APPENDIX G

Preserve Management and Monitoring Details

APPENDIX G1

Vernal Pool Monitoring Protocols

APPENDIX G1
Vernal Pool Monitoring Protocols

G1.1 Vernal Pool Monitoring

Long-term monitoring within the South Sacramento Habitat Conservation Program (SSHCP) plan area will provide valuable information on the success of vernal pool conservation. Regional plan area-wide monitoring (monitoring at a landscape scale) is critical for management, including management effectiveness monitoring to evaluate the response of the ecosystem to different management actions. It is critical for understanding (a) status and trends (b) impacts of any management actions and (c) to determine when there is a need for adaptive management. While all management actions should be monitored to some extent, adaptive management is generally the process of experimentally testing the effectiveness and/or feasibility of different management alternatives where the outcome of the management is uncertain (e.g., Williams et al. 2012).

The appropriate sampling design, including survey methods designed to collect large-scale data, is important in designing meaningful monitoring programs. Monitoring and management programs must be approached with attention to:

- appropriateness of selected response variables (e.g., reduction of thatch, water quality, etc.)
- temporal/spatial scales of measurement (i.e., over what time period and where),
- frequency/timing of measurements (e.g., how often and relation to conditions such as rainfall),
- precision and accuracy of measurements,
- ability to detect a change if it happens, and
- fiscal responsibility.

Regional or plan area-wide monitoring must be designed to obtain a statistically rigorous sample that, over time, will result in the ability to monitor the status of the vernal pool in the SSHCP plan area and determine whether the habitat is being adequately conserved by the plan.

G1.1.1 Vernal Pool Habitat Monitoring Goals

VP Monitoring Goal 1: Develop and implement a standardized formal monitoring program that collects data in sufficient detail to evaluate the health of vernal pools.

VP Monitoring Goal 2: Use results of standardized formal monitoring programs to develop adaptive management protocols, identify triggers for adaptive management, and develop pilot studies to fill data gaps and address uncertainties related to adaptive management.

G1.1.1.1 Vernal Pool Plan Area Wide Habitat Conservation

Vernal pools occur in throughout the SSHCP Plan Area. Conservation of the habitat within the Urban Development Area (UDA) is important because it is believed that the highest concentrations of a number of vernal pool species, including vernal pool tadpole shrimp (*Lepidurus packardi*), Sacramento Orcutt grass (*Orcuttia viscida*), and slender Orcutt grass (*O. tenuis*), are located in vernal pools inside the UDA. Conservation of vernal pools outside the UDA is also important because it is the intent of the SSHCP to preserve a wide range of vernal pools over a geographically diverse area. Further, some vernal pool species are either only known from areas outside the UDA, such as California tiger salamander (*Ambystoma californiense*) or most documented occurrences for some species are outside the UDA, including pincushion navarretia (*Navarretia myersii* ssp. *myersii*), vernal pool fairy shrimp (*Branchinecta lynchi*), Ricksecker's water scavenger beetle (*Hydrochara rickseckeri*), and western spadefoot (*Spea hammondii*).

Conservation goals and objectives are found in the conservation strategy for the vernal pools (Chapter 7, Table 7-2). The monitoring protocol intends to monitor the overall Plan's success and whether and how the Plan meets its conservation goals and objectives. The broad SSHCP conservation goal and objectives for vernal pools that will be achieved by the Plan are listed in Table G1-1.

Table G1-1
Vernal Wetlands Biological Goals and Objectives

Overall Biological Goal	Vernal Pool Biological Objectives
Goal 3. Ensure the persistence of each covered species within the Plan Area by preserving, restoring, and creating SSHCP terrestrial and aquatic landcovers throughout the Plan Area to provide suitable breeding, feeding, and/or sheltering habitat for each species minimize habitat fragmentation, and provide habitat connectivity that allows individuals to move and disperse throughout the preserve system.	**Objective VGVP1.** Preserve a minimum of x acres of valley grassland – vernal pool landcover with a minimum of x acres of vernal pools. Up to x acres of vernal pools will be preserved if all estimated impacts occur. The Implementing Entity will prioritize preservation of valley grassland – vernal pool land cover based on the preserve assembly criteria.
	Objective VGVP2. Preserve and maintain enough of the watershed of preserved vernal pools, to maintain the vernal pools' existing hydrological regime and biological functions. This would include a minimum 50-foot setback and a 50-foot buffer at the outer perimeter of each vernal pool preserve within the UDA.
	Objective VP1. Preserve a minimum of x acres of vernal pools within or adjacent to (within one mile of) the Mather Core Area and/or the Cosumnes Rancho Seco Core Area. Up to x acres of vernal pools will be preserved if all estimated impacts occur. Mitigation for vernal pools impacted within a vernal pool Core Recovery Area will occur within or adjacent to a vernal pool core recover area (adjacent is defined as up to one mile from the recovery core area). The Implementing Entity will assure that at least x-acres of vernal pools are preserved within the Mather Core Area, and at least x-acres of vernal pool are preserved within the Cosumnes/Rancho Seco Core Recovery Area.
	Objective VP2. Restore or create a minimum of x acres of vernal pools within or adjacent to (within one mile of) the Mather Core Area and/or the Cosumnes Rancho Seco Core Area. Up to x acres of vernal pools will be restored and/or created if all estimated impacts occur. At least 50 acres will be restored or created within or adjacent to the Mather Core Area.

G1.1.2 Monitoring Questions

Success in meeting the overall conservation goal and objectives listed in Table G1-1 will be determined through monitoring and addressing the following primary questions related to the SSHCP operating conservation strategy for vernal pools:

- What is the historical and current distribution of vernal pools within the SSHCP planning area?
- How many acres of vernal pools (natural and restored and/or created) are preserved, and what is their distribution in the SSHCP Preserve System?
- How stable is vernal pool habitat in the SSHCP Preserve System?
- To what extent do anthropogenic activities threaten vernal pools, and specifically what type of SSHCP covered activities pose the greatest threat?
- To what extent do SSHCP covered activities-related development and altered hydrology in the vernal pool watershed affect the long-term viability of vernal pools in the SSHCP Preserve System?
- Are and what invasive species are impacting vernal pools in the SSHCP Preserve System?
- How successful are vernal pool mitigation sites (natural vs. restored and/or created pools) in the SSHCP Preserve System?
- How is climate change affecting vernal pool ecology in the SSHCP Preserve System?

In addition, the following secondary adaptive management and mitigation questions will also be answered:

- What are the best sites for restoring and/or creating vernal pools in the SSHCP Preserve System?
- What vernal pool restoration and/or creation methods are most successful in re-establishing vernal pools in the SSHCP Preserve System?
- What vernal pool management techniques are most successful in maintaining sustainable vernal pools in the SSHCP Preserve System?

G1.1.3 Monitoring Design

G1.1.3.1 Baseline Survey

There is already considerable baseline information for vernal pools in the SSHCP planning area, including within existing (e.g., South Mather) and planned preservation areas (e.g., Sacramento County Department of Economic Development 2013; Appendices B-1 and B-2 of the Aquatic Resources Plan (ARP)). As news lands are considered for acquisition for the SSHCP Preserve System, they will be surveyed for vernal pool resources which will be mapped to establish to add to the existing baseline dataset. Sites considered for acquisition will be evaluated using several criteria:

- Potential to support vernal pool covered species;
- Supports high density vernal pool complexes;
- Contains large or deep vernal pools;
- Adjacent to currently preserved lands; and
- Located on parcels 20 acres or greater in size and/or occur in larger, open space areas.

While many of the vernal pools in the SSHCP plan area have already been identified (e.g., Sacramento County Department of Economic Development 2013; Appendices B-1 and B-2 of the ARP), it is likely that some have been missed, that new pools have been created, and that some s have been lost since the last vernal pool mapping effort. New initial comprehensive baseline surveys on candidate preserve sites should, to the extent feasible, include mapping of all vernal pools on site (using GPS/GIS technologies) during the wet season when pools are inundated. The surveys should assess habitat quality for both the vernal pool basin and the surrounding watershed.

Site Selection

Long-term monitoring of vernal pools will be conducted in the Preserve System with a sample size of vernal pools large enough to detect trends in important response variables that reflect vernal pool ecological functions (e.g., hydroperiod, occupation by covered species, etc.). Sample sites (or macro-plots) will be selected using stratified random sampling or pseudo-random sampling to ensure a representative set of sample sites. Sampling factors may include geomorphology, soil types, topography, vegetation communities, and proximity to development edges. Sample size will be increased as preserves are added to the system.

The appropriate sample size for each preserve site will be determined as part of the individual management plan for each preserve. The minimum sample size should be based on factors such as the size of the preserve, the number of vernal pool features, the heterogeneity of the preserve (e.g., different soil types or topographic features of the site), and adjacent land uses, and must take into account periodic sampling variability related to annual weather patterns such as drought and El Nino events.

Within each macro-plot, 3 or 4 vernal pools will be selected for long term-monitoring, as described in Section 1.4.

Monitoring Schedule

Monitoring visits should be scheduled consistently to collect compatible and comparable data over time. However, generally it is desirable to collect substantial baseline data in the first few years of a monitoring program to establish the variability of a system. Because vernal pool ecology is strongly tied to annual precipitation, monitoring should attempt to establish baseline conditions through at least one wet-dry cycle. Initially for the first six to eight years, monitoring plots should be visited annually during the wet season to collect baseline data for annual variability. Thereafter monitoring frequency likely could be reduced, such as not more than every three years on average, but with the objective of sampling at least once during different precipitation conditions (i.e., dry, average, and wet) over an eight to ten year period.

The monitoring schedule should also reflect the response variable being monitored and measured. For example, general vegetation conditions in the vernal pool watershed may have relatively low variability and only change significantly over longer time scales, allowing for less frequent monitoring. However, if a site is vulnerable to invasion by fast-colonizing invasive species, more frequent monitoring may be needed.

Monitoring for hydrology will be conducted at least once during three periods within the same monitoring cycle. A monitoring cycle is defined as the wet season from October 16 to April 14 in a given year. The first survey should occur once following inundation (see discussion in Section 1.4). The second survey should occur mid-season once the first floating hydrophytes appear. The third survey should occur during the dry-down phase.

It is likely that new monitoring methods will be developed over time (e.g., automated monitoring for some response variables) and that data compiled and analyzed as part of the SSHCP will bring a better understanding of the effectiveness of current monitoring protocols, including adequate frequency and timing of surveys for the different response variables. As such monitoring schedules will be evaluated at the discretion of the SSHCP Implementing Entity with input from the Technical Advisory Committee (TAC) and modifications will be made when deemed necessary.

Monitoring will only occur on sites that are either controlled by the SSHCP implementing entity, where the implementing entity has a formal agreement such as a conservation easement or on sites owned by parties that agree to work cooperatively with the SSHCP implementing entity.

G1.1.4 Vernal Pool Habitat Monitoring

Goals for the vernal pool monitoring program include:

- Identify vernal pool habitat variables that are correlated with cover species distribution and abundance in the SSHCP Preserve System;
- Identify management actions to maintain or improve vernal pool habitat quality, including upland habitat/watershed and vernal pool basins, in the Preserve System; and
- Identify trends and circumstances in the Preserve System that require adaptive management responses.

Most habitat monitoring should occur concurrently with the wet season invertebrate sampling events. Sites should be surveyed after the first substantial storm event (rainfall greater than 0.15 inch) during the rainy season (October 16 - April 14) to determine whether and when pools have been inundated. According to U.S. Fish and Wildlife Service protocol, a pool is considered to be inundated when it holds greater than 3 cm (1.2 inches) of standing water 24 hours after a rain event. This initial assessment can occur at a representative reference set of vernal pools distributed throughout the Preserve System. After inundation status has been determined, selected pools within each macro-plot should be sampled at least three times during the wet season per monitoring cycle; the first sampling should be conducted approximately one month after inundation; the second sampling should be conducted when the first floating hydrophytes appear; and the third sampling should be conducted during the early stages of drying (but before the pool is completely dry).

Data to be collected in the permanent monitoring plots include:

- Pool location and surface area: the perimeter of each pool should be mapped using GPS technology with reasonable accuracy (e.g., currently 6” to 1’ with standard GPS units).[1]
- Water level: measure the deepest part of the pool using a depth staff permanently installed and secured in the deepest part of the pool.
- Water temperature
- Water quality/chemistry (e.g., alkalinity, conductivity, dissolved ammonium, turbidity, salinity, total dissolved solids, algal blooms): collect water samples using acid washed plastic bottles. Measure samples using a water quality meter and/or sent to a laboratory for analysis.
- Level of habitat disturbance: qualitatively note habitat disturbances including grazing, mowing, OHV activity, impediments, fragmentation, trash/debris etc.

[1] Professional land surveyors could map vernal pools with even greater precision, but 6” to 1’ in considered accurate enough for the vernal pool monitoring program.

- Plant species composition: qualitatively determine plant species composition (wetland and surrounding upland) at each monitoring pool, including dominant, sensitive, indicator and non-native species. Vernal pool tadpole shrimp, for example, are commonly found with plant species that require similar inundation periods (Mediterranean barley, toad rush, false dandelion, and Italian rye grass, coyote thistle, downingia, goldfields, spikerush, wooly-marbles, hair Grass, and aquatic buttercup). Several plant species have incompatible inundation cycles and thus may indicate a lower probability of tadpole shrimp occurrences (e.g., cattails, willow, cottonwood, duckweed, nut grass, Baltic rush, and bullrush).
- Qualitative habitat quality: establish at least two permanent vantage points per pool and take photographs from vantage points during each sampling event.

Because "plot fatigue" can occur when multiple visits are made to the same plot within the same survey season and year after year, surveys should include measure to reduce chronic disturbance. For example, during wet season surveys, disturbance during seining can be avoided by placing rocks to step on in the vernal pool basin.

To prevent cross-sample contamination, samples will be returned to the same pool from which they were retrieved. Also, because vernal pool biota are microscopic and highly vagile, they can inadvertently stick to objects and can easily be transported across vernal pool complexes. Therefore, extra care will be taken to avoid cross-contamination between pools, specifically if multiple pools from multiple complexes are surveyed by the same survey personnel. All equipment will be thoroughly cleaned before visiting a new vernal pool complex. Field vehicles will be restricted to paved roads.

Collection of individuals for purposes of laboratory identification and/or museum vouchers will be discouraged. Monitoring and sampling will be conducted by experienced personnel in possession of a valid U.S. Fish and Wildlife Service 10(a) take/handling permit.

G1.1.5 Vernal Pool Species Monitoring

G1.1.5.1 Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp Monitoring Goals

Vernal pool monitoring include three goals for vernal pool tadpole shrimp (VPTS) and vernal pool fairy shrimp (VPFS):

VPTS & VPFS Monitoring Goal 1: Develop and implement a standardized formal monitoring program that collects data in sufficient detail to evaluate species trends in presence and abundance within vernal pools currently known to be occupied by VPTS or VPFS.

VPTS & VPFS Monitoring Goal 2: Develop and implement a standardized formal monitoring program that collects data in sufficient detail to evaluate the expansion of VPTS or VPFS into vernal pools previously known not to be occupied by VPTS or VPFS, including both through natural dispersal and colonization and through artificial inoculation implemented as part of an adaptive management strategy.

VPTS & VPFS Monitoring Goal 3: Use results of standardized formal monitoring programs to develop adaptive management protocols, identify triggers for adaptive management, and develop pilot studies to fill data gaps and address management uncertainties before full-scale management is implemented (e.g., does the management work and does it have any unintended adverse consequences?).

G1.1.5.2 VPTS and VPFS Conservation Strategy Goals

Conservation (including management) of the shrimp species within the UDA is important because the UDA supports important vernal pool complexes that are thought to support the highest concentrations of VPTS The VPTS also has slightly different habitat requirements than some other vernal pool crustaceans, with a life cycle that depends on larger or deeper hydrological systems with longer lasting aquatic phases. Most of these pool types occur within the UDA. Most of the documented occurrences for VPFS, however, are outside the UDA, as is a substantial percentage of the VPTS occurrences (see Table 7-5 in Chapter 7 of the SSHCP).

The monitoring protocol for VPFS and VPTS will monitor the overall Plan's success and whether and how the Plan meets its conservation goals and objectives (see Table G1-1 and Table 7-2 in Chapter 7-2).

G1.1.5.3 VPTS and VPFS Monitoring Questions

Success of these conservation strategy for VPTS and VPFS will be determined through monitoring and addressing the following primary conservation and preservation questions:

- What is the historical and current distribution of VPTS and VPFS in the SSHCP Preserve System, and how many and what acreage of occupied pools (natural and restored and/or created) are preserved?
- How stable are the VPTS and VPFS populations over time in the SSHCP Preserve System.
- What habitat covariates are associated with long-term persistence of healthy VPTS and VPFS populations in the SSHCP Preserve System (e.g., vernal pool basin size, vernal pool complex size, upland habitats, hydroperiods, non-natives species, etc.)?

- To what extent do existing and anticipated environmental conditions (e.g., invasive plant and wildlife species, climate change) and covered activities threaten VPTS and VPFS in the Preserve System?
- To what extent do development covered activities and altered hydrology in the vernal pool watershed affect the long-term viability of the VPTS and VPFS populations in the Preserve System?
- How do suitable habitat conditions for VPTS and VPFS differ from those of other large branchiopods species or from one another?
- How successful are vernal pool mitigation sites (including existing natural pools and restored and/or created pools) in the Preserve System?

In addition, the following secondary adaptive management and mitigation questions will also be addressed:

- What are the best sites for re-establishing VPTS and VPFS in the Preserve System?
- What vernal pool restoration techniques are most successful in re-establishing VPTS and VPFS populations in the Preserve System?
- What vernal pool management techniques are most successful in maintaining sustainable VPTS and VPFS populations in the Preserve System?

G1.1.5.4 Baseline Surveys

A representative sample of vernal pools on SSHCP existing preserves will be surveyed for presence of VPTS and VPFS to establish a baseline dataset of the distribution of the two species in the existing preserves. Sample macro-plots will be selected using the stratified random or pseudo-random sampling methods described in Section 1.3.1 for vernal pools in general. These existing preserves baseline surveys for VPTS and VPFS will occur during the wet season when pools are inundated and the species are detectable. Specimens will be collected with dip nets and returned to the same pool immediately after identification.

For new preserve sites, surveys will be conducted for presence of VPTS and VPFS. Depending on the size of the site and variability of the site conditions, surveys may be conducted in a representative sample of vernal pools (e.g., on large sites with many pools) or all the pools (e.g., on small sites or sites with a small number of pools). For new preserve sites being considered for acquisition for the Preserve System, presence/absence surveys may also be conducted as needed in non-randomly selected pools if the randomized selection process appears to omit pools considered to be highly suitable for the species and their omission could result in a false negative finding for the preserve site. That is, a more subjective sampling method may be more appropriate for establishing presence/absence on a candidate preserve site, while random sampling methods are necessary for making probabilistic inferences from monitoring data to larger areas. The main caution is that species occupancy in vernal pools that are selected in a non-random way cannot be used to infer conditions in other vernal pools (e.g., proportion of pools occupied).

G1.1.5.5 Site Selection

Long-term monitoring of VPTS and VPFS will be conducted in the Preserve System with a sample size of vernal pools large enough to detect trends in populations, such as proportion of occupied pools, relative population abundance, etc., as described in Section 1.3.1. It is expected that pilot studies will be needed to establish adequate sample sizes with the statistical power to detect VPTS and VPFS population trends (e.g., what sample size is needed to detect a 25% occupancy/population increase or decrease with 80% power of detection?). Generally, the more variable the sample data are between surveys (which is a problem of detection error), the larger the number of sample sites needed. As the vernal pool monitoring program is fleshed out, reasonable change thresholds (that may trigger management) and the desired power of the statistical tests will need to be determined by the Implementing Entity in consultation with the TAC.

The necessary sample size for each preserve site will be determined as part of the individual management plan for each preserve, but will also need to be coordinated with the overall monitoring program for the Preserve System. For example, if a preserve site supports vernal pool conditions (e.g., hydrology, soils, topography) that are well represented in the Preserve System, relatively few sample sites on the particular site may be needed as part of the Preserve System-wide monitoring program. However, if the site supports a unique or poorly represented type of vernal pool in the Preserve System, more sample sites may be needed to ensure that adequate data for that vernal pool type is being collected. Whatever sampling scheme is implemented on an individual preserve, it will need to serve the dual purpose of (1) monitoring the status of VPTS and VPFS on the particular preserve site (e.g., in order to inform site-specific management), and (2) monitoring the status of the species in the overall Preserve System (e.g., in order to determine whether the operating conservation strategy is meeting the Plan goals and objectives).

G1.1.5.6 Monitoring Schedule

The monitoring protocol designed to address the above questions will include habitat and species-specific monitoring that accommodate the species' different life cycles. While occupancy monitoring ideally is conducted during the wet season, cyst bank status and density monitoring, should it become necessary, is best evaluated during the dry season; hence, monitoring could occur during the wet and dry seasons. However, because cyst bank status is a more intrusive and intensive monitoring method, it is anticipated to play a small role and/or would be used on limited basis to address specific questions (e.g., cyst survival during extended drought periods), as opposed to being implemented on a broad scale. The monitoring schedule should be re-evaluated and adjusted, if necessary, every three to five years to ensure that appropriate data are collected to measure the Plan's conservation goals. This review will be conducted by the Implementing Entity in consultation with the TAC.

Monitoring visits should be scheduled consistently to collect compatible and comparable data over time. Initially for the first six to eight years, monitoring plots should be visited annually during the wet season to collect a rigorous baseline dataset. Thereafter monitoring frequency likely could be reduced, such as not more than every three years on average, but with the objective of sampling at least once during different precipitation conditions (i.e., dry, average, and wet) over an eight to ten year period.

As described in Section 1.3.1, a monitoring cycle is defined as the wet season from October 16 to April 14 in a given year. Generally, three surveys per cycle are conducted at each sample vernal pool, with the first following inundation; the second survey at mid-season once the first floating hydrophytes appear; and the third during the dry-down phase. For VPTS and VPFS, presence/absence surveys will be conducted in the same pools within the macro-plots monitored for general habitat conditions (see Section 1.4). Sampling for VPTS and VPFS will be timed, to the extent feasible, with general surveys, but will also be timed to coincide with the period the species are most readily identifiable in the field (typically January to mid-February). Generally, up to two surveys will be conducted within a monitoring cycle at each sample vernal pool. If both species are detected during the first survey in pool, re-sampling of the same pool is not necessary. If surveys are negative after two sample events, the qualified biologist will have the discretion to conduct additional samples at pools where he/she believes one or both of the species may be present, and for some reason the first two samples were conducted under marginal conditions for detection.

Approximately every 10 years during highly suitable weather patterns (i.e., timing and amount of rainfall), recent aerial photographs or some other remote sensing data (e.g., satellite imagery) will be reviewed and reconnaissance-level surveys will be conducted to update the overall distribution and status of vernal pools in the Preserve System. The purpose of the Preserve System-wide review is to generate any new information about the entire vernal pool system, including those pools that are not included in the statistically-based sampling effort. Depending of the results of the reconnaissance-level surveys, some pools may be targeted for follow-up surveys to determine the status of VPTS and VPFS. For example, good management practices may result in occupancy with VPTS or VPFS where the species had not been found before. Alternatively, anthropogenic influences (e.g., along edges) may have eliminated VPTS or VPFS from previously occupied vernal pools or a vernal pool complex.

G1.1.5.7 VPTS and VPFS Monitoring Protocol

Goals:

- Determine presence/absence of VPTS and VPFS in the Preserve System vernal pools;
- Determine relative abundance (productivity) in vernal pools across the Preserve System;
- Determine species richness and diversity in the Preserve System vernal pools;
- Identify predatory species in the Preserve System vernal pools; and
- Identify factors that may degrade habitat quality of the Preserve System vernal pool.

Wet season sampling is important to understand the status of the species; species occupancy (presence/absence); abundance or productivity; and determine covariates (e.g., habitat conditions, predators). Monitoring will be scheduled as describe in Section 1.5.6. During each survey, representative portions of the pool bottom, edges, and vertical water column shall be adequately sampled using a dip net appropriate for the size of the pool. Net mesh size shall not be larger than (1/8) inch.

A standardized dip net pull will be used for each survey and is defined as extending the net and pulling it back using a sweeping motion intended to sample approximately 4 cubic feet of water.

Information for the following response variables will be collected:

- Species present or absent (in the case of VPTS and VPFS)
- Relative abundance of VPTS and VPFS: the number of individuals of both species captured during each dip net pull. Relative abundance will be assigned according to the following categories.
  - Low = average <1 individual per standardized dip-net pull
  - Medium = average 1-5 individuals per standardized dip-net pull
  - High = average 6-25 individuals per standardized dip-net pull
  - Very High = average >25 individuals per standardized dip-net pull
- Species richness and diversity: number of different taxa (by species, if possible), including the presence of all live stages (tadpole/metamorph/adult) of amphibians.
- Presence of predatory species, including, western spadefoot (also a covered species) and waterfowl and shorebirds.

- Opportunist (mosquito/chironomus) abundance: abundance of invertebrate families least sensitive to changes in water quality and habitat suitability. These may include mosquitoes and chironomid midges of the genus chironomus.
- Presence of trash, algal blooms, trampling, etc. that may degrade habitat quality.

G1.1.5.8 Management for VPTS and VPFS

Management for VPTS and VPFS will include routine preserve management and maintenance and adaptive management. Routine management will include actions expected to benefit VPTS and VPFS, including fencing, signage, patrols, trash removal, public education, and restrictions on public access, etc. Routine management also refers to biologically-based habitat management actions that are known or strongly expected to have a high degree of success. For example, control of certain highly invasive species in the watershed of vernal pools such as yellow starthistle (*Centaurea solstitialis*) that can develop dense stands in grasslands may affect watershed hydrology. While management of habitat factors such as invasives controls can be considered a routine management action, the actual conditions under which controls are implemented and the methods used may be less certain. Where there is uncertainty in the effectiveness or feasibility of a management action(s), or the potential for unintended biological effects (e.g., non-native species used for biocontrol), an adaptive management strategy may be needed.

The conditions under which adaptive management should be applied will need to be determined by the Implementing Entity in consultation with the TAC as the management plan is developed. Some examples of conditions under which adaptive management actions may be triggered as a result of monitoring include the following:

- If VPTS or VPFS occurrences in occupied monitoring pools have declined a certain percent relative to the baseline data and initial monitoring survey results over specified monitoring periods. Pilot studies are needed to determine what percent population changes over what period of time will be detectable with acceptable statistical power <u>and</u> that are biologically significant (i.e., just because a statistically significant change may be detected, it is not necessarily biologically significant).
- Certain preserves are not maintaining populations with routine management relative to adjacent preserves over a specified monitoring period (i.e., the cause of the decline is uncertain.
- Monitoring information indicates that adverse factors relative to VPTS or VPFS health or habitat degradation exist, including disease, predation, algae infestation, etc. than are not amendable to routine management and the most effective management action is uncertain.

- Known or new invasive species are invading and degrading vernal pool habitats despite routine management (e.g., new control methods may need to be tested).

Because adaptive management, by nature, is experimental, management measures will need to be evaluated through pilot studies that test their effectiveness and feasibility, as well identifying any unintended adverse effects, on small scale before they are applied on a large scale. The results of the pilot studies will be evaluated by the Implementing Entity in consultation with the TAC.

The following are examples of potential adaptive management measures:

- Habitat Management:
  - Invasives control: Identify alternative feasible invasive control methods, such as grazing, prescribed burns, herbicides, mechanical removal, biocontrols (e.g., fungi, bacteria, insects). Test selected alternative methods, including different applications of a particular control (e.g., grazing regime or type of grazer). Determine whether and what rate and methods of invasives controls are adequate or most effective for the target species (e.g., fall vs. spring prescribed burns).
  - Thatch management: develop a grazing management plan to control thatch buildup without adversely affecting the vernal pool ecosystem (e.g., Marty 2007). A grazing management plan should, for example, specify the types and stocking rates of livestock (Animal Month Unit, AMU), grazing schedule, and the optimal grazing results (e.g., through the measurements of Residual Dry Matter, RDM). Consider whether fire management may be an alternative effective large-scale method to control thatch without harming the vernal pool ecosystem and the VPTS or VPFS. Identify smaller-scale thatch control methods, such as mowing or weed whacking, where large-scale grazing and/or burns cannot feasibly be applied,
  - Hydrological function and land use: Based on monitoring of hydrological covariates (e.g., watershed condition, hydroperiod, water chemistry) implement measures designed to improve hydrological functions and their effect on VPTS and VPFS. Hydrological studies should be conducted as a pilot program on a subset of monitoring pools (including connected and fragmented pools) to study the effects of management of factors such as surface and subsurface hydrology and vernal pool fragmentation on vernal pool conditions on the status of the species. In addition, existing land use and management practices that may be adversely affecting vernal pool habitat functions (e.g., type and intensity of grazing, pesticide/herbicide/fertilizer use of surrounding land uses, land alterations, flood control, mining operations, contaminated run-off, etc.) should examined and potential management interventions identified and tested.

- Species Management:
  - Predator control: Introduction of the bullfrog (*Rana catesbeiana*) to areas inhabited by the VPTS or VPFS appears to increase predation threats to these species. Although bullfrogs do not establish permanent breeding populations in vernal pools, dispersing immature males may temporarily occupy ephemeral wetlands during the rainy season. Bullfrogs are also extremely difficult to eradicate, because they have no natural enemies and can travel long distances between aquatic habitats. In addition, waterfowl and shorebirds may prey on crustaceans in shallow and clear pools. While waterfowl and shorebird predation is a natural "baseline" condition, in combination with non-native predators such as bullfrogs, predation could severely reduce VPTS or VPFS populations that threaten survival and recovery of the species in the Plan Area. Predator control programs therefore may need to be implemented if monitoring indicates that predation is a substantial threat to VPTS or VPFS populations; e.g., bullfrogs are found in vernal pools. Targeted predator controls programs that do not involve introducing non-native species (e.g., predatory fish), use of toxicants, or draining vernal pools should tested. For example, removal methods such as trapping should be investigated, but such methods would need to avoid take of VPTS and VPFS. See, for example, Louette et al. (2013).
  - Disease control: shrimp species appear to be susceptible to bacterial infections and parasites. Flukes (Trematoda) of an undetermined species have parasitized VPFS at the Vina Plains in Tehama County (USFWS 2005). Microsporiodiosis also is known to affect some fairy shrimp species. The main cause of these diseases is believed to be contaminated water. Treatment of contaminated water sources, including groundwater, is the only known antidote to these types of infections and diseases.
- Information Comparison: compare information from othe vernal pool ecosystems/species and evaluate whether this information is applicable to management of VPTS or VPFS in the SSHCP Plan Area.
- Stewardship program:
  - Re-evaluate success of current land stewardship programs.
  - Re-evaluate access controls; establish new access controls, if necessary.
  - Monitor adjacent land uses and determine the potential effect of these land uses on the health of the vernal pool ecosystem, VPTS and VPFS.

G1.1.5.9 Future Studies/Data Gaps for VPTS and VPFS

As described in Section 1.5.7, dip-netting will be used to assess relative abundance of VPTS and VPFS during baseline studies. However, information about cyst bank densities, population sizes, and population viability would contribute to managing vernal pool ecosystems for these two species, especially with projected climate change that may stress vernal pools and their constituent species in the coming decades. An understanding of the relationship between cyst bank densities and population viability over time, for example, would be extremely helpful in assessing long-term population trends and identifying when management interventions are critically needed.

VPTS and VPFS produce cysts that may remain dormant in vernal pool sediment for many years, and only a fraction of the cysts may hatch even when physical conditions are optimal. It is possible, therefore, for presence/absence surveys to continue detecting fairy shrimps for a period of time even if the population is in decline and viable offspring are no longer produced in a given pool (U.S. Fish and Wildlife Service, Draft Fairy Shrimp Monitoring Plan, 2008).

For these reasons, future studies of VPTS and VPFS may include a study of cysts, as outlined below.

Goals:

- Determine cyst bank density;
- Determine population size; and
- Determine population viability.

Dry season sampling is not required at this time but could become an important tool to monitor the stability and density of the tadpole shrimp cyst bank. Aside from the dry season fairy shrimp sampling protocol presented below, there is no viable population density model/protocol available in California currently available. The dry season fairy shrimp sampling protocol probably is too invasive to be used repetitively at a large-scale during SSHCP monitoring, but potentially could be applied at small scale at targeted populations. Dr. Andrew Bohonak of San Diego State University is currently developing and refining a density-estimating protocol intended to collect data in a rigorous manner while minimizing impacts to vernal pool biota. Density estimation should not be conducted until this protocol has been accepted as appropriate.

If population density measurements should be necessary to evaluate the dynamics of a failing VPTS or VPFS population in an otherwise functioning ecosystem (see adaptive management above), and until Dr. Bohonak's protocol is available, the following dry season sampling protocol may be applicable. Soil sampling should be conducted every three sampling seasons to collect, culture, and analyze cysts. The dry season and wet season sampling cycle should be the same (each dry season sample should be collected in the same year as the wet season sample). Sampling should be conducted per U.S. Fish and Wildlife Service protocol (2001), as follows:

- Soil shall be collected when it is dry to avoid damaging or destroying cysts which are more fragile when wet. A hand trowel or similar instrument shall be used to collect approximately one liter volume sample per pool of the top 1-3 centimeters of pool sediment. Whenever possible, soil samples shall be collected in chunks. The trowel shall be used to pry up intact chunks of sediment, rather than loosening the soil by raking and shoveling which can damage cysts.
- To avoid significantly impacting the sample pools it is recommended that a total of 10 soil samples of approximately 50 ml each shall be taken from each pool (not the 100 ml samples recommended in the U.S. Fish And Wildlife Service protocol), for a total soil sample volume of approximately 500 ml per pool.
- Soil sampling locations should include: 1.) one soil sample taken from the edge of the pool, at least four soil samples shall be taken from equidistant points along the longest transect of the pool; 2.) one soil sample taken from the edge of the pool, at least four soil samples shall be taken from equidistant points along the widest transect of the pool; or 3.) if neither the longest or the widest transect encompasses the deepest part (or parts) of the pool, then at least two soil samples shall be taken from the deepest part (or parts) of the pool.
- Soil sieving should be conducted to extract cysts from soil samples. The soil samples shall not be ground, crushed, or otherwise manipulated in order to expedite the sieving process. A relatively short period of pre-soaking the soil sample may be helpful/necessary in order to facilitate the sieving process. Small aliquots (approximately 50 ml in volume) of soil shall be gently washed with water through a graded series of U.S. standard eight inch soil sieves ending in mesh sizes 300 micron (um), and 150 micron (um).
- Washed and sieved soil fractions from the 300 um and 150 um sieves shall be examined under a dissecting microscope for tadpole shrimp and fairy shrimp cysts. The process shall be repeated until all individual soil samples have been examined. All sieved material shall be processed and dried as quickly as possible, preferably within one hour from the initial wetting.
- Cysts should be removed from the soil, separated by cyst type into labeled vials, allowed to air-dry, and then stored dry.
- Cyst density information for each soil sample location shall be calculated by dividing the total number of cysts recovered by the total amount of soil from the individual aliquots from that soil sample location. Total cyst density information for each soil sample location shall be reported for each species in terms of: none; 1-25 cysts/100 ml soil; 26-

50 cysts/100 ml soil; 51-100 cysts/100 ml soil; 101-199 cysts/100 ml soil; or more than 200 cysts/100 ml soil.

Cysts should be cultured and hydrated and identified to the genus and species level, if possible, to determine the percentage of VPTS or VPFS cysts within the sample.

G1.2 Reference Cited

Louette, G., S. Devisscher, and T. Adriaens. 2013. "Control of Invasive American Bullfrog Lithobates catesbeianus in Small Shallow Water Bodies. European Journal of Wildlife Research 59:105–114.

U.S. Fish and Wildlife Service. USFWS). 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Region 1, U.S. Fish and Wildlife Service, Portland, Oregon.

APPENDIX G2

Functional Survey Groupings

APPENDIX G2
Functional Survey Groupings

Preserve Vernal Pool – Wet Season Surveys

Attribute/Species (Scientific Name)	Survey Type	Survey Window*
Inundation/ponding	Aerial photos/field verification	Winter/Spring
	Plants	
Ahart's dwarf rush (*Juncus leiospermus* var. *ahartii*)	Wet season	February 15 through April 30
Dwarf downingia (*Downingia pusilla*)	Wet season	March 1 through May 31
Legenere (*Legenere limosa*)	Wet season	April 1 through June 30
Pincushion navarretia (*Navarretia myersii* ssp. *myersii*)	Wet season	April 1 through May 31
Boggs Lake hedge-hyssop (*Gratiola heterosepala*)	Wet season	April 1 through July 31
	Wildlife	
Vernal pool tadpole shrimp	Wet season	Wet season – winter/spring
Vernal pool fairy shrimp (*Branchinecta lynchi*)	Wet season	Wet season – winter/spring
Mid-valley fairy shrimp (*Branchinecta mesovallensis*)	Wet season	Wet season – winter/spring
Ricksecker's water scavenger beetle (*Hydrochara rickseckeri*)	Wet season	Winter/spring
California tiger salamander (*Ambystoma californiense*)	Larval surveys – dip netting	March through May
	Adult surveys – drift fences, pitfall traps, night visual	October 15 through March 15
Western spadefoot (*Spea hammondii*)	Larval surveys	October through May

* Survey windows subject to revision.

Preserve Vernal Pool – Dry Season Surveys

Attribute/Species (Scientific Name)	Survey Type	Survey Window
Residual dry matter	Dry season	Fall
	Plants	
Sacramento Orcutt grass (*Orcuttia viscida*)	Dry season	May 1 through June 30
Slender Orcutt grass (*Orcuttia viscida*)	Dry season	May 1 through July 31
Sanford's arrowhead (*Sagittaria sanfordii*)	Dry season	May 1 through September 30

Preserve Riparian Surveys

Attribute/Species (Scientific Name)	Survey Type	Survey Window
CRAM	—	All year
Restoration monitoring	—	All year

Attribute/Species (Scientific Name)	Survey Type	Survey Window
Wildlife		
Cooper's hawk (*Accipiter cooperii*)	Foraging	All year
	Nesting	March 15 through August 15
White-tailed kite (*Elanus leucurus*)	Nesting	March 15 through August 15
Swainson's hawk (*Buteo swainsoni*)	Nesting	March 15 through August 15
Western pond turtle (*Actinemys marmorata*)	Aquatic/basking sites	June through September (sunny days to observe basking)
Giant gartersnake (*Thamnophis gigas*)	Aquatic/basking sites	May 1 through September 30
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	Exit hole surveys	All year

CRAM = California Rapid Assessment Method

Preserve Vernal-Pool Grassland and Valley Grassland Surveys

Attribute/Species (Scientific Name)	Survey Type	Survey Window
Residual dry matter	—	Fall
Wildlife		
Tricolored blackbird (*Agelaius tricolor*)	Foraging	All year
	Nesting	March 15 through June 15
Western burrowing owl (*Athene cunicularia*) (occupied nesting burrows)	Nesting/Wintering	All year
Ferruginous hawk (*Buteo regalis*)	Foraging	November 1 through February 28
Swainson's hawk (*Buteo swainsoni*)	Foraging	March 15 through August 15
Northern harrier (*Circus cyaneus*)	Foraging	All year
	Nesting	March 15 through August 15
White-tailed kite (*Elanus leucurus*)	Foraging	All year
Loggerhead shrike (*Lanius ludovicianus*)	Foraging	All year
	Nesting	February 1 through June 30
American badger (*Taxidea taxus*)	Grassland/savanna	All year
Pallid bat (*Antrozous pallidus*)	Foraging	April through November
Western red bat (*Lasiurus blossevillii*)	Foraging	April through November
Yuma myotis (*Myotis yumanensis*)	Foraging	April through November

Cropland and Irrigated Pasture Preserve Surveys

Attribute/Species (Scientific Name)	Survey Type	Survey Window
Crop type	Mapping/Field Inspection	During growing season
Wildlife		
Greater sandhill crane (*Grus canadensis*)	Foraging – cropland and irrigated pasture grassland	September 1 through February 15
Loggerhead shrike (*Lanius ludovicianus*)	Foraging – cropland and irrigated pasture grassland	All year

Attribute/Species (Scientific Name)	Survey Type	Survey Window
Swainson's hawk (*Buteo swainsoni*)	Foraging – cropland and irrigated pasture grassland	March 15 through August 15
Northern harrier (*Circus cyaneus*)	Foraging – cropland and irrigated pasture grassland	All year
	Nesting – cropland and irrigated pasture grassland	March 15 through August 15
Tricolored blackbird (*Agelaius tricolor*)	Foraging – cropland and irrigated pasture grassland	All year
	Nesting – cropland only	—
Western burrowing owl (*Athene cunicularia*)	Wintering – cropland and irrigated pasture grassland	July 16 through February 14 (non-breeding season)
	Nesting – cropland and irrigated pasture grassland	February 15 through July 15 (breeding season)
White-tailed kite (*Elanus leucurus*)	Foraging – cropland and irrigated pasture grassland	All year
Pallid bat (*Antrozous pallidus*)	Foraging – all agricultural land types, roosting – orchards only	April through November
Western red bat (*Lasiurus blossevillii*)	Foraging – all agricultural lands, roosting – orchards only	April through November

Bat Roost Surveys

Attribute/Species (Scientific Name)	Survey Type	Survey Window
Roost installation inspection	Field verification	Any time
Wildlife		
Pallid bat (*Antrozous pallidus*)	Roosts	April through November
Yuma myotis (*Myotis yumanensis*)	Roosts	April through November

INTENTIONALLY LEFT BLANK

APPENDIX G3

Preserve Management Toolbox

APPENDIX G3
Preserve Management Toolbox

G3.1 Introduction

This appendix presents a management "toolbox" that will be used in the development of individual Preserve Management Plans (PMPs). The Implementing Entity will consult this appendix during PMP preparation to identify those management activities that could apply to their parcels to achieve the measureable objectives and other commitments of the South Sacramento Habitat Conservation Plan (SSHCP) Conservation Strategy. The following describes the toolbox of potential land management methods, their potential applications, and potential limitations to provide information for how and why the methods will be applied. These descriptions do not include discussions of detailed management methods such as timing, frequency, or combining methods. Such details will be incorporated into individual PMPs depending on the selected methods. Following the description of land management methods, the methods are presented in a matrix (Table G3-1) that identifies how they might be used to address threats and stressors to SSHCP land cover types and Covered Species habitats.

G3.2 Routine Preserve Maintenance and Land Management

Routine management refers to a variety of Preserve management activities generally expected to benefit Covered Species and their habitats, including fencing, signage, public education, trash and refuse removal, general inspections, patrols, and enforcement. Most of the routine management activities are related to minimizing the effects of adjacent urban development and associated human activities on biological resources within Preserves.

Patrols also are expected to reduce intentional and accidental fire ignitions (e.g., from discarded cigarettes).

Fencing

Installation and regular inspection of fencing and gates, and immediate repair when necessary, is critical to exclude indirect effects such as trash dumping, off-road-vehicle activity, and trespassing on SSHCP Preserves. Fencing maintenance is also critical for control of livestock that will be used for vegetation management. Internal cross-fencing, if desired to more closely control grazing locations, must be carefully considered to ensure that water remains available for livestock and to avoid restrictions on wildlife travel corridors.

Maintain Agricultural Facilities and Structures

Facilities and structures that are necessary for pre-acquisition agricultural operations on a new SSHCP Preserve should be repaired and maintained, and those for which there is no current or anticipated need should be removed or re-used elsewhere within the SSHCP Preserve System.

Abandoned and derelict structures such as sheds and barns may be used by bats for day roosts, including at least two of the covered bat species (pallid bat (*Antrozous pallidus*) and Yuma myotis (*Myotis yumanensis*)). Therefore, these should only be removed or moved elsewhere if they are unoccupied by bats.

Debris and Trash Removal

All Preserves and Preserve parcels and adjoining areas should be regularly inspected for debris and trash accumulation, including that resulting from agricultural operations on Cropland and Irrigated Pasture Preserves. At a minimum, the Implementing Entity will conduct bi-annual cleanup days to remove trash from each SSHCP Preserve, and will coordinate with the county to have illegal dumping cleared from adjacent roadway shoulders.

If there are stockpiles of what must be retained on a Preserve site, they should be on graveled or bare dirt areas that have been pre-treated with herbicides to control weeds.

Methods for Preserve Fire Breaks

Fire breaks adjacent to public roads are required by Plan Area fire protection districts. Districts recommend fire breaks to be 16 feet in width and created using a disk line or scrape line in the spring or early summer after grass growth has slowed. Disked fire breaks are preferred as they will support plants the following year and scraped breaks do not. Internal fire breaks within Preserve units should be phased out. Fire breaks required for prescribed burns should consist of creating a black line around the prescribed burn area.

Methods to Limit Off-Road Travel

The Implementing Entity will limit off-road-vehicle use by Preserve staff on Preserves to during the wet season. When off-road-vehicle use is required for ranching operations, operators will not drive through vernal pools.

Method to Minimize Impacts from Existing Utility Corridors

Holders of utility easements that traverse Preserves will be escorted by Preserve Managers to ensure that their activities remain within the easements and that access routes are consistent with the PMP.

Install and Maintain Appropriate Signage

All SSHCP Preserve parcels will have signs posted along any fenceline and any gate that adjoins a public road or other public area (e.g., public parks). Sign content is at the discretion of the

Implementing Entity depending on the purpose of the sign (e.g., no trespassing, description of the Preserve), but must include a public information telephone number.

G3.3 Habitat Vegetation Management, Thatch Control, and Non-Native Plant Control

Grazing

Grazing management is expected to be a primary habitat management tool on SSHCP Preserves to control vegetation such as annual grass thatch and some invasive weeds. The primary grazers in the Plan Area will be cattle, but targeted grazing may be conducted using sheep and goats depending on the size of the Preserve and the objective of the grazing (e.g., a specific invasive species or an area not available for cattle grazing). Grazing can have beneficial and adverse effects on natural resources in the SSHCP Preserve System depending on factors such as stocking rates and timing of grazing activities, and grazing management will address both types of effects. Over-grazing and large congregations of grazers can have severe effects on vegetation communities, Covered Species habitat, soil conditions, stormwater runoff, and water quality, and a lack of grazing or under-grazing can result in buildup of thatch, which can reduce habitat quality for SSHCP Covered Species, including altering vernal pool hydrology, altering vegetation community composition, and increasing the risk of catastrophic wildfires. Generally, grazing objectives are expressed as the desired residual dry matter (RDM) left after grazing, but may also include objectives related to protecting certain resources (e.g., Riparian zones, Oak Woodland).

Controlled grazing can be a useful management tool for a variety of natural resources. For example, it can be used to control thatch buildup in the Vernal Pool Grassland, Grassland, and Woodland Savanna land covers. Reducing thatch can maintain vernal pool hydroperiods and allow vernal pool species to complete their aquatic life cycle phases. Reducing thatch also improves growth and recruitment of upland plant species such as annual wildflowers and oak trees (as long as trampling or browsing of seedlings and saplings is controlled); reduces the buildup of fuels that increases the chance of catastrophic wildfires; improves overland movement capabilities of species such as California tiger salamander (*Ambystoma californiense*) and western spadefoot (*Spea hammondii*); and encourages use by burrowing species such as California ground squirrel (*Otospermophilus beecheyi*), gopher, and other rodents whose burrows provide refuge or denning habitats for Covered Species such as tiger salamander, western spadefoot, giant gartersnake (*Thamnophis gigas*), and burrowing owl (*Athene cunicularia*), and provides prey for several of the bird Covered Species.

Managed grazing on SSHCP Preserves will be needed to address potential adverse effects of grazing, including impacts on wetland, riparian, and woodland vegetation (e.g., trampling and browsing); soil disturbances; invasive exotic species establishment; and water quality impacts where cattle and other grazers may congregate. These are indicated as "inappropriate grazing" effects in Table G3-1.

Managed grazing to avoid adverse effects includes appropriate stocking rates, seasonal timing of grazing activities, rotational grazing patterns, distributing resources such water and mineral and salt licks to disperse cattle and avoid congregation in sensitive areas (e.g., Wetland and Riparian habitats), and exclusion fences to protect sensitive areas.

Prescribed Burns

Prescribed burns (also called controlled burns) can be used as an alternative to grazing as a Grassland and Vernal Pool Grassland management tool. Prescribed burns may also be used to reduce thatch and reduce fuel loads in Shrub Land cover types. Prescribed burns may improve vegetation communities by reducing total cover (that shades out recruits), removing senescent individuals, controlling pests, and promoting nutrient cycling. It is expected that prescribed burns will primarily be used only in the larger SSHCP Preserves to control thatch, but may also be used as a targeted method to control certain invasive plant species such as medusahead (*Taeniatherum caput-medusae*) and goatgrass (*Aegilops cylindrica*) that are unpalatable to grazers.

Although prescribed burning may be used to control other invasive species, its effectiveness has not been well tested. Factors such as the optimum season(s) to burn and the frequency of burns in the Plan Area need to be investigated. It is unlikely that prescribed burns will be used on a large scale in SSHCP Preserves located in the Urban Development Area because of public safety and air quality concerns, but it may be useful on a smaller scale and/or in more remote areas of the SSHCP Preserve System.

Mowing

Similar to grazing and prescribed burns, mowing may be used to control thatch and invasive species. Mowing generally will be used in the larger-size SSHCP Preserves with Vernal Pool Grassland land cover, and probably will be used on smaller SSHCP Preserves than grazing management and prescribed burning management actions, and where these other land management methods cannot be feasibly used.

Similar to prescribed burning, the optimum seasons and frequency of mowing, and the appropriate mowing heights (e.g., to affect targeted species but avoid inadvertent impacts to species) are resource-specific and will need additional study to understand the most effective applications of mowing.

Manual Removal of Vegetation

Manual removal refers to the use of weed trimmers, raking, hand- or tool-pulling, chainsaws, digging, hand-cutting, and other methods. These typically are used at small scales to target certain vegetation issues. Manual removal may be desirable were large-scale methods could cause substantial damage to sensitive resources such as native riparian species. Raking can be used to reduce thatch in smaller areas where other methods cannot be used, and the other methods are often species-specific removal methods. For example, weed trimmers are effective in cutting back infestations of starthistle (*Centaurea solstitialis*).

Pesticides (Including Herbicides)

As discussed in Chapter 5, pesticide use on SSHCP Preserves is not a SSHCP Covered Activity. However, herbicides may be used for management in targeted situations where potential adverse effects on sensitive resources (e.g., unintended drift, runoff) will not occur and no take of Covered Species is possible. Most of the available herbicides are non-selective for specific types of plants (e.g., glyphosate and paraquat), so they will be limited to targeted situations. Herbicide use is also expensive and labor intensive. Herbicides may be effective when used in conjunction with other removal methods such a "cut-and-spray" of invasive plants. Herbicides will be well-tested at a small scale before applied at a larger scale.

Biological Controls

Biological controls generally refer to use of biological organisms (e.g., pathogens, insects) to control invasive plants and animals. Relatively little is known about effective biological controls for Plan Area management issues, but some research indicates the potential for biological controls for invasive plants such as starthistle, Italian thistle (*Carduus pycnocephalus*), and milk thistle (*Silybum marianum*).

G3.4 Wildlife Management on Preserves

Domestic Animal Control

With the exception of livestock—domestic animals used exclusively in agricultural operations—domestic animals will be prohibited within Preserves. Signs prohibiting the presence of domestic animals within Preserves will be clearly posted along any fenceline and any gate that adjoins a public road or other public area (e.g., public parks). Pet dogs along public roadways or trails crossing or adjacent to Preserves must remain on a leash at all times. The Implementing Entity will monitor for unattended domestic or feral animals that are observed within the Preserves, report the occurrences to the appropriate animal control agencies, and take other necessary steps to legally remove feral animals.

Guard Animals for Herds

Grazing herds (especially sheep, if used) might be protected from naturally occurring predators through use of guard dogs or donkeys. Lethal control of native predator species will not be used on SSHCP Preserves.

Trapping

Trapping refers to a broad set of management tools that may be used to remove invasive wildlife and urban-related predators. For example, brown-headed cowbird (*Molothrus ater*) trapping can be used to reduce nest parasitism; cowbirds are known to parasitize loggerhead shrike (*Lanius ludovicianus*) nests.

Trapping may be used to control bullfrogs (*Lithobates catesbeianus*) and crayfish in aquatic Covered Species breeding habitats.

Trapping may be used to remove certain urban-related non-native predators or non-native pests such as raccoons, opossums, and non-native rats and mice from sensitive areas where they are impacting a SSHCP Covered Species, under the direction or with permission from the California Department of Fish and Wildlife.

Rodent Burrow Management

Burrow management primarily refers to maintaining existing ground squirrel burrows and enhancing burrow availability for use by Covered Species such as California tiger salamander, western spadefoot, giant gartersnake, and burrowing owl. Maintaining and enhancing ground squirrel burrows will be related to other land management activities, such as thatch management. Burrowing mammals tend to be more prevalent where vegetative cover is lower.

Pesticides

The Implementing Entity will ensure that pesticide use will not result in any direct or indirect adverse effects on Covered Species by limiting use of pesticides and controlling application to only where needed. An example of a potential beneficial use of pesticides is Argentine ant control (*Linepithema humile*) (e.g., nest/mound treatments and broadcast application), but only where it can be shown to have no effects on native species, habitats, and other factors such as water quality.

Vector control in Sacramento County refers to mosquito and West Nile virus controls. West Nile virus is known to infect Cooper's hawk (*Accipiter cooperii*) and loggerhead shrike, and raptors such as white-tailed kite (*Elanus leucurus*) could be infected through ingestion of prey such as smaller birds and rodents or directly by bites. Similar to pesticide use on SSHCP Preserves, vector control has potential for both beneficial and detrimental indirect effects on wildlife, including Covered Species. Although controlling mosquitos to reduce the chance of West Nile virus infections will be beneficial to humans, spraying Preserve habitat with pesticides (e.g., Dibrom) can have harmful effects on water quality and potential direct and secondary toxic effects on wildlife. Releasing mosquitofish (*Gambusia affinis*) can also adversely affect Covered Species such as vernal pool invertebrates, California tiger salamander, and western spadefoot.

G3.5 Management of Aquatic Land Covers on Preserves

Sediment Removal

Sediment removal may be a useful management tool for maintaining aquatic land covers and some semi-aquatic Covered Species—such as California tiger salamander and western pond turtle (*Actinemys marmorata*)—that can benefit from deeper water within a ponded area. For example, deeper water may provide tiger salamanders protection from some predatory birds such as herons and urban-related predators such as raccoons. Sediment removal may be conducted in conjunction with draining Emergent Wetland land cover and open water, described below.

Wetland Draining

Draining primarily is a tool for managing bullfrogs, crayfish, and non-native predatory fish in California tiger salamander and western spadefoot breeding habitats. Perennial wetlands (e.g., stockponds) that are suitable for tiger salamander, western spadefoot, and western pond turtle may benefit from periodic draining in the summer/fall to eliminate non-native predators that require aquatic habitat. Also, wetland draining may control excessive emergent wetland vegetation that degrades aquatic habitat for tiger salamander.

INTENTIONALLY LEFT BLANK

Table G3-1
Threats, Stressors, and Potential Management Methods

Resource	Threats and Management Issues	Potential Management Methods																				
		Vegetation Management and Non-Native Plant Control						*Hydrology Management*		*Wildlife Management*						*Routine Maintenance*						
		Grazing	*Prescribed Burns*	*Mowing*	*Manual Removal*	*Herbicides*	*Biological Controls*	*Sediment Removal*	*Wetland Draining*	*Trapping*	*Pesticides*	*Domestic Animals*	*Vector Control*	*Burrows*	*Guard Animals*	*Fencing*	*Structures*	*Trash Removal*	*Fire Breaks*	*Off-Road Travel*	*Maintain Nature Trails*	*Signage*
Aquatic Habitats and Species																						
Vernal Pool and Vernal Pool Grassland Watersheds, Vernal Pool Species	Thatch	●	●	●	●	●																
	Invasive plants	●	●	●	●	●	●										●	●		●	●	
	Invasive wildlife						●		●	●	●	●				●		●				
	Hydrology	●	●	●	●	●														●		
	Nitrogen deposition		●																	●	●	
	Inappropriate grazing	●										●			●	●	●					
	Human activity											●				●	●	●		●	●	●
	Altered fire regime	●	●	●	●	●												●	●	●	●	●
Other Wetlands	Invasive plants	●			●	●	●										●	●		●	●	
	Invasive wildlife						●		●	●	●	●				●		●				
	Hydrology	●			●	●		●												●		
	Inappropriate grazing	●										●			●	●	●					
Riparian	Invasive plants	●			●	●	●										●	●		●	●	
	Invasive wildlife						●		●	●	●	●				●		●				
	Inappropriate grazing	●										●			●	●	●					
	Hydrology	●			●	●														●		
Valley Grassland	Thatch	●	●	●	●	●																
	Invasive plants	●	●	●	●	●	●											●		●	●	
	Inappropriate grazing	●										●			●	●	●					
	Altered fire regime	●	●	●	●	●												●	●	●	●	●
Amphibians	Thatch	●	●	●	●	●																
	Hydrology	●	●	●	●	●		●												●		
	Emergent vegetation				●				●													
	Invasive plants	●	●	●	●	●	●										●	●		●	●	
	Invasive wildlife						●		●	●	●	●				●		●				
	Inappropriate grazing	●										●			●	●	●					
	Upland refugia	●	●	●	●	●					●			●								
	Human activity											●				●	●	●		●	●	●
	Native predators							●														
	Urban-related predators							●		●		●				●						

Table G3-1
Threats, Stressors, and Potential Management Methods

Resource	Threats and Management Issues	Potential Management Methods																				
		Vegetation Management and Non-Native Plant Control						*Hydrology Management*		*Wildlife Management*						*Routine Maintenance*						
		Grazing	*Prescribed Burns*	*Mowing*	*Manual Removal*	*Herbicides*	*Biological Controls*	*Sediment Removal*	*Wetland Draining*	*Trapping*	*Pesticides*	*Domestic Animals*	*Vector Control*	*Burrows*	*Guard Animals*	*Fencing*	*Structures*	*Trash Removal*	*Fire Breaks*	*Off-Road Travel*	*Maintain Nature Trails*	*Signage*
	Pesticides										•											
	Disease											•										
	Altered fire regime	•	•	•	•													•	•	•	•	•
Semi-Aquatic Reptiles	Thatch	•	•																			
	Hydrology	•	•	•	•	•		•												•		
	Invasive plants	•	•	•	•	•	•										•	•		•	•	
	Invasive wildlife						•		•	•	•	•				•		•				
	Inappropriate grazing	•										•			•	•	•					
	Human activity											•				•	•	•		•	•	•
	Urban-related predators									•		•				•						
	Pesticides										•											
	Altered fire regime	•	•	•	•	•										•		•	•	•	•	•
Upland Habitats and Species																						
Woodland	Thatch	•	•	•	•	•																
	Invasive plants	•	•	•	•	•	•										•	•		•	•	
	Invasive wildlife						•		•	•	•	•				•		•				
	Inappropriate grazing	•										•			•	•	•					
	Hydrology	•	•	•	•	•														•		
Bird Covered Species	Hydrology	•	•	•	•	•														•		
	Invasive plants	•	•	•	•	•											•	•		•	•	
	Invasive wildlife						•			•	•	•				•		•				
	Inappropriate grazing	•										•			•	•	•					
	Dens (burrowing owl)	•	•	•	•	•					•			•							•	
	Human activity											•				•	•	•		•	•	•
	Urban-related predators									•		•				•						
	Pesticides										•											
	Altered fire regime	•	•	•	•	•												•	•	•	•	•
	Disease											•	•									
Mammals	Hydrology	•	•	•	•	•														•		
	Invasive plants	•	•	•	•	•											•	•		•	•	
	Inappropriate grazing	•										•			•	•	•					
	Human activity											•				•	•	•		•	•	•

Table G3-1
Threats, Stressors, and Potential Management Methods

Resource	Threats and Management Issues	Potential Management Methods																				
		Vegetation Management and Non-Native Plant Control						*Hydrology Management*		*Wildlife Management*						*Routine Maintenance*						
		Grazing	*Prescribed Burns*	*Mowing*	*Manual Removal*	*Herbicides*	*Biological Controls*	*Sediment Removal*	*Wetland Draining*	*Trapping*	*Pesticides*	*Domestic Animals*	*Vector Control*	*Burrows*	*Guard Animals*	*Fencing*	*Structures*	*Trash Removal*	*Fire Breaks*	*Off-Road Travel*	*Maintain Nature Trails*	*Signage*
	Urban-related predators									•		•				•						
	Pesticides										•											
	Altered fire regime	•	•	•	•	•												•	•	•	•	•
	Disease								•			•	•									

INTENTIONALLY LEFT BLANK

APPENDIX G4

Management Plan Template

APPENDIX G4
Management Plan Template

(Example- For Discussion Purposes Only)

G4.1 Introduction

G4.1.1 Name and Location of the Property

G4.1.2 General Goals for the Property

G4.1.3 Primary Considerations that Drive Development and Implementation of the Management Plan

G4.1.4 Expected Timeframe for the Management Plan's Implementation

G4.1.5 Parties to Be Involved in Plan Implementation May Be Identified

G4.2 Property Description

G4.2.1 Land Cover Types

G4.2.2 Delineated Jurisdiction Features

G4.2.3 Species Inventory

G4.2.4 Problem Conditions

G4.2.5 Threats to Desirable Attributes

G4.2.6 Potential Ecologic Restoration/Enhancement Opportunities

G4.2.7 Connections

G4.2.7.1 Boundary Descriptions

G4.2.7.2 Access Points

G4.2.7.3 Adjacent Landowners and Land Uses Pertinent to Understanding Management Problem

G4.2.7.4 Priorities to Be Addressed in the Plan

G4.2.7.5 Nearby Preserves Exist that Provide Points of Reference for Activities at the Subject Property

G4.3 Management History

G4.4 Public Use

G4.4.1 Permitted Uses

G4.4.2 Trail Types

G4.4.3 Signage

G4.5 Management Objectives

G4.6 Management Prescriptions

G4.6.1 Management Prescription 1

G4.6.1.1 Person Days Needed

G4.6.1.2 Timing of Activities

G4.6.1.3 Technical Resources

G4.6.1.4 Parties Who Will or Could Be Responsible for Accomplishing the Prescriptions or Parts of Prescriptions

G4.6.1.5 Monitoring and Adaptive Management Plan

G4.6.2 Management Prescription 2

G4.7 Species Monitoring Pan

G4.7.1 Monitoring Schedule

G4.8 Annual Work Plan

G4.9 Management Tools

G4.9.1 Preserve Monitoring Schedule

G4.9.2 Photo-Monitoring Points

G4.9.3 Inventory Responsibilities

G4.9.4 Fire Management Plan

G4.10 Funding or In-Kind Resource Needs

G4.10.1 Working Budget

G4.11 Appendices

G4.11.1 Legal Description, Property Plat, Deed, etc.

G4.11.2 Maps

G4.11.3 Cultural Resources Report

G4.11.4 Verified Wetland Delineation

INTENTIONALLY LEFT BLANK