
Net Population Effect	**No net effect or slight increase**	Over the long term, improved habitat management in reserve areas is likely to offset negative effects of habitat take. Monitoring to verify population responses and to reduce uncertainties about restoration actions should be undertaken.

5.2 Effects on Ecological Processes

In addition to species-by-species analyses, the plan should assess how implementation will affect important ecological processes that affect many species or natural communities in common, such as flooding, stream flows, fire, atmospheric nitrogen deposition, and exotic species invasions. Because myriad ecosystem processes affect many species in different ways, we don't recommend a comprehensive assessment of all natural and anthropogenic processes operating within the planning region, and how they might be affected by plan actions. Rather, we recommend analyzing changes in those ecological processes that are most influential in shaping and maintaining natural communities (for example, intermittent stream flows and periodic floods for sycamore alluvial woodlands; fire regimes for chaparral). For each natural community and process of interest, we recommend estimating the natural or historic range of variability (Landres et al. 1999) and assessing how the plan will likely affect this range (i.e., will plan implementation move the process closer to or farther from its natural range of variability?).

Characterizing the natural or historic range of variability (NRV or HRV, respectively) in a thorough and scientifically defensible manner can be very difficult, time-consuming, and controversial. However, an approximation of NRV or HRV that relies on existing knowledge (e.g., from the scientific literature and historical documents) of particular natural communities is feasible. Characterizing NRV or HRV requires knowledge of reference conditions, which may be contemporary (e.g., relatively large and unaltered examples of natural communities where natural processes still operate much as they have for centuries) or historical (e.g., from dendrochronology, pollen/charcoal analysis, notes of early land surveyors or naturalists, historical photographs and vegetation maps). Importantly, because the objective is to determine an acceptable range of variability that meets conservation goals, reference conditions should span multiple sites across the region and period of time, measured in at least decades. Characterizing NRV or HRV for water-flow regimes is critical for assessing effects on aquatic and riparian species.

The results of this analysis of ecological process changes should also provide inputs to the covered species analyses described in Section 5.1. These analyses should also be used to help guide development of the adaptive management program, with monitoring tasks designed to answer questions about the current or desired range of variability—and to test whether the hypothesized changes were correct—and management actions to remedy those situations where ecological processes are operating outside of the desired ranges.

5.3 Assessment of Aquatic Communities and Species

The value of habitats for native fishes depends on complex interactions between stream flow (and fast-water feeding potential), water temperature (and its effects on metabolism and growth rate), food production (substrate quality, flow, algal abundance) and visibility for feeding fish (turbidity, shade). Therefore, predicting plan effects on covered fish species will be difficult and must be done with explicit acknowledgement of uncertainties. Model assessments must be supplemented (or replaced) by sampling of fish populations over time (i.e., monitoring) to determine effects on distribution, abundance, and growth rates (e.g., using electrofishing). For example, if steelhead are doing well, even in relatively warm water, the combination of factors may well be suitable. Measuring "success" by only checking one or a few habitat variables (e.g., water temperature) is inappropriate.

5.4 Representation Analyses

Representation analysis involves evaluating how well a reserve system *represents*, or samples, the range of variation within an area of interest, such as whether it includes significant examples of all vegetation types, aquatic community types (Appendix E), species habitats, and geological substrates in the area. We recommend a representation analysis of physical (abiotic) habitats and natural vegetation within the plan area, assessing to what degree each type is represented in existing or potential reserves or special management areas, and hence which features or combinations of features are underrepresented and hence should be priorities for enhanced conservation in the plan. Physical attributes that should be considered in the representation analysis include watershed attributes (see Section 3.3), climate variables, geological substrates, and elevation zones or topographic features (e.g., ridgetops, foothills, or valley bottoms).

Often representation analyses are univariate in nature (e.g., they evaluate representation of the features of interest, such as vegetation types, habitats, and geologic substrates, one-at-a-time). However, we urge consideration of a multivariate representation analysis, which would help reveal how well joint occurrences of various features of interest are represented in the reserve system. For example, whereas a univariate representation analysis may suggest that serpentine soils are well conserved, a multivariate analysis may reveal that the bulk of conserved serpentine communities represent a small subset of the array of topographic or climatic conditions across serpentine soils that are important to Bay checkerspot butterflies. For most organisms, the combined effects of multiple features dictate habitat quality, which is why there is such an abundance of multivariate habitat suitability models (e.g., Hays et al. 1981; Hirzel et al. 2002).

We do not encourage a blind "data-mining" approach to multivariate representation analysis (e.g., performing Principle Components Analysis [PCA] on all possible combinations of variables). Rather, we encourage application of some insightful multivariate representation analyses based on the quality of available data and especially on what combinations of environmental variables are most likely to be meaningful to representing the range of environmental variability in the area, especially as it pertains to covered species. Obvious variables likely to explain much of the environmental variability in the area include elevation, precipitation, vegetation type, and major geological substrates.

In practice, what variables to include in a multivariate representation analysis depends on the types and resolution of available data and our ability to relate these data to habitat quality, species distributions, or some other measure of biological diversity. The spatial resolution of the data (area of cells in GIS) and the measurement resolution of the data (presence-absence, categorical, continuous) also determine the appropriate multivariable approach. At a minimum, joint occurrences can be tallied for multiple variables (e.g., low-elevation vs. high- elevation grasslands, serpentine vs. non-serpentine grasslands, etc.).

The larval slope-type categories that are important to Bay checkerspot butterfly phenology (Weiss 1996, Weiss and Murphy 1998) offer an example of the importance of multivariate approaches: One could tally the proportion of serpentine grasslands falling within each microclimatic slope category (see Appendix H) inside and outside of reserve areas to see if the full diversity of slope categories is represented in the reserve system. More sophisticated graphical and statistical analyses can also be performed to examine co-occurrences of multiple features of interest in the study area. The spatial arrangement of these features, and especially the spatial arrangement of co-occurrences of multiple features, can help inform reserve selection and reserve design.

5.5 Effects of Climate Change

Global climate change (Oreskes 2004) is projected to continue increasing temperatures in the study area, and will likely affect precipitation patterns, although the amount and direction of these changes are uncertain. Approximately 50% of the water used in the study area is imported from the Delta, via the South Bay Aqueduct and San Felipe Pipeline. Warming California temperatures will reduce the availability of this water by converting a portion of snow in the Sierra to rain, which will alter timing of runoff and reduce the water delivery efficiency of reservoirs. Amount of runoff in drought years will also be sharply reduced. These changes will affect the amount of water released into local streams (Coyote, Upper Penitencia, Arroyo Calero, Alamitos creeks) for groundwater recharge and maintenance of stream flows for fish.

Warmer (and possibly drier) conditions may also alter the length of the fire season and increase fire risks in forests (Westerling, et al. 2006), brushlands, and grasslands. Coping with increased fire risk will be especially hard as development moves into rural hillsides around Santa Clara Valley.

The effects of sea level rise will be evident in the San Francisco baylands and lower stream reaches. The relative elevation of these areas has already been affected in the last century by subsidence due to groundwater pumping. Flood management (including levees) will also be affected.

Since the nature of these changes is somewhat predictable (although their magnitudes and interactions may be uncertain) they should be considered as "changed circumstances" that are reasonably foreseeable over the 50-year plan duration. Likely effects on covered species should be considered in the conservation analysis, and management and monitoring contingencies should be built into the plan to counter adverse effects, to the degree possible. The great uncertainty about the magnitude of some effects, and the interactions between multiple effects, will require considerable attention in the long-term monitoring program.

6 Adaptive Management and Monitoring

Adaptive management is a systematic process for continually improving management policies and practices by learning from their outcomes. Its most effective form, "active" adaptive management, treats management actions as experiments designed to compare the efficacy of various alternatives (B.C. Ministry of Forests 2000). This plan's adaptive management strategy should be based on plan goals and objectives (as recommended in Section 2.1), yet be flexible and contain direct feedback loops to inform land managers and those overseeing HCP/NCCP implementation. If possible, specific *a priori* management thresholds should be developed under each plan objective. Management thresholds would tell the land manager when a change or action needs to take place (Noss and Cooperrider 1994). Therefore, plan objectives and action plans should evolve as more is learned about the system being monitored.

Although it is too early in the planning process to identify all necessary and sufficient management and monitoring guidelines, we offer some preliminary recommendations for select natural communities or issues of concern in the planning area. These should be considered for inclusion in the required Adaptive Management and Monitoring Plan. Additional scientific input should be sought during preparation of that plan, and during plan implementation.

6.1 Management Recommendations for Select Natural Communities

6.1.1 Grasslands

Management of grassland areas should be informed by the latest land-management research on use of managed grazing and fire to counter the adverse effects of annual grasses and thatch buildup on natural ecological processes and native species (Harrison et al 2003, Harrison et al 2006, Keeley 2002).

Serpentine grasslands are among the most important conservation targets for the plan. Non-serpentine grasslands are so highly dominated by exotic species that they are a lower conservation priority[20]. Despite being less invaded than other grasslands, serpentine grasslands are still threatened by a number of processes, such as the cessation of livestock grazing (because grazing helps counter adverse thatch buildup by exotic annual grasses); the arrival of new and more serpentine-tolerant invasive species such as goatgrass (*Aegilops triuncialis*); and atmospheric N deposition, which promotes the dominance of exotic annual grasses.

Grazing by livestock is likely to be an important grassland management tool. Studies at Coyote Ridge and elsewhere in the state show that grazing helps to reduce thatch and thus to maintain short-statured native annual forbs in serpentine grassland. Grazing has less beneficial effects on the composition of grasslands on more fertile non-serpentine soils, since these are almost entirely dominated by exotics. Unresolved questions remain about appropriate timing and intensity of grazing on serpentine grasslands, and even which livestock species provide the best results. The

[20] Soils are important to the extent that serpentine soils support grasslands with a much different species composition than other soils. However, within non-serpentine soils, soils appear to play relatively little role in determining grassland distribution or composition (Keeley 2006).

NCCP should use the best available research from local studies (Jasper Ridge, Coyote Ridge) and elsewhere in the state (McLaughlin UC Reserve, Sedgwick UC Reserve) to identify an appropriate grazing regime to maintain the native-dominated serpentine grasslands in the project area.

Invasions by weedy exotic species, especially Mediterranean annual grasses, have vastly changed the composition of all Californian grasslands. On non-serpentine soils, these changes are so profound that almost no native-dominated stands remain in the planning area. On serpentine soils, natives remain much more abundant, but ongoing invasion represents the most severe threat to native grassland species. Common invasives include:

- Barbed goatgrass is a recent invader with the potential to form monocultures on the rocky, sparsely vegetated serpentine soils that until recently were refuges for native and rare species. Many new infestations of barbed goatgrass have appeared at Coyote Ridge, which supports the only secure population of the bay checkerspot butterfly. Of the rare plants, the Metcalf Canyon jewelflower (*Streptanthus albidus* ssp. *albidus*) is at the greatest immediate risk from goatgrass.
- Italian ryegrass (*Lolium multiflorum*) and other exotic annuals have increased their dominance in serpentine grasslands because of atmospheric nitrogen deposition from automobile pollution. This is thought to be a prime factor in the disappearance of the Bay checkerspot butterfly from formerly large populations at Jasper Ridge and Edgewood Park (Weiss 1999).
- New exotic species continue arriving in California (Levine and d'Antonio 2005) and unknown species just as devastating as goatgrass could arrive and spread.

Fire probably also played an important historic role in maintaining the area's grasslands (Keeley 2006). Bay Area grasslands on non-serpentine soils are contracting due to shrub encroachment, and recent analyses suggest the cause is the cessation of livestock grazing in combination with fairly effective fire suppression. Fire has little long-term effect on the degree of exotic dominance, unless it is carefully timed to eliminate the seed input of specific exotic species (this usually means burning in late spring). It may be useful as a localized strategy to combat goatgrass, because research shows that late-spring burns in two consecutive years can substantially reduce goatgrass abundance. However, controlled burns are difficult to effect in the Bay Area because of air quality concerns. Alternatively, goatgrass infestations could be combated with hand pulling or herbicides.

We recommend developing management strategies for area grasslands in close coordination with the agencies conducting research and management to maintain the ecological integrity of Bay Area serpentine grasslands. These include US Fish and Wildlife Service (which has funded an ongoing adaptive management study by David Wright and Stuart Weiss), the Silicon Valley Land Conservancy, the Kirby Canyon Butterfly Trust, the Santa Clara County Open Space Authority, the Santa Clara County Parks Department, and the Environmental Trust of the Ranch at Silver Creek. Coordination and consolidation of efforts will make management simpler and more effective in the long run.

6.1.2 Chaparral and Coastal Scrub

Fire is a central concern in the management of chaparral and coastal scrub habitats. It is likely that the natural fire regime in many chaparral habitats was regular but relatively infrequent (fire-return intervals of 50 to 100 years). Recent studies suggest that, in contrast to better-studied Southern California, fire suppression in historic times has been relatively effective in the Bay Area. The cessation of Native American burning in combination with reduced livestock grazing and suppression of wildfires has led to expansion of shrublands at the expense of grasslands in the Bay Area (Keeley 2006).

Fire suppression represents a potential threat to species that depend on fire entirely or in part for their reproduction. According to CNPS, at least two rare species in the project area are fire-dependent (*Malacothamnus* spp., Appendix G). The degree of fire dependence of coyote ceanothus (*Ceanothus ferrisae*) has been debated, but it seems clear that fire can result in a massive increase in the seedling recruitment of this species (this happened after the accidental fire at Anderson Dam; Susan Harrison, personal observations), as is the case for many *Ceanothus* species.

Prescribed burns are difficult to effect in chaparral habitats in heavily populated areas such as the Bay Area because of safety and air-quality concerns. To be ecologically valuable, burns must be conducted in the dry season, when safety concerns are at their highest. Wet-season burns, although safer, can kill dormant seeds in the soil. It is important to note that in chaparral habitats, prescribed burns are unlikely to reduce wildfire hazards, and should not be used for this purpose (Keeley 2002).

We recommend that the NCCP (1) include strategies to take advantage of accidental fires to gain knowledge of the fire ecology of species of concern; (2) consider small-scale experimental prescribed burns to stimulate reproduction of target species (e.g., *Malacothamnus*, *Ceanothus*); and (3) develop wildfire management plans that minimize adverse environmental effects of fire-suppression activities (e.g., no wet-season prescribed burns, no fire lines through sensitive habitats).

6.1.3 Oak Woodlands and Savannahs

Oak woodlands and savannahs tend to have an understory dominated by exotic annual grasses. The lack of regeneration by blue oaks (*Quercus douglassi*) is a major long-term issue for maintaining the integrity and wildlife value of this habitat type (Swiecki and Bernhardt 1998). Control of exotic species may be an important aspect of successful oak restoration. Some research suggests that exotic annual grasses and forbs (e.g., yellow starthistle) may compete with oak seedlings for water and light, or may harm them indirectly through subsidizing high densities of small mammals (Gordon and Rice 2000; O. J. Reichman and J. Orrock, personal communications with Susan Harrison). Exclusion of livestock also appears to be necessary though not sufficient to permit regeneration (Swiecki and Bernhardt 1998).

We recommend that management strategies for oak woodland habitats include oak regeneration and exotic species control as major goals.

6.1.4 Riparian Forest and Scrub

As elaborated in the discussion of competing goals for riparian corridors (Section 2.1.3) maintaining perennial flows downstream of reservoirs is important for maintaining and enhancing native fish habitat, including for the threatened steelhead. But maintaining perennial flows may preclude restoration of the presumed natural condition of intermittent flows and open sycamore alluvial woodlands along the primary channels of these streams (especially Coyote Creek). We therefore recommend carefully researching where restoration and enhancement of historical sycamore alluvial riparian conditions is possible without compromising steelhead recovery actions. For example, we recommend attempting to restore sycamore alluvial woodlands along more braided side channels within the floodplain of Coyote Creek, perhaps aided by planting and irrigating sycamores until their roots reach the water table.

6.1.5 Lakes and Ponds

Management of permanent drains, ponds, and other wetland features may vary based on geographic context and the species they are being managed for. In some areas, it may be best to maintain permanent waters to provide habitat for certain covered species, such as western pond turtles. However, permanent ponds also provide habitat for exotic species that are detrimental to native species that evolved with ephemeral wetlands. Periodically draining ponds during late summer to control bullfrogs and other exotic species can therefore be a useful management tool to benefit rare amphibians. Site-specific management directives should be developed for the management of emergent wetlands and ponds to address such issues, based on site-specific monitoring surveys and management goals, during plan implementation.

As discussed earlier (Section 2.5) we recommend removing or altering conditions of some ponds to improve conditions for native species. Specifically, we recommend moving Ogier Ponds, Metcalf Percolation Pond, and Silviera Pond off channel; keeping the pond adjacent to Pacheco Creek near the mouth of Cedar Creek off-line; and managing Sprig Lake in Mt. Madonna County Park to provide rearing habitat for steelhead. We also recommend considering additional modifications and management actions at Pickel Reservoir to provide rearing habitat for steelhead.

As also discussed in Section 2.5, we recommend managing stream flows below reservoirs to maximize the amount and quality of rearing habitat for steelhead and Chinook salmon by optimizing the mix of release volumes and release water temperatures for these species. Releases should be managed to provide sufficient flows for adult access and smolt migration in late March through May.

In North County, the Coyote Creek and Guadalupe River watersheds should be high priorities for habitat enhancement as mitigation for impacts of covered activities. In south county the Uvas Creek watershed, followed by Pacheco Creek, should receive priority for enhancement actions. If SVCWD were to take over management of Pacheco Reservoir, it should be managed to enhance the steelhead population downstream in Pacheco Creek.

Finally, we recommend the following mitigation features for land uses that can adversely affect aquatic systems due to changes in runoff and sedimentation:

- Incorporate sediment detention basins into storm drain systems for new developments to minimize new sediment inputs to area streams.
- Regulate well pumping for rural developments and vineyards, and encourage use of city water pipelines to minimize ground-water impacts.
- Encourage contour plantings and vegetated buffer strips to minimize erosion and sedimentation from vineyards.

6.2 Preliminary Monitoring Recommendations

We recommend using the approach presented in Atkinson et al. (2004) to guide development of the monitoring program. This dovetails well with the hierarchical approach to setting goals, objectives, and criteria recommended in Section 2.1. Development of management-oriented conceptual models, as presented in Atkinson et al. (2004) is especially useful for relating plan goals to management actions within an adaptive management program.

6.2.1 Monitoring Recommendations for Select Covered Species

The type and intensity of monitoring for target resources should vary with species. In general, monitoring effort should be sufficient to understand relative population status, trends, threats, and responses to management at reasonable levels of precision for all covered species. However, it is not essential to obtain precise estimates of population size for all species, and limitations of time, money, expertise, and access make obtaining such estimates unreasonable. Moreover, intensive population monitoring can actually harm some species, and it is unnecessary to achieve plan goals for many of them.

For animals, relative indices of distribution and abundance may suffice for most species, such as derived from simple presence-absence surveys, periodically sampled throughout reserves, and corrected using detection probabilities (Azuma et al. 1990, MacKenzie et al. 2002). We recommend reviewing Vojta (2005) and associated papers recently published as a Special Section of the *Journal of Wildlife Management*: "The value and utility of presence-absence data to wildlife monitoring and research."

For rare plants, we recommend working closely with the Santa Clara County CNPS, which is in the process of developing a rare plant monitoring program with an initial focus on species with NCCP, HCP, and/or CEQA status. Coordinating with an active and well organized volunteer force is likely to increase the effectiveness of monitoring and especially the discovery of new species locations. Monitoring goals should focus on the ability to detect changes in population density, especially changes in response to management treatments, and not on absolute estimates of population size or viability. A census-based approach to estimating population viability is available through diffusion approximation methods (Morris and Doak 2003).

For serpentine grasslands, we recommend working closely with the agencies already involved in these efforts to monitor invasive species (see Section 6.1.1). Key goals include the detection of new noxious invaders, the detection and eradication of new and controllable infestations ("nascent foci") of goatgrass, and the detection of overall change in exotic and native abundance in response to management (e.g., grazing, mowing, fire). For the Bay checkerspot butterfly and its host and nectar plants (*Plantago erecta*, *Lasthenia californica*), well-researched monitoring protocols already exist, involving transect counts of butterfly larvae and fixed-plot counts of plant densities. We recommend working closely with the agencies and individuals already conducting serpentine grassland and butterfly monitoring.

For fish, we recommend periodic sampling (i.e., using electrofishing) to determine distribution, abundance, meso-habitat (i.e., pool, riffle, head of pool) use and growth rates of juvenile steelhead. Monitoring by snorkeling cannot adequately sample shallow habitats used by fish in warm, high flow conditions and does not provide precise data on fish sizes or ages. It is also very inefficient in shaded or even moderately turbid habitats. Late summer monitoring in rearing habitat provides distribution patterns of rearing, which is important to assess restoration effectiveness. Monitoring downstream migration of smolts by trapping can provide a useful index of watershed productivity. However, this can be quite expensive and subject to sampling difficulties related to spring stream flows (especially late storms) and trap efficiency (clogging, sabotage etc.). Therefore, it should be used only occasionally (every 5-10 years). If trapping is used, smolt sizes and ages (from scales) should be determined.

6.2.2 Monitoring Recommendations for Other Select Issues

Not all monitoring should be focused on populations of covered species. It is at least as important to track measures of ecological integrity, habitat value, and threats to ecosystem health. Here we provide some preliminary recommendations for monitoring particular issues of interest:

- *Oak Recruitment:* The monitoring plan should compare areas where oak regeneration is occurring to those where it is not to identify factors limiting oak regeneration. Additional study of interactions between fire, grazing, and oak recruitment are warranted.
- *Road Kill:* We recommend performing road-kill surveys in those areas where road improvements are made or new traffic is generated, using a Before-After/Control-Impact (BACI) sampling design.
- *Aquatic habitat factors:* Factors to consider for periodic monitoring along streams include bank stability, geomorphology (down cutting), substrate quality (for insect production and fish spawning), turbidity, temperature, escape cover (overhanging vegetation, woody structures, undercut banks), amount and type of shading, and stream flow.
- *Fire regime:* Fire-return intervals and fire intensities should be monitored and compared against the natural ranges to inform land managers when intervention (prescribed fire or post-fire remediation) may be necessary.

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Appendix A
Biographies of Advisors

Steven R. Beissinger, Ph.D., Professor of Conservation Biology and A. Starker Leopold Chair in Wildlife Biology, UC Berkeley, Department of Environmental Science, Policy & Management. Dr. Beissinger's research includes conservation, behavioral and population biology of threatened and exploited species throughout the US. and internationally. Over the past decade Steve and his students have studied the demography, diet and population dynamics of an endangered seabird (the Marbled Murrelet), the population biology of a parrot in Venezuela, and environmental and microbial constraints on the onset of incubation in birds. His research has resulted in over 130 articles in scientific publications. He is senior editor of the books *Population Viability Analysis* and *New World Parrots in Crisis: Solutions from Conservation Biology*. He has served on Recovery Teams, is a Fellow of the American Ornithologists' Union and London Zoological Society, and serves on the Board of Directors of the National Audubon Society. He is a research associate of the Smithsonian Institution and the University of California Museum of Vertebrate Zoology.

Joan L. Florsheim, Ph.D., Associate Research Scientist, Geology Department, UC Davis. Specializing in fluvial geomorphology and earth surface processes, Dr. Florsheim is a member of the Paleoenvironmental Change faculty group at UC Davis. Currently, her research involves field investigations in fluvial systems in the Central Valley and in North Coastal California. Her research studying effects of floodplain processes and topography at intentional levee breaches has been applied to riparian restoration. Dr. Florsheim also studies baselevel change on floodplain-fan sediment storage and channel morphology, and effects of land uses on sediment budgets and aquatic habitat. Her additional research interests include hillslope, watershed, estuarine and tidal wetland processes, influence of wildfire on geomorphic and hydrologic processes, ecology, and applied geomorphology. Dr. Florsheim received her doctorate from UC Santa Barbara in 1988.

Susan Harrison, Ph.D., Professor, Davis Campus Director, UC Natural Reserve System, Division of Environmental Studies, UC Davis. Dr. Harrison is a highly accomplished researcher with expertise in plant ecology, invasion biology, and conservation. Her major area of emphasis is spatial ecology, which examines the influence of heterogeneous environments on populations, communities, and patterns of diversity. Over the course of her career she has published 89 journal articles, and served on numerous advisory and strategic steering committees that address nature reserve planning and public research issues. Recently, she was awarded Honorary Fellow from the California Academy of Sciences. Dr. Harrison currently conducts research on endemic-rich plant communities of California's serpentine outcrops, and exotic species invasion and native species survival. A graduate from UC Davis for both BS in Zoology and MS in Ecology, Dr. Harrison received her Ph.D. from Stanford University, where she served as a Research Associate and Postdoctoral Fellow.

Kenneth Rose, Ph.D., Professor, Department of Oceanography & Coastal Sciences/Coastal Fisheries Institute, Louisiana State University. Dr. Rose provides a national perspective in fish conservation, and has expertise in fish ecology and population modeling. His current research involves mathematical and computer modeling of aquatic populations, communities, food webs and ecosystems. He is particularly interested in using models-applied analyses, such as ecological risk assessment and fisheries management. His work has led to numerous journal articles and he has served on many national advisory panels regarding fish and water policy. He is a former member of the CALFED Independent Science Board and the Science Review Panel for the Environmental Water Account (EWA). His work on the EWA included study of California's fresh-water systems and managing optimum flows for Chinook salmon in Central Valley streams, combining models with biological needs. Dr. Rose received his doctorate from the University of Washington in 1985.

Jerry Smith, Ph.D., Associate Professor, College of Science, Biology Department, California State University, San Jose. Dr. Smith specializes in fresh water and estuarine ecology, with an emphasis on community structure and life history strategies of native fishes. He is a published researcher with numerous journal articles and other peer-reviewed reports to his credit. As a frequent speaker for professional conferences and symposiums, Dr. Smith addresses a variety of topics related to special-status fish and frog species ecology and distribution, and watershed and fishery conservation. For over a decade, his commitment to fish conservation has been expressed through his service as a member of several federal and state recovery teams for California steelhead, Chinook, Coho salmon, and Delta smelt, species that range throughout California waters. Dr. Smith received his doctorate from UC Davis in 1977.

Wayne Spencer, Ph.D., Senior Conservation Biologist, Conservation Biology Institute, San Diego. Dr. Spencer is a conservation biologist and wildlife ecologist with expertise in conservation planning and endangered species recovery. He has worked on various regional NCCPs and HCPs in California as a consulting biologist, science advisor, and science facilitator. His research focuses primarily on rare and endangered mammal species, including the endangered Stephens' kangaroo rat and Pacific pocket mouse. He previously studied the ecology and evolution of mammalian space-use patterns, spatial cognition, and the brain. He is a Research Associate with the San Diego Natural History Museum, and serves on the Science Advisory Committee for South Coast Wildlands. Dr. Spencer serves as Lead Advisor for the Santa Clara Valley HCP/NCCP. He received his MS in Wildland Resource Science at UC Berkeley in 1981 and his Ph.D. in Ecology and Evolutionary Biology at the University of Arizona in 1992.

Raymond White, Ph.D., Invertebrate Ecologist, Independent Consultant. Due to his extensive knowledge of special-status invertebrate species, Dr. White is regularly consulted for design and implementation studies on endangered and threatened species. He specializes in butterfly and fairy shrimp species within the California bay area. Dr. White has authored two Habitat Conservation Plans for endangered/threatened butterfly species on San Bruno Mountain and south San Jose. Among the long list of species he's consulted on are the Bay checkerspot butterfly, Callippe silverspot butterfly, and the San Bruno elfin. He also holds a current (2005) permit to perform protocol-level surveys and identifications for each of the listed California fairy shrimp species. Dr. White also is an educator, teaching courses in biology, zoology, and ecology at several universities and colleges in the Bay Area. He received his doctorate in biological sciences from Stanford University in 1973, where he previously obtained an M.A. in 1971.

Appendix B
Field trip Summary

Santa Clara Valley HCP/NCCP
Science Advisors Workshop Field Tour, July 6, 2006
10:30 a.m. to 3:45 p.m.
Notes

Stop	Location	Topics Covered	Notes
1	Laguna Seca wetland along Santa Teresa Road	David Zippin, J&S; Troy Rahmig, J&S o Laguna Seca wetland o Coyote Valley Specific Plan (+ enroute) o Historical Ecology and Conservation Strategy	• Historically valley oak/savannah habitat (1890's) • Remnant stand of willows • This winter, lowest spots under 1-2 ft of water • Discing ok by USACOE; but not dredging or filing • Serves as mitigation area for development • Area ultimately intended to be turned over to the water district for restoration and burrowing owl habitat • Should SA focus on burrowing owl habitat in valley lands? Expensive • Connectivity – could provide key corridor between Santa Cruz Mtns and south San Jose • Mapping measurement errors?
2	Santa Teresa County Park	David Zippin, J&S; Alan Launer, Stanford o Almaden Urban Reserve o Conservation opportunity o Views of Coyote Ridge o Management issues within existing open space o Serpentine chaparral o Serpentine outcrops o Tulare Hill	• Water sources could be another source of funding • No protected watershed lands. • Fire-shaped landscape, patchy (sage scrub, black sage, CA sagebrush). • City and County do not allow development in slopes greater than or equal to 15% • City policies discourage clustering, which promotes increased fragmentation of habitat • Potential development along Coyote Ridge • Ridgeline development discouraged by county • Development permitted by cities, generally occurs in the valley • David Zippin notes that the Plan defines 4 categories of open space • Potential 5500 acre development could potentially be used as HCP mitigation area? • Can Plan have affect on types of agriculture? • What portion of the flat areas (those less than 5% slope) are in a natural state? Most flat areas have been developed.
3	Coyote Creek Parkway at Metcalf Park Picnic Area Restrooms	Matthew Jones, J&S; Ken Schwarz, J&S, Troy, David o FAHCE activities in Coyote Creek o Fish Passage	• Coyote Creek Dam originally installed in 1934. Fish ladders were installed in 1999. • Contains Steelhead and Chinook runs. Chinook are cued from transferred Delta waters – historically, they were only occasionally present.

		Barriers o Coyote Creek Parkway NRM o Amphibian/aquatic reptile habitat o Sycamore alluvial woodland	• Conservation question – is the Chinook salmon a conservation target for this HCP? Historically, Chinook may have had low occurrences. Relatively new to this area since they are following Delta waters. • FACE will also be producing an HCP. It will be a challenge to make sure FACE HCP effort and this HCP effort are coordinated and woven together. • Monitoring regime for FACE consists of adult fish counts.
4	Kirby Canyon landfill entrance road	David Zippin; Erica Fleishman ▪ Bay checkerspot butterfly ▪ Serpentine plants ▪ Serpentine grassland management ▪ Nitrogen deposition impacts	• The southern tip of the ridge has special ceanothus and sag ponds (possible habitat for tiger salamanders?). • The ridge and hillside is currently under a conservation easement held by Waste Management for another 20 years (easement may be for 100 years?). the conservation easement is currently maintaining important microhabitat for butterfly survival. • Nitrogen deposition, primarily from vehicle emissions from Hwy 101, is a problem on serpentine soils. • Goat grass (an invasive species) is a concern in this habitat.
5	Highway 152 at Casa de Fruta	Dave Johnston; Jonathan Ambrose; Troy Rahmig o Pacheco Creek o Pacheco Reservoir o Kit fox movement issues o Watershed Mgmt / Water Quality	• Ranchers have a private, unregulated reservoir that stores 6,000 acre feet of water from Pacheco Creek upstream of the site. The flows are inadequate for Steelhead survival – waters are too warm. • Steelhead population is dependent on this unregulated reservoir. The steelhead also rear up near this reservoir • There are no protected open space areas in this location • South Fork enters below • Potential habitat for San Joaquin kit fox, although Hwy 152 is a barrier. Science Advisor feedback on this species was requested. • Hwy 152 barrier • Wayne noted that maps should provide a more regional perspective, including migration routes and ranges • Ambrose noted that cattle grazing creates sycamore woodland in the area, upstream of Casa de Fruta.

Appendix C
Science Advisory Workshop

Santa Clara Valley HCP/NCCP
Summary of Science Advisors Workshop
Thursday, July 6, 2006
8:30 a.m. – 5:30 p.m.
Courtyard by Marriot, Morgan City, CA

MORNING SESSION - PUBLIC PARTICIPATION PORTION OF WORKSHOP: JULY 6, 2006, 8:30 A.M. TO 10:00 A.M.

ATTENDANCE

Science Advisors in Attendance

Susan Harrison, Ph.D.
Sean Barry
Joan Florsheim, Ph.D.
Steve Beissinger, Ph.D.
Raymond White, Ph.D.
Kenneth Rose, Ph.D.
Jerry Smith, Ph.D.

Agency Staff in Attendance (during public portion of meeting & field trip 8:30 a.m. – 3:30 p.m.)

Mike Mena (City of San Jose)
Darryl Boyd (City of San Jose)
Pat Showalter (SCVWD)
Dave Johnston (DFG)
Brenda Johnson, Ph.D. (DFG)
Ranu Aggarwal (County of Santa Clara)
Steve Golden (City of Morgan Hill)
Ann Calnan (VTA)

Public in Attendance (during public portion of meeting only 8:30 a.m. – 10:00 a.m.)

Donald Mayall (CA Native Plant Society)
Paul Campos
Stuart Weiss
Jennifer Hogan
Ken Reiller

Consultants in Attendance

Uma Hinman (Kleinschmidt)
Wayne Spencer (Conservation Biology Institute)
Troy Rahmig (JSA)
Bruce DiGennero (Essex Partnership)
Kenn Schwail (JSA)
David Zippin, Ph.D. (JSA)

PRESENTATIONS

Welcome (Johnson)

Brenda Johnson from Department of Fish and Game welcomed the group and thanked the Science Advisor's for participating in the process. Johnson is the State's Science expert for NCCPs and has been involved in these plans in California for about 10 years. She provided an overview of the two laws: the Federal ESA HCP and the State NCCP Act. The Federal Act encourages independent scientific input, while the State Act requires it.

Overview of Science Process for NCCP/HCP (Spencer)

Wayne Spencer presented a power point slide show as shown in Attachment B. The presentation described the following general points:

- NCCP is 1991 state law and is designed to conserve multiple species and the habitats they depend on at a landscape scale including ecosystem processes. NCCP goal is to contribute to species recovers and prevent future pop declines.
- NCCP requirements under SB107 (effective Jan 1, 2003) codified existing internal policies at CDFG.
- HCP 5-point policy (1999) informed by experience in California in response to criticisms from scientific and conservation communities.
- Role of the Science Advisors is to review data, principles, and methods and to advise on biological goals.
- Models can be used to assist with reserve design and effects.

Overview of Jones and Stokes approach to the HCP/NCCP (Zippin)

David Zippin, Ph.D., a plant ecologist with Jones and Stokes Associates provided a PowerPoint presentation entitled "Santa Clara Valley Natural Habitat Conservation Plan/Community Conservation Plan" as shown in Attachment C. The key issues described in the presentation include the following:

- HCP/NCCP Goals
- HCP/NCCP Process
- Study area
- Covered Species
- Conservation needs and issues

During the discussion, Dr. Kenny Rose requested clarification on the mapping units used for the land cover maps. Additionally, Dr. Jerry Smith requested clarification of the mapping done for riparian woodland and sycamore alluvial woodland.

Zippin directed the Science Advisors to a list of the 35 covered species (Table 1-2) and requested that they review the list and provide feedback, including recommendations on whether any of the species should be removed or others added. JSA also identified eight no-take species. The no-take species will not be on the permit applications and would not be included in the plan, which ensures no jeopardy finding at the end.

PUBLIC COMMENT PERIOD

Following the presentations, the meeting was opened up to public comment. Four of the five commenters were present. The fifth comment was received via email. Please see the following table for a summary of the public comments received.

Name	**Topic**	**Comments**
Stuart Weiss	Key science and management challenges	Expressed a need for management for needs for invasive species. Noted that there are ongoing conservation efforts and monitoring pools with a wealth of information available. Offered to share data and protocols with the Science Advisors when they were ready. Will be meeting with JSA to go over their data. Extended an invitation to tour the area in April when the wildflowers were blooming.
Ken Reiller	Steelhead trout conservation in Pajaro watershed.	Noted that his goal is to facilitate coordination of conservation efforts in the Pajaro Watershed. Encouraged the Science Advisors and JSA to look at the "bigger picture," such as considering the life stages of steelhead trout outside the planning area.
Don Mayall	I want to introduce myself and my organization – California Native Plant Society (CNPS).	The CNPS is an advocacy group dedicated to science. Expressed strong support for the process.
Pat Showalter (SCVWA)	Background comments.	Pat works for the Santa Clara Valley Water Agency and provided some background on the planning area. Pat said the urban limit lines detailed on the maps provided by JSA are lines that were established in the mid 1960's to delineate growth. She believes the lines to be quite firm. She noted the wide variance in rainfall and it's effects on microclimates and vegetation/habitat types within the planning area. For

Name	Topic	Comments
		example, rainfall varies from 50 inches on the west side of the valley to 12 inches on the east side, which are only a couple of miles apart. Additionally, rainfall can vary up to 250% with dry vs. wet years. She asked the group if climate change had been taken into consideration in the Plan. Is there any way to plan for and/or delineate climate change? What will it mean for the region?
Bob Rohde (NRCS) – via email	Species extinction	What species on the proposed list have the greatest potential of extinction within the next 50 years, despite the positive effects of the HCP/NCCP?

Questions from the public were accepted by the Science Advisors for consideration.

Following the public comment period, a field trip was provided for the Science Advisors, consultants and stakeholders.

BRIEF SUMMARY OF AFTERNOON SESSION – SCIENCE ADVISORS AND CONSULTANTS: JULY 6, 2006

ATTENDANCE

Science Advisors in Attendance

Susan Harrison, Ph.D.
Sean Barry
Joan Florsheim, Ph.D.
Steve Beissinger, Ph.D.
Raymond White, Ph.D.
Kenneth Rose, Ph.D.
Jerry Smith, Ph.D.
Wayne Spencer, Ph.D.

Consultants in Attendance

Uma Hinman (Kleinschmidt)
Bruce DiGennero (Essex Partnership)

OVERVIEW

Following the field trip, the Science Advisors discussed data and analysis, and species and reserve design. The following discussion points were noted for data and analysis:

- Clarify the accuracy of the various GIS data layers
- Consider additional data sources
- Develop explicit goals and objectives
- Clarify what the real issues are (e.g. connectivity, representation, water flows, sustaining viable populations, nitrogen deposition, etc.)
- Define a proposed approach to reserve design and identification of management measures (what are the tools and techniques that will be used?).
- Consider a treats analysis at a geographic level. Map the treats.
- Be explicit about trade-offs. Use modeling as a tool for evaluating trade-offs and informing the decisions.
- Clarify how the habitat sensitivities and priority habitats were determined.

The following summarizes the discussion topics regarding species and reserve design:

- Consider indicator/keystone species that may not be “covered” species, particularly with respect to reserve and corridor design.
- Clarify how the level of species take will be analyzed and set.
- Clarify what will be done regarding species that we know little about. Which species are these?
- Look outside the planning area boundary for context, connections, and partnerships.
- Do not assume Urban Limit Lines or other green lines are fixed. Local regulations can change.
- Think about habitats in terms of processes and gradients, including spatial processes (e.g. flooding).
- Focus on management of processes (rather than reserve design) for fish and other aquatic species, specifically on water flows.
- Identify specific points in the planning process where additional independent science input would be valuable.
- Establish objectives for landscape analysis and species analysis.

Appendix D
Initial Questions
Addressed by Science Advisors

Species Addressed

Is the current list of species to be addressed by the plan comprehensive enough to achieve the plan's biological goals? Should any species be added to assist in reserve design (e.g., species with no special protection status but that may serve as useful reserve design or monitoring indicators)? Should any species be removed as highly unlikely to be found in the plan area or affected by the plan?

Are there any new or pending taxonomic revisions or other scientific issues that would affect the list of species addressed?

Are there effective ways of grouping species to assist in designing, managing, or monitoring a reserve (e.g., by species guilds or communities, landscape-level versus site-specific management requirements, narrow endemics versus wide-spread species)?

Existing Data

Do the documents you reviewed appropriately compile and interpret existing information, and do they present a firm scientific foundation for conservation planning? Are there additional data sources or literature pertaining to the resources of the plan area that should be incorporated into the database and considered during planning and analysis?

Was the land cover map developed with a methodology adequate for regional conservation planning? What improvements could be made during the planning process or during plan implementation?

What gaps in existing information create the greatest uncertainties for planning, analyzing, managing, and monitoring an ecosystem reserve in this setting? What are the most effective methods for addressing these data gaps? Do you have or know of additional data on covered species occurrences or habitat suitability?

What types of conceptual or analytical models might be used to address information gaps, assess plan effects, or otherwise inform plan development and implementation? Are habitat suitability models or other models recommended for predicting species ranges where distribution data are sparse? If so, what standards for formatting, parameterizing, or testing such models are recommended? Are the models prepared or proposed by the plan consultants appropriate for their intended purposes? Are the existing data for input variables sufficiently accurate and precise to model species' distributions sufficient for regional conservation planning?

What if any models of physical or biological processes might be useful, such as ecological models of population or community dynamics, models of animal movements, or models of nutrient or water flows?

Conservation Guidelines and Reserve Design Process

What basic tenets of reserve design are pertinent to planning a reserve system in this area, and how should these tenets be translated into measurable standards and guidelines for reserve design? What theoretical or empirical support is available for designing necessary and sufficient biological core areas, linkages, wildlife movement corridors, buffers, or other aspects of reserve design?

What objective methods are recommended for designing a necessary and sufficient reserve system to meet plan goals? Are explicit reserve selection algorithms (such as the SITES or PATCH programs) recommended, and are existing data sufficient for their application? How can scientifically justifiable goals be set for such methods in this plan area?

What physical or biological characteristics should be considered in defining reserve-design goals for the study area to ensure an adequately representative and robust reserve system (e.g., considering vegetation communities, species distributions, geological substrates, hydrological subdivisions, or climate regimes)? What ecosystem gradients are most important to consider (e.g., elevation, climate, disturbance regimes)?

Does existing information reveal specific geographic locations that are critical to reserve design within the study area or that contribute to biological conservation in adjoining areas (e.g., biodiversity "hotspots," habitat linkages, movement corridors, rare microhabitats, genetically unique population areas)?

What is the importance of "satellite" populations of bay checkerspot butterflies to population dynamics in the study area and how much emphasis should be placed on restoring suitable habitat in these satellite sites?

Will the conservation program of the Fisheries Aquatic Habitat Collaborative Effort (FAHCE) in the Guadalupe and Coyote watersheds conserve aquatic species in those watersheds to NCCP standards (i.e., will those actions contribute to species recovery)?

How is the Pajaro watershed different from the Coyote and Guadalupe watersheds in terms that matter for the covered species, and how should conservation actions in these watersheds differ or be similar to conserve the covered species?

What ecological processes are most critical to maintaining ecosystem and species viability, and how can these ecological processes be effectively accommodated in designing an ecosystem reserve for this region?

How can long-term processes or cycles (e.g., population dynamics, disturbance cycles, ecological migration) be effectively addressed? What effects might local or global climate changes have on this ecosystem and the target species, and how can these effects be effectively addressed?

Conservation Analyses

How should plan effects on target resources be assessed? What types of data can best be quantified (habitat acres, population sizes, species distributions, etc.) to analyze plan effects on target species and ecosystem processes? What other issues must be addressed to confidently assess plan effects on species or ecosystem viability (e.g., effects on symbionts, competitors, mutualists, predators, population genetics, etc.)?

How are current or future land uses likely to directly or indirectly affect biological resources on reserve areas? How should uncertainties about plan effects be addressed in the conservation analysis?

Management and Monitoring

What mitigation or management actions are necessary and sufficient to meet the plan's preliminary biological goals? How might adverse effects of plan implementation on target resources be minimized via the adaptive management program? What specific biological threats in the study area should be the targets of management? What specific management tools do you recommend to combat and minimize these threats to maintain and enhance populations of covered species?

What are the expected benefits of ecological restoration or habitat creation in the study area? To what degree can restoration mitigate take of habitats or species, or restore ecological functionality within reserve areas?

What specific management principles or hypotheses are most important to test via the adaptive management program? What specific aspects of the environment should be monitored (e.g., species distributions, population sizes or trends, community diversity, water quality or flow dynamics, disturbance factors, invasive species)? Can we define measurable thresholds or acceptable ranges for these monitoring metrics beyond which specific management or monitoring actions might be triggered in the adaptive management program?

What specific monitoring protocols are necessary and sufficient to detect changes in species populations or processes? Are there good indicator or umbrella species that can be monitored as proxies for other species or aspects of ecosystem health that are more difficult or costly to monitor (e.g., the use of aquatic insect diversity as an index of aquatic biological integrity)?

Appendix E
Detailed Information
Concerning Select Aquatic Resource Issues

Provided by Jerry Smith

Monterey Roach

California roach (*Lavinia symmetricus*) is a species of special concern in California because some subspecies, such as the Red Hills roach (*L. s*. ssp.) and Pit River roach (*L. s. mitrulus*), are scarce. However, the Monterey roach (*L. s. subditus*) is widespread and common within its native range (the San Lorenzo, Pajaro, and Salinas river watersheds). Within the Pajaro River watershed of Santa Clara County, the Monterey roach is present in Llagas Creek upstream of Chesbro Reservoir, in Uvas Creek up and downstream of Uvas Reservoir, North Fork Pacheco Creek upstream of Pacheco Reservoir, and probably in the South Fork of Pacheco Creek and Cedar Creek, tributaries to Pacheco Creek (Smith 2006). Roach are not present in the Pajaro River itself. In the Pajaro River watershed in San Benito County roach are common in Dos Picachos Creek, the San Benito River, and several San Benito tributaries, including Tres Pinos, Laguna, and Clear creeks (*Ibid*.). Monterey roach do not warrant inclusion in the Santa Clara County HCP as either a scarce or declining species, nor as an umbrella for other species or habitat conditions.

Monterey roach have been lost from some habitats in the Pajaro River system due to construction of reservoirs. Attenuated winter flows from the reservoirs have apparently allowed hitch (*L. exilicauda*), a native minnow of downstream habitats, to expand upstream into Pacheco, Uvas and Llagas creeks below the reservoirs. Abundant hitch can reduce the closely related roach by competition and hybridization (Smith 1982). Uvas Reservoir frequently spills large floods, so hitch abundance fluctuates from scarce to common in Uvas Creek, but they always are less abundant than roach. Roach are now absent from Llagas Creek and Pacheco Creek downstream of the reservoirs. The loss of roach in Llagas Creek occurred in 1977 when drought dried the streambed downstream of the reservoir and eliminated roach; although present upstream of the reservoir, roach have not been able to recolonize through the reservoir in the almost 30 years since the drought (Smith 1982 and 2006). Transplanting roach from above to below the reservoir would reestablish the species in lower Llagas Creek.

Stream and Fish Habitat Mapping

The stream habitats within the planning area have previously been classified/categorized and mapped using GIS into fish/habitat communities, based upon species composition and habitat conditions. The map, "Potential Fisheries in Selected Santa Clara County Streams," was developed to support the Santa Clara Valley Water District's[21] maintenance mitigation strategies. Dr. Jerry Smith updated the map in July 2006 to reflect barrier removal and/or sampling results that occurred in the intervening years since the original map was created. The GIS data and

[21] Joe Abel was the SCVWD contact.

map(s) breaks the stream habitats into seven categories, and although developed for other purposes, is appropriate for HCP evaluations since it emphasizes habitat conditions for, and distribution of, steelhead and Chinook salmon. The ten categories are cold trout, cold steelhead, warm potential trout/steelhead, warm native, mixed/salmon, mixed native/introduced, fish scarce, no fish value, no data/probably no value, no data and estuarine. These categories are described below.

Cold Trout. These are perennial habitats upstream of reservoirs where conditions are suitably cool enough to support resident rainbow trout (*Oncorhynchus mykiss*), often with California roach (*Lavinina symmetricus*), Sacramento sucker (*Catostomus occidentalis*) and riffle sculpin (*Cottus gulosus*) present. Prior to reservoir construction, most of these habitats supported steelhead and possibly some salmon (*O*. spp.). Much of the original steelhead habitat in the study area is presently above these reservoirs (Vasona, Guadalupe, Almaden, Anderson, Chesbro and Uvas reservoirs). Pacific lamprey (*Lampetra tridentata*) is another anadromous species of concern that is normally absent from this habitat upstream of the reservoirs. However, lampreys are able to ascend the spillway at Uvas Reservoir (Smith 1982) to utilize upper Uvas Creek.

Resident trout are also present above natural and smaller man-made barriers on Smith, Penitencia, Bodfish, Little Arthur, and Upper Penitencia creeks. (Note: Upper Penitencia Creek is the stream name and is not connected to Lower Penitencia Creek. Due to realignment, a similar situation now exists for Upper Silver Creek and Lower Silver Creek.)

Cold Steelhead. A small portion of this habitat is on undammed tributaries, such as Tar, Bodfish, Little Arthur creeks (tributaries to Uvas Creek), Cedar Creek (tributary to Pacheco Creek) and Arroyo Aguague (tributary to Upper Penitencia Creek). However, most of the remaining steelhead habitat in the study area is downstream of reservoirs on Los Gatos, Guadalupe, Alamitos, Arroyo Calero, Coyote, Upper Penitencia, Chesbro, Uvas, and Pacheco creeks. The SCVWD operates all of the reservoirs, except Cherry Flat on Upper Penitencia Creek (City of San Jose) and North Fork Pacheco (Pacheco Water District). Releases from all reservoirs are used for ground water percolation and/or to supply downstream diversions. The mapped stream segments in this category normally provide an appropriate mix of: a) *relatively* cool water (rarely above 22-24 degrees C); b) high stream flow to provide fast-water feeding habitat for steelhead; c) relatively clean, coarse substrate for insect production; and d) sufficient sun and water clarity to provide for algal growth (as a base of the food chain) and to allow steelhead to feed on drifting insects in fast water (Smith 1982 and 2006 and Smith and Li 1983). Much of the stream habitat in this category is warmer than typical trout or steelhead habitat, but the high summer stream flows allow steelhead to sufficiently feed on drifting insects to cope with the metabolic costs of the warmer water (Smith and Li 1983). In many cases feeding and growth are sufficient to produce smolt-sized steelhead in one summer, rather than the 2 summers usually required in typical, cool steelhead habitat (Smith and Li 1983, Smith 1982 and 2006). Steelhead in summer are found almost exclusively in fast-water habitat in riffles, runs, and heads of pools (Smith and Li 1983). A variety of native fish species are usually present in this habitat downstream of reservoirs (see warmwater fishes, below), including Pacific lamprey.

Warm Potential Trout/Steelhead. These habitats are usually further downstream of reservoirs than the cold steelhead reach and are often deficient in one or more of the 4 factors listed above. Higher water temperatures increase steelhead food demands, often sufficiently to starve the fish. Variable year-to-year stream flows, or reduced stream flows due to percolation, reduce the fast-water steelhead feeding habitat needed to meet the metabolic demands of high temperature.

Insect production is low due to poor substrate, turbidity, or low stream flow. Feeding is reduced by heavy shading or high turbidity. Management for increased stream flows or reduced water temperatures in this zone may make the habitat more regularly suitable for steelhead. Usually, warm-water native fish (see below) tend to dominate in this habitat type, with any juvenile steelhead scarce and/or strongly restricted to suitable fast-water feeding habitat.

Warm Native. Three warm-water native fish associations were originally found in the region (Smith 1982), but only 2 are still present. These habitats are dominated by native warm-water fishes, often including Sacramento sucker, hitch or roach, Sacramento pikeminnow (*Ptychocheilus grandis*), threespine stickleback (*Gasterosteus aculeatus*), and prickly sculpin (*Cottus asper*). Most of the mapped reaches contain at least 3-4 of the above species as the minnow-sucker association of Smith (1982). North Fork Pacheco Creek (above the reservoir) and Upper Silver Creek (tributary to Coyote Creek) contain roach associations, dominated by California roach, with relatively scarce stickleback (Upper Silver Creek) or Sacramento Sucker and prickly sculpin (North Fork Pacheco Creek). The third potential native warm-water fish community is the Sacramento perch (*Archoplites interruptus*) /Sacramento blackfish (*Orthodon microlepidotus*) community (Smith 1982). This low-gradient stream association is absent from the study area, and from the rest of California, because of the scarcity of Sacramento perch and the dominance of even high quality downstream habitats by introduced fishes, including sunfishes (*Lepomis* spp.) and common carp (*Cyprinus carpio*).

Foothill yellow-legged frogs (*Rana boylei*) and California red-legged frogs (*R. draytonii*) can occur in relatively undisturbed reaches of the warm native, cold steelhead and cold trout zones.

Mixed/Salmon. Chinook salmon (*O. tshawytscha*) presently spawn in Coyote Creek, the Guadalupe River, and its tributaries. Some of the reaches they use are mapped as "cold steelhead" or "warm potential trout/steelhead," indicating the higher quality year-round habitat that steelhead are potentially able to use for rearing. However, since Chinook spawn in early winter and juveniles migrate to the ocean in their first spring, Chinook are able to use habitats that turn very warm or have low water quality in summer. Most of these habitats also have a fish community composed of a mixture of native species (Sacramento sucker and hitch) and introduced species (carp and red shiner (*Cyprinella lutrensis*)).

Mixed Native/Introduced. These warm-water habitats contain a mixture of native and introduced species. This includes lower portions of Coyote and Llagas creeks and Guadalupe River, and the Pajaro River and most pond and reservoir habitats. Native tule perch (*Hysterocarpus traski*) have apparently been reintroduced to Coyote Creek via the pipeline from San Luis Reservoir; they are present in the onchannel Ogier Ponds.

Fish Scarce. These habitats are normally dry during summer and fall. However, they may serve as migration routes for steelhead and other fishes and/or as reproductive habitat for rapidly-developing amphibians such as tree frogs (*Hyla regilla*) or western toads (*Bufo boreas*).

No Fish Value. These habitats rarely have water, except in winter, and do not provide significant habitat for fish.

No Data. Fish species present are unknown, but may have fisheries values.

No Data / Probably No Value. Fish species present are unknown, but because of location or habitat conditions the reach is unlikely to have habitat value for fish. Note: most of the no data or no data / probably no value stream reaches are seasonal streams, extreme headwaters, or highly modified urban channels. Gathering data on most of them is not necessary to HCP planning.

Estuarine. Lowermost reaches of streams where conditions are saline and tidal (such as on Guadalupe Slough, lower Guadalupe River and Lower Coyote Creek). Normally outside of HCP study area.

Table E-1. Fish and amphibian species in relation to fish/habitat communities within freshwater portions of Santa Clara County streams. X indicates habitats commonly or reliably occupied; (x) indicates habitats occupied intermittently or at low densities.

Fish/Habitat Community							
Species	**Cold Trout**	**Cold Steelhead**	**Warm potential Trout/ Steelhead**	**Warm Native**	**Mixed Salmon**	**Mixed Native & Introduced**	**Fish Scarce**
Resident trout	X						
Steelhead		X	(x)				X (migration)
Salmon		(x)	(x)		X		(x) (migration)
Riffle sculpin	X	X					
Sucker	(x)	X	X	X	X	X	
Lamprey	(x)	X	X	(x)	X	(x)	X (migration)
Roach	(x)	X	X	X	X		
Pikeminnow		(x)	X	X			
Prickly sculpin			X	X	X		
Hitch			(x)	X	X	X	
Blackfish						X	
Tule perch						(x)	
Nonnatives common					X	X	
Red-legged frog	X	X	(x)	(x)			
Yellow-legged frog	X	(x)		X			
Western Toad				X	(x)	(x)	(x)

Steelhead Enhancement Program Prioritization

This section provides additional detail regarding the recommendation to maintain existing populations of ESA-listed steelhead in all five major watersheds within the Planning area. To guide steelhead management, prepare a steelhead population enhancement program for four of the five watersheds that considers the following:

- First, the steelhead in Pacheco, Llagas and Uvas creeks in South County are in a separate distinct population segment (formerly a different evolutionarily significant unit (ESU)) from those in Coyote Creek and Guadalupe River. Therefore, substantial effort must be made to enhance populations in both groups.
- Second, redundancy of populations is desirable to protect against natural disasters (i.e. fires) or made-made disasters (i.e., toxic spills). Therefore, at least two watersheds should receive substantial effort at habitat enhancement in both the north and south parts of the county.
- Third, watersheds with the highest steelhead potential, with the widest array of natural habitats, most diverse native fish communities, and fewest nonnative fish populations should probably receive the most effort to maintain and enhance populations of steelhead and other native fish species.

a) In South County, Uvas Creek has by far the most potential steelhead habitat and easiest migration conditions. Uvas also has the most complete complement of native fish species (Table E-2), although it lacks Sacramento blackfish, which are associated with low gradient (flood-proof) habitats. Of all five watersheds, the runoff in Uvas Creek watershed also has the least attenuation of winter flows by reservoir storage (average runoff from above the reservoir is about three times the storage). In addition, two significant tributaries enter Uvas Creek downstream of Uvas Reservoir. Uvas Creek has few nonnative fish, due to the relatively natural flow regime. High winter stream flows and lack of slack-water habitat appear to limit nonnative fish species abundance (Smith 1982).

1. Llagas Creek has the least steelhead potential of the three south watersheds, due to the difficulty of spring downstream migrations. However, reservoir/percolation operations in the Uvas and Llagas watersheds are linked by a pipeline that can take Uvas Creek watershed water (where runoff is greater) to the Llagas Creek watershed (where percolation potential is greater). From a steelhead standpoint, conflicts in water operations in the two watersheds should be resolved in favor of keeping as much water in Uvas Creek as possible.
2. Pacheco Creek has substantial potential for improving conditions for steelhead if operations of the Pacheco Reservoir are altered. However, the Pacheco Creek Water District is not participating in this HCP process.

b) In North County, the two major watersheds appear to have similar potential. Coyote Creek has a slightly more complete complement of native fish species. However, Coyote Creek has the most attenuated winter flows, because of the very large storage capacity of Anderson Reservoir. Additionally, due to the presence of the Ogier and Metcalf on-channel ponds, Coyote Creek has more nonnative fish, even in areas located upstream of urban San Jose. Presently, the Guadalupe River watershed probably has a similar amount of steelhead habitat in Los Gatos, Guadalupe, Alamitos and Arroyo Calero creeks as the Coyote Creek watershed does in Upper Penitencia Creek and the reach of Coyote Creek between Anderson Dam and Ogier Ponds. However, removal of the on-channel Ogier Ponds would substantially increase the potential steelhead habitat on Coyote Creek.

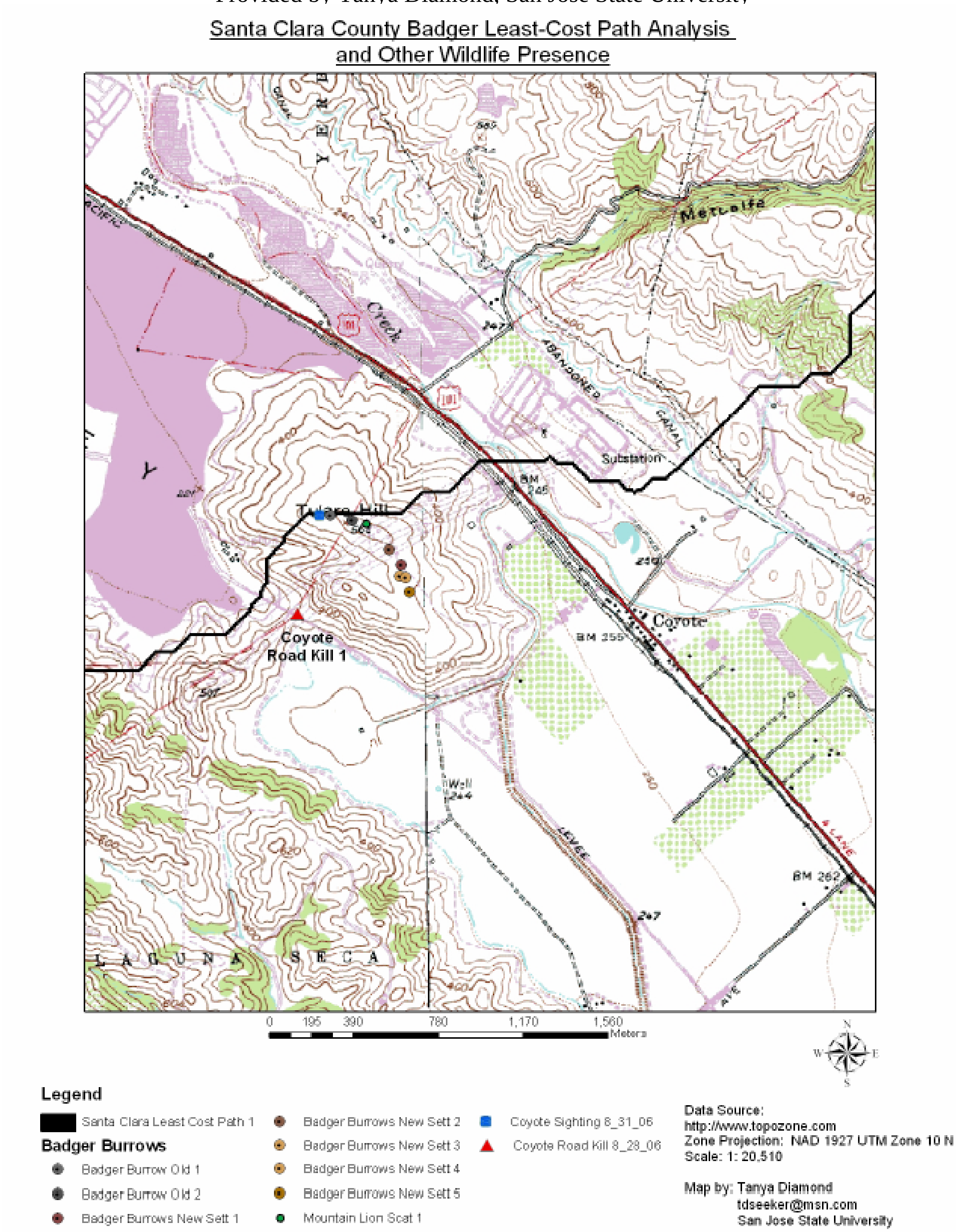
Table E-2. Native freshwater fish species present downstream of the reservoirs in the watersheds of Santa Clara County. X indicates habitats commonly or reliably occupied; (x) indicates habitats occupied intermittently or at low densities.

Native Species	**Uvas**	**Llagas**	**Pacheco**	**Coyote**	**Guadalupe**
Steelhead	X	(x)	X	X	X
Chinook Salmon				(x)	X
Riffle Sculpin	X				X
Sac. Sucker	X	X	X	X	X
Ca Roach	X			X	X
Pac. Lamprey	X	(x)		(x)	(x)
Sacramento Pike Minnow	X	X	(x)	(x)	
Stickleback	X	X	X	X	X
Hitch	X	X	X	X	X
Prickly Sculpin	X	(x)	X	X	X
Sac. Blackfish		X		(x)	
Tule Perch				X	(x)

Appendix F

Badger and Other Carnivore Observations in Vicinity of Tulare Hill

Provided by Tanya Diamond, San Jose State University



Appendix G
Additional Ecological Information on 15 Rare Plants

Note: Data provided by Santa Clara County CNPS

Plant Species	Flowering	Germination	Fruiting	Seed Dispersal
Balsamorhiza macrolepis ssp. *macrolepis*		Oct-Jan	Apr-Jul	May-Nov
Ceanothus ferrisae		Oct-Feb.	Feb-Jun.	May-Nov.
Campanula exigua		Sep-Oct	Jun-Aug	Jun-Nov
Cirsium fontinale var. campylon		Oct-Apr	Mar-Nov	Mar-Nov
Collinsia multicolor		Oct-Mar	Apr-Jun	May-Aug
Dudleya setchellii		Oct-Dec	Jun-Aug;	mainly Jun-Aug, though plants are often found with seed throughout the year
Fritillaria liliacea		Oct-Dec;	Mar-May	Jun-Jul
Hoita strobilina	Jun-Sep, in some years May, Oct	Oct-Mar	Jul-Nov;	Jul-Jan
Lessingia micradenia var. glabrata		Dec-Apr;	Aug-Dec	Sep-Jan.
Malacotahmnus arcuatus	May-Jul, Aug-Sep some years;	germination is **fire-dependent,** occurs Aug-Dec	Jun-Oct	Jun-Nov.
Malacothamnus halli		germination is **fire-dependent**, occurs Aug-Dec	Jun-Oct	Jun-Nov
Monardella villosa ssp. *globosa*	May-Aug;	Oct-Mar;	Jun-Sep	Jun-Dec
Sanicula saxatilis		Sep-Dec;	May-Jun	May-Dec.
Streptanthus albidus ssp. *albidus*		Oct-Mar		Jun-Dec
Streptanthus albidus ssp. *peramoenus*		Oct-Mar;	May-Jul;	May-Dec.

Appendix H
Characterization of Bay Checkerspot Butterfly Habitat

Provided by Raymond R. White

One can define Bay Checkerspot Butterfly habitat needs in terms of the density of *Plantago*, *Orthocarpus* (*Castilleja*) presence, herbage height, open spaces, nectar, gopher mounds, elevation, slope exposure and so on, but the empirical data of larval occurrence collected over the past 15+ years by Dr. Stuart B. Weiss covers most of Coyote Ridge (~140 sample points recently, Weiss 2003). These data should be used to determine whether any of the serpentine grassland of Coyote Ridge can reasonably be omitted from a preserve for the butterfly. Since the sample points are all classified as to slope quality, these data also identify where fine scale topographic diversity occurs.

A principle, with respect to a primary serpentine inhabitant for the Bay Checkerspot Butterfly, is that small scale topographic diversity of habitat bearing *Plantago erecta* Morris (dwarf or California plantain) is required. Dr. Stuart B. Weiss (1996, 2003) has monitored butterfly populations on five categories of slope/exposures over the past 15+ years. These are very cool, cool, moderate, warm, & very warm. Butterfly numbers are least variable on cool slopes, but population numbers build up dramatically on moderate, warm, and some very warm slopes during the best years. This build-up in numbers is very local, adjacent to cool and very cool slopes and buffers butterfly numbers during the less favorable years (Rich & Weiss 1991). Warm slopes immediately adjacent to moderate and cool slopes can provide early oviposition to those other slopes even in years when survival on the warm slopes is not possible. Butterflies can move among slopes and even larvae can move tens of meters (Weiss *et al*. 1987). The small scale of these movements makes it important to preserve areas that possess the greatest topographic diversity of serpentine supporting *Plantago* within the smallest area possible. A warm slope separated from cool slopes by hundreds of meters will rarely be occupied. A warm slope abutting a cool slope is highly valuable.

Removal of small numbers of butterflies or larvae from large populations for research or for re-introductions to unoccupied potential habitat can be allowed so long as two conditions are met. Samples must not exceed 0.6% of the estimated local population and the earliest cohort must not be removed. It is important to leave the earliest cohort of each life stage undisturbed since this is most likely to succeed in contributing to the next generation. Removal of butterflies and larvae for research from the Jasper Ridge populations averaged 6% (0-27%) per generation and seem not to have increased the risk of extinction significantly (0 to 15%) (Harrison *et al.* 1991), so the proportion recommended above is one-tenth (0.6% *cf*. 6%) of the value seen there.