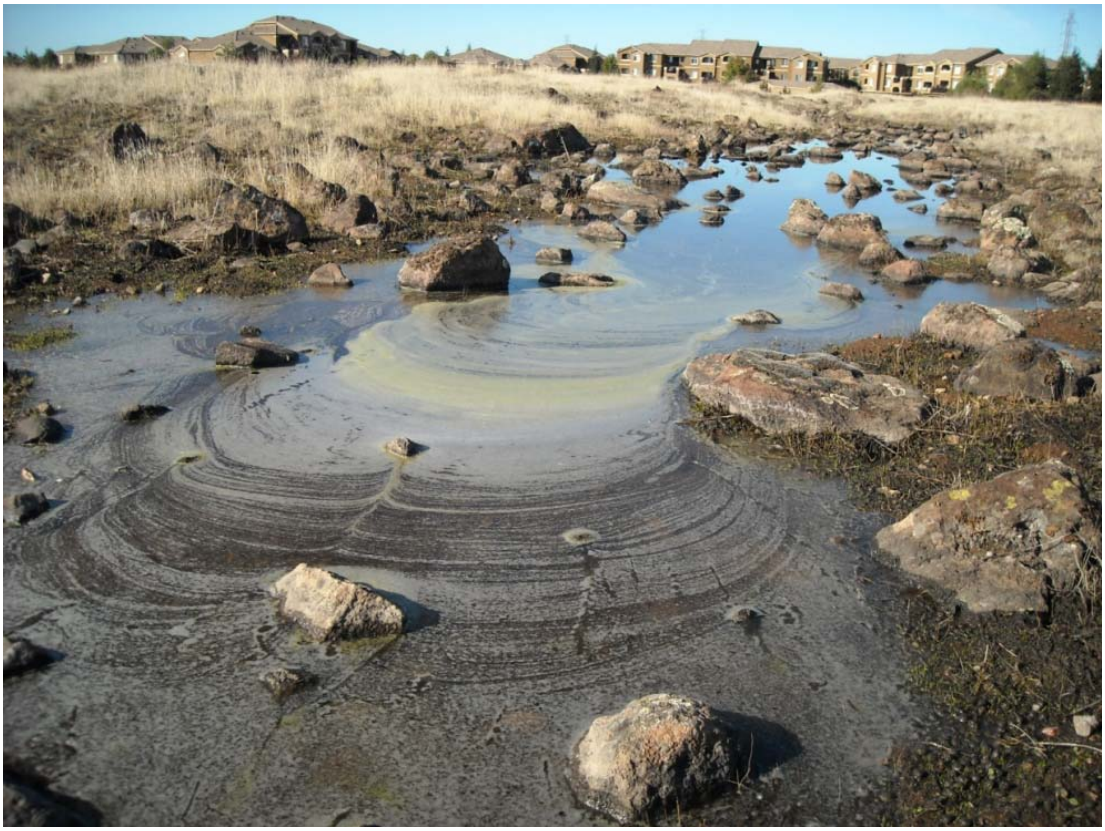
Effectiveness of Small Vernal Pool Preserves



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- Placer Land Trust for administering the study;
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- Carol Witham (VernalPools.org), Robert Gilliom, Joselin Matkins, and Jeff Ward (Placer Land Trust) for their continued input and review during the course of the project.

ABSTRACT

This study evaluates the status, conditions and trends of small vernal pool preserves (< 60 acres total area) in California's Central Valley. The goals of the study were to evaluate the effectiveness of small vernal pool preserves in conserving vernal pool resources and to provide those who establish, manage, evaluate, or regulate small preserves with an improved understanding of the value and pitfalls of small preserves; tools for evaluating when and where new small preserves should be established; and the best means to establish, manage, and monitor small preserves. The project team contacted 54 preserve managers to obtain project participation. Participation was voluntary and confidential. It proved challenging to find sites that both were suitable and had managers willing to participate in the study, and ultimately only 11 small preserves were included in the study. Because of this selection process, the selected preserves are not considered a random nor fully representative sample. However, the 11 preserves in the study provided a substantial range of conditions and insights into the issues pertinent to small vernal pool preserves. Data were gathered through questionnaires completed by preserve managers, review of preserve management and monitoring documents provided by the preserve managers, and site visits.

Small preserves share conditions and issues relevant to all preserves, including the importance and value of protecting rare and endangered habitats and species; the need to limit potential impacts from human trespassing or overuse; the importance of developing well-prepared management and monitoring plans and providing a sufficient non-wasting endowment or other funding source to ensure management and monitoring tasks are carried through; and the importance of a responsive regulatory process. In addition to these more general conditions, the study identified numerous conditions and issues that are more characteristic of even unique to small preserves:

- Small preserves can be important for the conservation of extremely rare and highly localized species, especially those that are restricted to highly developed areas, where frequently no other opportunities exist for their protection. Agencies should consider this factor when determining when and where to permit the establishment of small preserves.

- The management of thatch (dead grass) through regular grazing or mowing is often critical for maintaining ecological health within vernal pools and associated annual grasslands. The size of small preserves presents unique challenges related to thatch management and invasive plant control. Small preserves often must pay livestock operators to graze (rather than charging a fee as on large preserves), may not have a source of reliable on-site water, and surrounding residents may object to the close proximity of livestock. Thus, thatch management is often lacking, sporadic or otherwise inadequate on small preserves. This is often an important factor in the frequently observed declining ecological conditions in small preserves, which may include an increase in invasive plant cover and loss of rare species over time.

- Small preserves, especially those in proximity to moderate to high density residential areas, are prone to much higher levels of human and domestic animal impact as compared with large preserves or more remote small preserves.

- In combination, these unique management challenges translate to the need for much more intensive management and monitoring efforts and consequently typically much higher funding requirements on a per acre basis for small preserves as compared with large preserves. This higher funding requirement should be considered when determining endowments for small preserves.

- Small preserves may provide one of the few remaining open spaces in highly developed areas. As such, they have the capacity to provide easily accessible sites for public education and appreciation regarding vernal pools and their conservation. One preserve, located near dense residential development, has a well developed public use and education program, but also exhibited low levels of human impacts because of carefully facilitated access. Several other small preserves in the study near residential areas that did not allow public

access showed high levels of human impact from unplanned trails, vandalism and trash build-up. This indicates that it may be more cost-effective and beneficial in terms of site maintenance and public appreciation of vernal pools, to facilitate responsible and engaged public use of small preserves rather than to attempt excluding public access.

1.0 INTRODUCTION

This study evaluates the status, conditions and trends of 11 small vernal pool preserves in California's Central Valley. In this study, a "small" preserve is defined as a preserve with an area less than 60 acres, whether isolated or contiguous with adjacent open space, that is independently managed as a preserve. This size was selected by the project team as a reasonable threshold to detect conditions and issues that may be characteristic of smaller preserves. The preserves evaluated in this study support natural, created, or restored vernal pools, or some combination thereof. The study includes only sites that were actively established as preserves and not areas that were simply "avoided" in the context of larger development projects, but have no management requirements. Even though these avoided areas may support significant vernal pool resources, they are difficult to evaluate because of a lack of data and little to no recorded documentation about their existence.

Numerous small vernal pool preserves have been established over the past few decades with the large majority established as mitigation. Although precise numbers are unavailable, the study authors estimate that more than 100 such preserves currently exist in the state, supporting more than 2,000 acres of habitat and numerous occurrences of federal- or state-listed threatened or endangered species. Some of these occurrences represent local populations of exceptionally rare and endangered species that have been protected in situ as surrounding areas have been developed. Also, it is expected that new small preserves will be established in the future, primarily for mitigation.

This study was undertaken to gauge the current conditions and trends of selected Central Valley small vernal pool preserves to contribute to the understanding of the effectiveness of small preserves in conserving the sensitive resources for which they were established to protect. The study evaluates multiple parameters related to the functioning and success of these preserves:

- general physical and biological characteristics;
- infrastructure, public use and surrounding land use;
- preserve establishment and funding;
- preserve management;
- preserve monitoring;
- ecological conditions and trends;
- education and public outreach; and
- regulatory compliance and oversight.

This study also provides a brief narrative discussion of each preserve included in the study (Appendix A) to give a more comprehensive view of how individual preserves function.

The goal of this study is to provide those who establish, manage, evaluate, or regulate small preserves—preserve managers, agency personnel, consultants, landowners, etc.—an improved understanding of the value and pitfalls of small preserves; tools for evaluating when and where new small preserves should be established; and the best means to establish, manage, and monitor small preserves based on lessons learned from existing small preserves.

This study, along with a study of cumulative impacts on Central Valley vernal pools, was conducted jointly by Vollmar Consulting and AECOM. John Vollmar and Cassie Pinnell of Vollmar Consulting were the lead authors of this study. Several others individuals contributed to the study design and review: Gerrit Platenkamp, Matt Wacker, Ron Unger, and Shannon Hickey of AECOM; Robert Gilliom, Joselin Matkins, and Jeff Ward of Placer Land Trust (PLT); and Carol Witham, a representative of the environmental consortium that obtained the funding for this study.

Funding for both studies was provided by PLT through the West Placer Habitat Protection Program (WPHPP), which focuses on protecting vernal pool grassland habitat in western Placer County. PLT is administering these two studies as a component of this program. WPHPP received its funding through settlement funds obtained by a consortium of environmental organizations from the proposed Westpark/Fiddyment Ranch development in western Placer County. This consortium includes the Butte Environmental Council, California Native Plant Society, Defenders of Wildlife, Sierra Foothills Audubon Society, and Sierra Club Mother Lode Chapter.

2.0 BACKGROUND

Vernal pools are ephemeral wetlands that support a unique assemblage of native wildlife and plant species specifically adapted to the combination of winter/spring inundation and summer/fall desiccation characteristic of the Mediterranean climate where they occur (Jain 1976, Witham et al. 1998). Vernal pools are typically found on level to nearly level terrain. They become seasonally inundated by rainwater due to an underlying restrictive soil layer (hardpan, claypan, cemented lahar [volcanic mudflow], or bedrock) that prevents downward percolation of rainwater and causes water to pond in depressional basins. Vernal pool habitats are found worldwide where appropriate climate and geomorphic conditions exist, including the western North and South America, southwest Australia, South Africa, and the Mediterranean basin (Keeley and Zedler 1998). Where they occur, vernal pools are generally regarded as unique or sensitive habitats because of their rarity on the landscape and high number of native species that only occur in vernal pools (i.e., vernal pool endemics).

California, with its Mediterranean climate and extensive suitable terrain and soils, is a global hotspot for vernal pools. However, California also has an increasing human population, with most development concentrated on more level terrain—including many areas where vernal pools are most common. In the last 200 years, an estimated 90–95% of the historic vernal pool acreage in the state has been lost through agricultural conversion or development (Holland 2009). Although this historic loss is dramatic, the remaining habitat continues to be lost at a rapid pace with nearly 100,000 acres lost between 1997 and 2005 alone (Holland 2009).

Concurrent with these accelerating impacts and increasing awareness of the ecological value of vernal pools has been an increase in the regulatory oversight of vernal pool impacts. The U.S. Army Corps of Engineers (USACE) and California's regional water quality control boards (RWQCBs) have both been involved in regulating impacts on vernal pools as jurisdictional wetlands. USACE recently published new "Arid West" wetland delineation standards that specifically address vernal pools (USACE 2006). Numerous wildlife and plant species endemic to vernal pools have been listed as endangered or threatened under the federal and state Endangered Species Acts in the past 30 years, with the first listings taking place in 1979. Also, proposed statewide conservation and recovery actions have been addressed in the recently published *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (USFWS 2005) and in previous listing packages and recovery plans for individual species.

Mitigation standards for impacts to vernal pools have also evolved over the past 30 years in response to increased regulatory oversight and improved understanding of vernal pool ecology and conservation biology. Mitigation in the form of habitat preservation, creation, and restoration has been achieved by development projects through four primary methods: on-site mitigation, off-site mitigation, purchase of mitigation bank credits, and payment of in-lieu fees. On-site mitigation involves reserving a portion of the project site as undeveloped and maintaining this area as a permanent mitigation preserve (Photo 2-1). Off-site mitigation involves establishing a single, permanent mitigation preserve on a property separate from the project site. Purchase of mitigation bank credits involves purchasing the required mitigation acreage from a bank that has been permitted by the regulatory agencies to provide mitigation for multiple projects. In-lieu fee involves paying funds into an account established by the U.S. Fish and Wildlife Service (USFWS) to be used to purchase vernal pool preserve lands or future bank credits.

Early (1970s and 1980s) vernal pool mitigation requirements were achieved by establishing on-site or off-site preserves because mitigation banks and the in-lieu fee program had not yet been developed. The concept of using larger, regional mitigation banks followed the development of concepts in conservation biology, whereby larger preserves were considered more ecologically sustainable than smaller, isolated "postage stamp" preserves (Noss 1983). This preference has continued to evolve among the regulatory agencies as the process for establishing banks has been improved. Recent mitigation guidelines published by USACE (*Federal Register*, Vol. 73: 19594–19705, April 10, 2008) and supported by other federal and state regulatory agencies explicitly identify purchasing mitigation bank credits as the preferred means for development projects to satisfy vernal pool mitigation requirements. Nonetheless, numerous small vernal pool preserves exist and, based on information gathered through this study, it is expected that new small preserves will be established in the future. Of the 11 preserves in this study, 10 were established for mitigation, all but one as on-site preserves. These preserves were established

between 1979 and 2007, and three of the preserves (two on-site and one off-site) were established since 2006, after mitigation banking was well under way. Only one donated small preserve was identified by this study; it seems unlikely that donated preserves will ever make up a significant portion of existing small vernal pool preserves.

There are several reasons why new small preserves will continue to be established. First, it may be much cheaper for a project proponent to establish an on-site preserve than to purchase credits in a bank, especially for projects with larger vernal pool impacts. During 2007–2008, prices at established mitigation banks for vernal pool credits ranged from $150,000 to $750,000 per acre for created or restored vernal pools and $30,000 to $90,000 per acre for preserved vernal pools, with higher prices typically in areas with more limited remaining vernal pool habitat such as the Santa Rosa Plains and West Placer County (Vollmar pers. obs.). Second, suitable mitigation banks may not be available in the vicinity of a project site, forcing a project to establish a preserve either on-site or off-site. Third, a portion of a project site may have such a high concentration of vernal pools and/or associated listed or other special-status species that development of the area is not permitable or economically feasible. Because development must be avoided, the developer may opt to utilize the area as a mitigation site. Fourth, isolated small preserves may be the only means of protecting a small number of remaining occurrences of special-status species situated within highly developed or fragmented vernal pool habitats, such as regions around Sacramento, western Placer County, central Solano County, Sonoma County, and San Diego County (e.g., Contra Costa goldfields (*Lasthenia conjugens*), Orcutt grasses (*Orcuttia* spp.), Sebastapol meadowfoam (*Limnanthes vinculans*), and San Diego fairy shrimp (*Branchinecta sandiegoensis*). Some regional Habitat Conservation Plans and Natural Community Conservation Plans include specific provisions for small preserves to protect these types of species.

Given these circumstances, it is expected that new small preserves will continue to be established as a component of vernal pool mitigation when deemed appropriate by developers or regulators. Also, existing small preserves will need continuing management to ensure the preservation of resources they were established to protect. This study is intended to provide land managers, regulators, and others with insight and guidance on the establishment and management of small vernal pool preserves based on lessons learned from 11 existing preserves.

Photo 2-1. Small vernal pool preserve within an urbanized landscape
(Source: Photograph taken by Vollmar Consulting in 2009)

3.0 METHODS

3.1 LEVEL OF EFFORT AND SELECTION OF SITES

The project team undertook an intensive effort to locate suitable small preserves within the study region and obtain the authorization and cooperation of preserve managers in providing preserve information and documents. A site was considered suitable for this study if it was:

- equal to or less than 60 acres in total area;
- an established preserve with some level of past or on-going management;
- documented to support preserved, created, and/or restored vernal pools;
- isolated or managed independently from adjacent undeveloped or preserved land;
- located within the study region; and
- managed by persons willing and able to provide site information.

The project team selected 60 acres as a reasonable size threshold where certain conditions or issues that may be characteristic of small vernal pool preserves would become evident such as more pronounced edge effects, greater difficulty in implementing site grazing, and higher per acre management costs.

A total of 54 individuals were contacted to identify suitable preserves and gain the participation of preserve managers. The individuals contacted represented private consulting firms, federal, state, and county government agencies, and nonprofit land trust organizations. Participation was voluntary and confidential and no compensation was provided. Other potential preserves were identified by reviewing lists of mitigation banks and information about vernal pool mitigation sites obtained through Freedom of Information Act requests for USACE records of Section 404 permits, which were made as a separate component of the larger PLT vernal pool study (AECOM 2009).

The initial target sample size for the project was 30 sites in the study region. This target was selected to provide a robust cross-section of conditions and issues relevant to small preserves and, depending on the selected sites, allow statistical analysis of certain site characteristics and trends. It proved challenging, however, to find this number of sites that both were suitable and had managers willing to participate in the study. Ultimately, a total of 11 sites were included in the study. More details on the reasons for this sub-target number are discussed in Section 4.0, "Results." Some bias, no doubt, resulted from the selection process. As an example, it is conceivable that managers of preserves in particularly poor condition or with other problems may have been less interested in participating in the study. Also, the small sample size makes it unlikely that the selected sites reflect the full range of conditions and issues of small preserves. Therefore, the sites included in the study are not considered to represent a random or fully representative sample.

3.2 DATA GATHERING

Data on the study preserves were gathered through questionnaires completed by preserve managers, review of preserve management and monitoring documents provided by preserve managers, and site visits conducted by project team members, as described below.

3.2.1 QUESTIONNAIRES

The project team developed a questionnaire to gather key site information, a copy of which is provided in Appendix B. The questionnaire was completed by preserve managers participating in the study and included questions related to preserve attributes and infrastructure, sensitive resources, mitigation elements, financial endowments, preserve management and monitoring, and preserve conditions and trends. The questionnaire was developed to provide insights into the purpose of site establishment; the purpose, extent, and success of site

management and monitoring; and the status and trends in site conditions. Information was compiled under confidentiality agreements and is intended to provide insights into the general conditions and trends within small preserves. This study was not intended to present the quality or success of individual sites.

3.2.2 SITE VISITS

All study preserves were visited by project team members to assess current site conditions and enhance, expand, or verify information provided in the questionnaires. The team developed and field-tested a field survey form (**Appendix C**) to standardize data collection. Site visits were conducted from October 2008 through January 2009 and were scheduled in groups based on preserve location in an attempt to minimize potential external variables such as rainfall and climate. Whenever possible, site visits were conducted with site managers or biologists so that the project team could obtain more in-depth information. Aerial images from Google Earth (2008) were also reviewed before field visits to note any features of special interest.

At each site, the entire perimeter was walked to verify land uses, edge disturbances, general habitat conditions, and fencing and signage conditions reported by preserve managers in their questionnaire responses. Any variation between information reported by preserve managers and conditions observed in the field was recorded on the field survey form. The site was then traversed multiple times, covering most of the preserve, to note conditions in the interior of the site and to collect data on the biological condition of the preserve.

A minimum of six vernal pools were surveyed at each preserve (except at sites with fewer than six pools). Where possible, three pools within 100 feet of the preserve edge (edge pools) and three pools greater than 100 feet from the preserve edge (interior pools) were surveyed. The 100-foot threshold between ‘edge’ and ‘interior’ pools was selected as a reasonable threshold for higher levels of human trespass, trash accumulation, and passive invasive weed establishment from adjacent non-preserve areas. An effort also was made to survey pools of different sizes (large, medium, and small) and origin (created, restored, and preserved), as well as pools supporting special-status species or with obvious signs of disturbance. Representative photographs of both pools and upland conditions were taken at each site.

3.2.3 DOCUMENT REVIEW

Preserve managers were asked to provide copies of resource management plans, monitoring reports, and any other documents that could provide additional information about the status of the preserves. When available, these documents were reviewed for management and monitoring strategies, as well as for trends related to disturbance and ecological conditions.

3.3 DATA ANALYSIS

All questionnaire and field data were collected using standardized data forms designed to gather information in a quantifiable, consistent manner. All data were entered into a Microsoft Access database and linked by preserve site. Qualitative data taken from supporting documents and field notes were incorporated into the report but not managed in the project database.

4.0 RESULTS

Questionnaires were completed by preserves managers for 11 preserves included in the study; sites visits were conducted on 10 of the 11 preserves; management and monitoring documents were provided by preserve managers for eight of the 11 preserves. To maintain anonymity, each preserve was assigned an identification letter (A-K) that is referred to throughout the sections below, and no citations are provided for preserve documents or personal communications with preserve managers. The preserves included in the study are located in Placer, Sacramento, Solano, Shasta, and Tulare Counties.

As noted above, the initial goal of the project was to include a minimum of 30 preserves. Ultimately, it proved very challenging to find this many because of a combination of factors including the small number of suitable preserves that exist in the study region, possible reluctance of some organizations to participate in the study, and lack of responsiveness of some organizations that had initially expressed interest. The small sample size and selection process undoubtedly resulted in bias and therefore the preserves included in the study are not considered to be a random nor even fully representative set of small preserves. Nonetheless, the 11 participating preserves provide a substantial range of conditions and insights into the issues pertinent to small vernal pool preserves.

Information on preserve characteristics, conditions, and trends was gathered through the questionnaires, site visits, and document review. Summaries of these results are presented in Tables 4-1 to 4-14 and address the following eight categories relevant to the small preserve assessment:

- general physical and biological characteristics (Tables 4-1 and 4-2);
- infrastructure, public use and surrounding land use (Tables 4-3 and 4-4);
- preserve establishment and funding (Table 4-5);
- preserve management (Table 4-6 and 4-7);
- preserve monitoring (Table 4-8);
- ecological conditions and trends (Tables 4-9 to 4-14);
- education and outreach (Table 4-3), and
- regulatory compliance and oversight.

Note that rows within the tables have different shading (none, light gray and dark gray). This shading indicates three sets of preserves with distinct conservation and funding characteristics as follows: Preserves A–C in non-shaded rows were recently established, are protected by conservation easements and have sizable endowments; Preserves D–H in light gray rows are older, are protected by deed restrictions or fee simple ownership, and have either endowments or other funding sources; Preserves I-K in dark gray rows are also older and protected by deed restrictions or fee simple ownership, but have no endowment or funding source. These differences were found to be related to important overall differences among the preserves in terms of management, monitoring and overall condition.

Section 5.0, “Discussion of Key Findings and Recommendations”, provides a thorough interpretation of preserve information and presents key findings and recommendations related to each above-listed category. No specific information was gathered on regulatory compliance and oversight, and therefore no table is provided. However, certain information related to this topic was gleaned through this study as discussed in Section 5.0.

Appendix A provides a brief narrative discussion of each preserve included in the study. These narratives are intended to augment the information presented in Sections 4.0 and 5.0 to give a more comprehensive view of how the individual preserves function. Appendix B provides an example of the survey questionnaire that was completed by the preserve managers. Appendix C provides a copy of the data form completed during site visits to individual preserves by the project team. Appendix D presents representative photographs from the small preserves highlighting conditions and issues addressed in the study.

Table 4-1
General Physical and Habitat Characteristics of 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Total Area (acres)	General Shape	Approx. Max. Width (feet)	Approx. Min. Width (feet)	All Vernal Pools			Preserved Vernal Pools			Created Vernal Pools			Restored Vernal Pools			Upland Habitats		Non–Vernal Pool Wetlands
					Number	Acreage	% Cover	Number	Acreage	% Cover	Number	Acreage	% Cover	Number	Acreage	% Cover	Non-native Annual Grassland	Blue Oak Woodland	
A	53	Oval	1,050	600	34*	ND	ND	ND	ND	ND	0	0	0	0	0	0	>80%*	0%	ND
B	6	Square	375	300	4*	0.02	0.3	4*	0.02	0.3	0	0	0	0	0	0	97%	0%	3%
C	15	Oval	ND	ND	1	ND	ND	0	0	0	0	0	0	1	ND	ND	0%	0%	0%
D	48	Rectangle	3,900	480	91	10.97	23	2	0.87	2	89	10.10	21	0	0	0	77%	0%	0%
E	36	Linear	900	300	6	0.88	2	0	0	0	6	0.88	2	0	0	0	64%*	30%*	4%
F	33	Square	1,800	900	281	1.68	5	211	0.99	3	70	0.69	2	0	0	0	95%	0%	0.3%
G	8	Flag	1,050	30	6*	ND	ND	6*	0	0	0	0	0	0	0	0	>70%*	60%*	ND
H	15	Rectangle	1,650	300	15*	ND	ND	15*	ND	ND	0	0	0	0	0	0	>30%*	8%*	ND
I	10	Triangle	600	300	12	1.86	19	4	0.60	6	8	1.26	13	0	0	0	74%	0%	7%
J	37	Rectangle	1,800	300	41	5.34	14	14	0.54	1	27	4.80	13	0	0	0	85%	0%	0.6%
K	40	Square	900	900	50*	ND	ND	50*	ND	ND	0	ND	ND	0	0	0	100%	0%	0%

Notes:

* = Approximation from remote analysis of aerial photography; ND = No data available; VP = vernal pool

Shading:

No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;

Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;

Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained from preserve managers, site visits, and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-2
Special-Status Species Reported at 11 Small Vernal Pool Preserves in California's Central Valley

Special-Status Species	Listing Status[1]	Preserve Number										
		A	B	C	D	E	F	G	H	I	J	K
Large Branchiopods												
Branchinecta lynchi Vernal pool fairy shrimp	FT	●	●		●		●				●	●
Lepidurus packardi Vernal pool tadpole shrimp	FE	●	●	●								
Linderiella occidentalis California fairy shrimp	FSC				●	●					●	
Amphibians												
Spea hammondii Western spadefoot toad	FSC	●							●			●
Plants												
Atriplex cordulata Heartscale	CNPS 1B											●
Atriplex persistens Vernal pool smallscale	CNPS 1B											●
Delphinium recurvatum Recurved larkspur	CNPS 1B											●
Downingia pusilla Dwarf downingia	CNPS 2				●							
Gratiola heterosepala Boggs Lake hedge-hyssop	CE CNPS 1B	●										
Lasthenia conjugens Contra Costa goldfields	FE CNPS 1B									●		
Legenere limosa Legenere	CNPS 1B	●		●								
Navarretia myersii ssp. *myersii* Pincushion navarretia	CNPS 1B							●	●			
Orcuttia tenuis Slender Orcutt grass	FT/CE CNPS 1B	●		●								
Orcuttia viscida Sacramento Orcutt grass	FE/CE CNPS 1B							●	●			
Trifolium depauperatum var. *hydrophilum* Saline clover	CNPS 1B									●		
Total Special-Status Species		**6**	**2**	**3**	**3**	**1**	**1**	**2**	**3**	**2**	**2**	**5**

Notes:

ND = No data available.

[1] Listing status: FE = federally listed as endangered; FT = federally listed as threatened; FSC = federal species of concern; CE = California listed as endangered; California Native Plant Society (CNPS) List 1B = rare, threatened, or endangered throughout its range; CNPS 2 = rare, threatened, or endangered in California, but more common elsewhere.

Shading:

No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;

Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;

Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained by Vollmar Consulting in 2009 from preserve managers, site visits, and review of preserve documents.

Table 4-3
Status of Infrastructure, Public Use, and Disturbance in 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Fencing Type[1]	Fencing Condition	Signage[2]	Fence/Sign Vandalism[2]	Public Access[2]	Trails[2]	Recreational Use[2]	Educational Use[2]	Domestic Animal (Pet) Use[2]	Trash/Debris[2]	Human Disturbance of Habitat [2]
A	BW, CL	Good	Y	N	N	N	N	N	N	L	L
B	BW, CL	Good	ND	N	N	N	N	N	N	L	L
C	BW	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
D	BW	Poor	N	M	N	L	L	L	M	L	L
E	BW, CL	Poor	N	H	N	M	H	L	M	L	M
F	PC, CL	Good	Y	N	N	N	L	N	M	L	L
G	PC	ND	N	ND	N	N	N	N	N	L	L
H	CL	Good	Y	L	N	N	N	N	M	L	L
I	PC	Good	Y	N	Y	M	H	H	L	L	L
J	PC, CL	Good	N	L	N	L	L	N	L	L	L
K	BW	Poor	Y	L	Y	N	N	L	N	L	L

Notes:
[1] Fencing types: BW = barbed wire; CL = chain link; PC = post and cable.
[2] N = None; L = Low; M = Moderate; H = High; NA = not applicable; ND = no data available.
Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers, site visits, and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-4
Summary of Surrounding Land Uses (within 1,000 Feet) for 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Total Area (acres)	Surrounding Land Use (% Area)						Bordered by Paved Roads?
		Native or Naturalized Habitats	Disturbed Field	Intensive Agriculture (Croplands)	Parks/ Recreation	Residential	Commercial/ Industrial	
A	53	–	50	–	–	50	–	No
B	6	75	–	–	–	25	–	No
C	15	90	–	–	–	–	10	Yes
D	48	27	–	–	7	40	15	Yes
E	36	63	–	–	–	8	23	Yes
F	33	15	–	–	6	36	41	Yes
G	8	15	–	–	10	75	–	Yes
H	15	–	–	–	25	75	–	Yes
I	10	25	–	–	–	–	75	Yes
J	37	25	–	–	–	75	–	Yes
K	40	–	–	100	–	–	–	Yes
Mean	**27**	**30**	**5**	**9**	**4**	**35**	**15**	**NA**

Notes:
NA = not applicable
Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers, site visits, and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-5
Easement, Endowment, and Funding Information for 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Total Area (acres)	Year Established	Establishment Mechanism	Resources Driving Preserve Establishment[1]	Preserve Type	Land Protection Instrument[2]	Site Manager	Endowment Amount	Other Funding Sources	Annual Amount Available	Annual Amount Required[3]
A	53	2006	Mitigation: Residential	Vernal pools, BRLY, LEPA, GRHE, LELI	On-site	CE	Land trust	$900,000	None	ND	ND
B	6	2007	Mitigation: Residential	Vernal pools, BRLY, LEPA	On-site	CE	Land trust	$400,000	None	ND	ND
C	15	2007	Mitigation: Residential	Vernal pools	Off-site	CE	Land trust	$180,000	None	$8,000	ND
D	48	1990	Mitigation: Mixed use	Vernal pools	On-site	DR	City agency	$390,000	None	$11,025	$31,307
E	36	1993	Mitigation: Commercial	Vernal pools	On-site	DR	Private landowner	$18,305	None	ND	$24,000
F	33	1988	Mitigation: Mixed use	Vernal pools	On-site	DR	City agency	$3,750	None	ND	$15,000
G	8	1979	Mitigation: Residential	Vernal pools, ORVI, NAMY	On-site	FS	State agency	$0	Public Funds	ND	$4,000
H	15	1979	Mitigation: Residential	Vernal pools, ORVI	On-site	FS	City agency	$0	Public funds	ND	$4,000
I	10	1998	Mitigation: Industrial	Vernal pools, LACO	On-site	DR	Private landowner	$0	None	ND	ND
J	37	1992	Mitigation: Residential	Vernal pools	On-site	FS	City agency	$0	None	$0	ND
K	40	1964	Conservation: Donation	Vernal pools, open space	NA	FS	Land trust	$0	None	$0	ND

Notes:

NA = Not applicable; ND = No data available.

[1] Species acronyms: BRLY = vernal pool fairy shrimp (*Branchinecta lynchi*); GRHE = Boggs Lake hedge-hyssop (*Gratiola heterosepala*); LACO = Contra Costa goldfields (*Lasthenia conjugens*); LEPA = vernal pool tadpole shrimp (*Lepidurus packardi*); NAMY = pincushion navarretia (*Navarretia myersii* ssp. *myersii*); ORVI = Sacramento Orcutt grass (*Orcuttia viscida*); LELI = legenere (*Legenere limosa*).

[2] Land protection instruments: CE = conservation easement; DR = deed restriction; FS = fee simple.

[3] Annual amount required to maintain and monitor site, as reported by preserve manager.

Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained from preserve managers and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-6
Status of Preserve Management Plans for 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Acres	Preserve Manager	Date Est.	Mgmt. Plan?	Date Prepared	Ever Updated?	Preparer	Agency Guidelines?
A	53	Land trust	2006	Yes	2006	No	Consultant	No
B	6	Land trust	2007	Yes	2006	No	Consultant	No
C	15	Land trust	2007	Yes	2007	No	Consultant	USACE
D	48	Public agency	1990	Yes	2000	No	Consultant	No
E	36	Public agency	1993	Yes	2000	No	Consultant	No
F	33	Public agency	1988	Yes	1999	No	Consultant	No
G	8	Public agency	1979	Yes	2006	No	Consultant	DFG
H	15	Public agency	1979	Yes	2006	No	Consultant	DFG
I	10	Private	1998	Yes	2000	No	Consultant	No
J	37	Public agency	1992	No	ND	ND	ND	ND
K	40	Land trust	1964	No	ND	ND	ND	ND

Notes:
DFG = California Department of Fish and Game; Mgmt. = management; ND = no data available; USACE = U.S. Army Corps of Engineers

Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-7
Frequency of Management Activities Conducted on 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Acres	Mgmt. Plan?	Endowment or Other Funds?	Site Maintenance					Thatch Removal and Invasive Plant Control				Habitat		Education/ Outreach
				Signage Maintenance	Fence Maintenance	Trash/Debris Removal	Trespass Patrol	Feral Animal Control	Grazing	Mowing	Prescribed Burning	Invasive Species Control	Erosion Control	Habitat Restoration	
A	53	Yes	Yes	4	5	1	–	1	5	2	NR	1	NR	–	–
B	6	Yes	Yes	4	4	5	4	4	–	–	–	4	–	–	–
C	15	Yes	Yes	1	1	5	–	–	1	–	–	1	–	–	–
D	48	Yes	Yes	1	1	2	4	–	2	2	–	2	1	1	1
E	36	Yes	Yes	1	5	4	4	1	–	–	–	2	1	1	1
F	33	Yes	Yes	1	1	2	4	–	–	–	–	1	1	1	–
G	8	Yes	Yes*	1	–	5	NR	–	–	–	–	–	–	–	1
H	15	Yes	Yes*	1	–	5	NR	–	–	–	1	1	–	–	5
I	10	Yes	No	–	–	–	–	–	–	–	–	–	–	–	–
J	37	No	No	–	–	–	–	–	–	–	–	–	–	–	–
K	40	No	No	–	–	–	–	–	–	–	–	–	–	–	–
Total Preserves				**8**	**6**	**8**	**4**	**3**	**3**	**2**	**1**	**7**	**3**	**3**	**4**

Notes:
Mgmt. = management; ND = No data available—frequency of activity was not reported by manager; NR = activity not required for site management; * = no endowment but dedicated public funds available.
– = Activity is not conducted; 1 = Activity is conducted infrequently or as needed (less than once per year);
2 = Activity is conducted annually (once per year); 3 = Activity is conducted biannually;
4 = Activity is conducted quarterly; 5 = Activity is conducted continuously or at numerous times throughout the year.

Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-8
Reported Monitoring Activities Conducted on 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Acres	Monitoring Plan?	Endowment or Other Funding Source?	Monitoring Activities Conducted?	Site Maintenance					Biological Resources							Thatch and Invasive Plants				Monitoring Results Used to Inform Site Mgmt.?
					General Site Inspections	Erosion	Fencing	Trash/Debris	Feral Animals	General Wildlife	General Vegetation	Vernal Pool Rare Plants	Vernal Pool Vegetation	Vernal Pool Listed Shrimp	Amphibians	Wetland Hydrology	Upland Plant Species	Photopoints	Residual Dry Matter	Invasive Species	
A	53	Yes	Yes	Yes	5	4	5	5	4	4	4	2	2	2	2	2	2	2	2	3	Frequently
B	6	Yes	Yes	Yes	4	4	4	4	2	4	4	2	2	2	2	2	2	2	2	2	Frequently
C	15	Yes	Yes	Yes	2	–	–	3	–	–	–	–	–	3	–	–	–	2	2	–	–
D	48	Yes	Yes	Yes	5	5	5	5	4	4	4	NA	2	2	NA	2	NA	NA	NA	4	Frequently
E	36	Yes	Yes	Yes	4	4	4	4	4	3	2	NA	NA	NA	NA	2	2	NA	NA	2	Frequently
F	33	Yes	Yes	Yes	4	4	4	4	2	2	2	NA	2	2	NA	2	NA	NA	NA	2	Frequently
G	8	Yes	Yes*	Yes	–	–	–	1	–	–	–	1	1	–	–	1	1	–	–	2	–
H	15	Yes	Yes*	Yes	–	–	–	1	–	–	–	1	1	–	–	1	1	–	–	1	–
I	10	Yes	No	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
J	37	No	No	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NA
K	40	No	No	No	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	NA
Total Preserves		**9**	**8**	**8**	**6**	**5**	**5**	**8**	**5**	**5**	**5**	**4**	**6**	**5**	**2**	**7**	**5**	**3**	**3**	**7**	**6**

Notes:
Mgmt. = management; NA = Activity is not required for this preserve due to lack of resources or lack of monitoring requirement; ND = No data collected
– = Activity is not conducted; 1 = Activity is conducted infrequently or as needed basis (less than once per year);
2 = Activity is conducted annually (once per year); 3 = Activity is conducted biannually;
4 = Activity is conducted quarterly; 5 = Activity is conducted continuously or at numerous times throughout the year.
Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-9
Preserve Establishment, Endowment, Management, and Monitoring Compared with Reported Overall Ecological Trends at 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Year Established	Preserve Acreage	Financial Endowment?	Management Plan?	Site Monitoring?	Monitoring Results Used?	Trend in Overall Ecological Conditions Since Preserve Establishment
A	2006	53	Yes	Yes	Yes	Frequently	Same
B	2007	6	Yes	Yes	Yes	Frequently	Decline
C	2007	15	Yes	Yes	Yes	Always	Unknown
D	1990	48	Yes	Yes	Yes	Frequently	Decline
E	1993	36	Yes	Yes	Yes	Frequently	Decline
F	1988	33	Yes	Yes	Yes	Frequently	Same
G	1979	8	No	Yes	Yes	ND	Decline
H	1979	15	No	Yes	Yes	ND	Decline
I	1998	10	No	Yes	No	ND	Decline
J	1992	37	No	No	No	ND	Unknown
K	1964	40	No	No	No	ND	Unknown

Notes:
ND = No data collected or available.
Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers and compiled by Vollmar Consulting in 2009

Table 4-10
Ecological Trends within Preserved and Created Vernal Pools Since Preserve Establishment at 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Acres	Overall Ecological Conditions		Ponding Duration	Native Plants	Non-native Grass Cover	Invasive Species Cover	Listed Large Branchiopods	Amphibians	Preserved Pool Rare Plants
		Preserve	Vernal Pools							
Preserved Vernal Pools										
A	53	Same	Same	Constant	Constant	Constant	Constant	Constant	Constant	Constant
B	6	Decline	Same	Constant	Constant	Constant	Constant	Constant	Constant	Constant
C	15	ND	ND	ND	ND	ND	ND	ND	ND	ND
D	48	Decline	Same	Constant	Constant	Increase	Increase	Constant	Constant	Constant
E	36	Decline	ND	ND	ND	ND	ND	NA	NA	NA
F	33	Same	Same	Constant	Constant	Constant	Constant	Constant	Constant	NA
G	8	Decline	Decline	Decrease	Decrease	Increase	Increase	NA	NA	Decrease
H	15	Decline	Decline	Decrease	Decrease	Increase	Increase	NA	ND	Decrease
I	10	Decline	Decline	Decrease	Decrease	Increase	Increase	NA	NA	Decrease
J	37	ND	ND	ND	ND	ND	ND	ND	ND	ND
K	40	ND	ND	ND	ND	ND	ND	ND	ND	ND
Created Vernal Pools										
D	48	Decline	Same	Constant	Constant	Increase	Increase	Constant	Constant	Constant
E	36	Decline	ND	ND	ND	ND	ND	ND	ND	ND
F	33	Decline	Same	Constant	Constant	Constant	Constant	Constant	Constant	ND
I	10	Decline	Improvement	Constant	Increase	Constant	Constant	NA	NA	Increase
J	37	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

NA = not applicable; ND = no data available

Shading:

No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained from preserve managers and compiled by Vollmar Consulting in 2009

Table 4-11
Observed and Reported Threats to Pool Hydrology at 11 Small Vernal Pool Preserves in California's Central Valley

Preserve No.	Acres	Observed Altered Hydrology[1]	Reported Altered Hydrology[2]	High Upland Species Cover[3]	High Non–Vernal Pool Grass Cover[4]	Vandalism[5]	Residential Runoff[6]	Other Runoff[7]	Altered Drainage/ Bermed[8]	Ponding Duration[9]
A	53	•							•	Constant
B	6	•			•	•			•	Constant
C	15	NA		NA	NA	NA	NA	NA	NA	ND
D	48	•		•	•				•	Constant
E	36	•		•	•	•				ND
F	33		•		•			•		Constant
G	8		•			•	•			Decrease
H	15	•	•				•	•	•	Decrease
I	10	•			•				•	Decrease
J	37	•					•	•		ND
K	40	•		•	•				•	ND
Total Preserves		**8**	**3**	**3**	**6**	**3**	**3**	**3**	**6**	

Notes:

NA = Survey data not collected; ND = Information not provided by survey participant.

[1] Altered hydrology observed in at least one pool during site visits conducted during this study.

[2] Events reported by land managers/biologists that altered the hydrology of at least one pool since preserve establishment.

[3] High upland (Facultative Upland or Upland) species relative cover (> 50%) within pools, as observed during 2008 site visits.

[4] High (Facultative, Facultative Upland, Upland, or No Wetland Indicator status) grass relative cover (> 50%) within pools, as observed during 2008 site visits.

[5] Includes damages to pool basin and edges from roads, trails, debris, or illegal discharge.

[6] Includes disturbances caused by altering drainage and water flow from residential development.

[7] Includes water runoff from commercial and industrial development.

[8] Pool drainage enhanced by ditches or ponding duration increased by berm construction.

[9] Condition of ponding duration since preserve establishment (information supplied by survey participants).

Shading:

No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained from preserve managers, site visits, and review of preserve documents and compiled by Vollmar Consulting in 2009

Table 4-12
Occurrence, Monitoring, Management, and Reported Condition of Listed and Other Special-Status Vernal Pool Plant Occurrences at 11 Small Vernal Pool Preserves in California's Central Valley

Preserve	Acres	Listed Plants	Other Special-Status Plants	Monitoring	Management	Reported Condition Since Preserve Establishment
A	53	•	•	•	•	Same
B	6	NA	NA	NA	NA	NA
C	15	•	•		•	ND
D	48	NA	•		•	Same
E	36	NA	NA	NA	NA	NA
F	33	NA	NA	NA	NA	NA
G	8	•	•	•	•	Decline
H	15	•	•	•	•	Decline
I	10	•	NA			Decline
J	37	NA	NA	NA	NA	NA
K	40	NA	•			ND

Notes:

NA = not applicable—no plant occurrences; ND = no data available

Shading:

No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained from preserve managers and site visits and compiled by Vollmar Consulting in 2009

Table 4-13
Invasive Plant Species Observed on 11 Small Vernal Pool Preserves in California's Central Valley

Preserve Number	Acres	Species[1]										
		TACA	CESO	BRMA	LELA	AIAL	CAPY	CIVU	SIMA	GLDE	COSE	Total[2]
A	53	H	H			M			L	L		5
B	6	H										1
C	15											NA
D	48		H									1
E	36	H	H					L				3
F	33	M										1
G	8						L					1
H	15	H	H	H			L				L	5
I	10				M							1
J	37	H										1
K	40	M										1
Total Preserves		7	4	1	1	1	2	1	1	1	1	

Notes:

[1] Species: AIAL = tree of heaven (*Ailanthus altissima*); BRMA = Large quaking grass (*Briza maxima*); CAPY = Italian thistle (*Carduus pycnocephalus*); CESO = yellow star-thistle (*Centaurea solstitialis*); CIVU = bull thistle (*Cirsium vulgare*); COSE = pampas grass (*Cortaderia selloana*); GLDE = small mannagrass (*Glyceria declinata*); LELA = perennial pepperweed (*Lepidium latifolium*); SIMA = milk thistle (*Silybum marianum*); TACA = medusahead (*Taeniatherum caput-medusae*).

Abundance: L = Low; M = Moderate; H = High

[2] NA = not applicable, site not surveyed

Shading:

No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.

Source: Data obtained from site visits by Vollmar Consulting in 2008 and 2009

Table 4-14
Ecological Trends of Upland Vegetation Components Since Preserve Establishment at 11 Small Vernal Pool Preserves in California's Central Valley

Preserve	Acres	Overall Upland Conditions	Specific Upland Vegetation Components				Invasive Species Management	Grazing/ Mowing
			Thatch Cover	Native Forb Cover	Native Grass Cover	Invasive Species Cover		
A	53	Improvement	Decrease	Constant	Constant	Constant	•	•
B	6	Same	Constant	Constant	Constant	Constant	•	
C	15	ND	ND	ND	ND	ND	•	•
D	48	Improvement	ND	Constant	Constant	Increase	•	•
E	36	Decline	ND	Decrease	Decrease	Increase	•	
F	33	Same	Increase	Constant	Decrease	Increase	•	
G	8	Decline	ND	Decrease	Decrease	Increase		
H	15	Decline	ND	Decrease	Decrease	Increase	•	
I	10	Decline	Increase	Decrease	Constant	Increase		
J	37	ND	ND	ND	ND	ND	ND	
K	40	ND	ND	ND	ND	ND		

Notes:
ND = No data collected.
Shading:
No Shading (A–C) = recently established preserves, protected by conservation easements, sizable endowments;
Light Gray (D–H) = older preserves, deed restrictions or fee simple ownership, either endowments or other funding sources;
Dark Gray (I–K) = older preserves, deed restrictions or fee simple ownership, no endowment or funding source.
Source: Data obtained from preserve managers and site visits and compiled by Vollmar Consulting in 2009

5.0 DISCUSSION OF KEY FINDINGS AND RECOMMENDATIONS

The eleven preserves included in this study represent a limited set of selected small vernal pool preserves. As emphasized above, both the small sample size and the selection process, which relied on voluntary participation by interested preserve managers, undoubtedly resulted in some bias and thus the preserves included in the study are not considered to be a random nor even fully representative set of small preserves. In fact, managers of poorly performing preserves may have been less likely to participate in the study. However, the selected preserves do present a substantial range of conditions and issues related to small preserves and this study provides key insights and guidance on the establishment and management of small vernal pool preserves based on lessons learned from these 11 existing preserves.

This study identifies numerous key findings and recommendations, as presented below, related to the conditions and issues that occur on small preserves. However, it is important to distinguish between those conditions and issues that are characteristic or distinctive of small preserves versus those that are more broadly characteristic of all preserves regardless of size.

Small preserves certainly share many conditions and issues relevant to all preserves. These include: the importance and value of the preserves in protecting rare and endangered habitats and species; the need to limit potential impacts from human trespassing or overuse; the importance of developing well-prepared management and monitoring plans and providing a sufficient non-wasting endowment or other funding source to ensure management and monitoring tasks are carried through; the value of including public education and outreach as a component of preserve management where appropriate to increase public appreciation and support for the protection of vernal pools and their associated native species; and the importance of having a responsive regulatory process whereby the regulatory agencies identify and notify preserves that are failing to complete management, monitoring and resource protection requirements.

Apart from these more general conditions, this study did identify several conditions and issues that are more characteristic or even distinctive of small vernal pool preserves. While no large preserves were included in this study for comparison, the study authors have extensive experience surveying and assessing large mitigation banks and other preserved lands supporting vernal pools. This experience was used as a general basis for comparing and contrasting conditions found on small versus large preserves. Of course, the 60-acre threshold used to define a ‘small’ preserve for this study is somewhat arbitrary and the differences between small and large preserves discussed below should be regarded as following a gradient as preserve size increases.

With regard to biological characteristics, some of the preserves in the study were established to protect and preserve extremely rare and highly localized plant species (slender Orcutt grass, Sacramento Orcutt grass, Contra Costa goldfields, and pincushion navarretia). The study authors are aware of numerous other small vernal pool preserves in the state that were established to protect such species, especially in highly developed or fragmented areas such as the Santa Rosa plains and San Diego County. Small preserves are important for preserving such species since frequently no other opportunities exist for their protection. This unique value of small preserves is recognized and incorporated into various regional habitat conservation plans (HCPs) and Natural Community Conservation Plans (NCCPs), such as the Solano HCP for Contra Costa goldfields and the south Sacramento County HCP for Orcutt grass species. Regulatory agencies should evaluate the available conservation opportunities for extremely rare and localized vernal pool species and consider the establishment of small preserves as perhaps the best or only means of conserving them.

The size of small preserves presents unique management challenges related to higher levels of human and domestic animal (pet) impacts as compared to larger preserves, especially when situated within heavily developed or fragmented areas. Small preserves have a much higher edge to area ratio, especially for preserves that are more linear in shape, as well as a much shorter distance into the center of the preserve. As a result, as shown in this study, small preserves, especially those in proximity to moderate to high density residential areas, are generally

prone to much higher levels of human and domestic animal impact as compared to large preserves or more remote small preserves.

The size of small preserves also presents unique management challenges related to thatch management and invasive plant control. As discussed extensively below, thatch management through regular grazing or mowing is generally critical for maintaining ecological health within pools and associated upland annual grasslands (Marty 2005, Pollak and Kan 1998; Tu et al. 2001). This is easier to achieve on large preserves where the owner or a lessee will graze the site as part of a separate, economically feasible ranching operation. Where the grazer is a lessee, the preserve owner or manager can even charge a grazing fee as a moderate income stream for the preserve. In contrast, small preserves are too small to entice ranchers to graze the sites for a fee. Instead, a small preserve generally must pay a livestock operator (either a rancher or more specialized grazing contractor) to graze the site. There are also other problems related to grazing on small preserves such as the potential lack of reliable on-site water, and objections from surrounding landowners to having livestock in close proximity to their homes. Because of these constraints, thatch management is often lacking, sporadic or otherwise highly inadequate on small preserves as clearly demonstrated by this study. The outcome is that small preserves are often prone to having declining ecological conditions, even when protected by a conservation easement and provided with a well-developed management plan and sufficient endowment or other funding source.

In combination, these unique management challenges translate into the need for much more intensive management and monitoring efforts and consequently much higher funding requirements on a per acre basis for small preserves as compared to large preserves. Preserve managers and regulatory agencies should take this into consideration when determining the size of endowments for new small preserves.

Small preserves also appear to have unique challenges in terms of regulatory oversight. This study found that there was little to no regulatory oversight of the preserves included in the study. In fact, in one preserve, a federally-listed plant species (Contra Costa goldfields) was reported to the agencies through monitoring reports as becoming extirpated from the preserve. Yet, there was no response or action on the part of the responsible agencies. Small preserves may suffer more neglect from the regulatory agencies since they are easy to overlook and may not have the same level of scrutiny as large mitigation banks. Agencies should be careful to provide oversight of small preserves, especially those that support localized occurrences of extremely rare species.

Small preserves can provide a unique public education and outreach component. In certain cases, small preserves may provide some of the only remaining open space in highly developed areas. Given their proximity to human populations, these preserves have the capacity for providing easily accessible sites for public education and appreciation regarding vernal pools and their conservation. One preserve in the study, located near dense residential development, has a well developed public use and education program that is actively used for local school field trips, illustrating this capacity. Interestingly, this preserve exhibited low levels of human impacts due to carefully facilitated access, a well designed trail system, and interesting, engaging signage. Several other small preserves in the study that were near residential areas but did not allow public access showed high levels of human impact from unplanned trails, vandalism and trash build-up. These comparisons indicate that it may be more cost-effective and beneficial in terms of both site maintenance and public appreciation of vernal pools, for small preserves to facilitate responsible and engaged public use rather than attempting to exclude public access.

Sections 5.1 through 5.8 below provide a more detailed presentation of the key findings, discussion, and recommendations related to small preserve as determined through this study, following the eight assessment categories identified in the Results section. These include:

- general physical and biological characteristics;
- infrastructure, public use and surrounding land use;
- preserve establishment and funding;
- preserve management;
- preserve monitoring;

- ecological conditions and trends;
- education and outreach; and
- regulatory compliance and oversight.

5.1 GENERAL PHYSICAL AND BIOLOGICAL CHARACTERISTICS

5.1.1 KEY FINDINGS

- The 11 preserves in the study had a cumulative area of 301 acres with a total of 50 acres of preserved, created or restored vernal pools.

- Preserves varied in shape from square or oval to linear; preserve shape is an important consideration size more linear preserves have a greater edge to area ratio and thus greater potential edge effects.

- All of the small preserves in the study support special-status species, with federal- or state-listed species documented on all but one of the preserves.

- Four of the special-status plant species documented on the preserves are extremely rare with a very limited number of highly localized occurrences indicating that small preserves may play an important role in protecting such species, especially where they occur within highly developed areas.

5.1.2 DISCUSSION

The 11 preserves included in the study ranged from 6 to 53 acres in total area (Table 4-1) with a cumulative area of 301 acres. The minimum and maximum width and overall preserve shape varied considerably. Minimum width ranged from 30 to 900 feet and maximum width ranged from 375 to 3,900 feet. Preserve shape determines edge to area ratio, which likely contributes to the level of susceptibility from edge effects (Photos 1-3, Appendix D).

The number of vernal pools in each preserve ranged from one to 128, and pool density ranged from 2% to 100%. Preserve C, with 100% wetland density, consisted of a single 15-acre restored vernal pool that was fenced around its upper margin. All of the 11 sites had preserved vernal pools; five of these sites also had created pools. Preserve C was the only site with restored pools (a single large pool). Cumulatively, these preserves support more than 50 acres of preserved, created, and restored vernal pools.

Non-native annual grasslands are the sole or primary upland habitat on most of the preserves (Photos 4-5, Appendix D). Three of the preserves also support blue oak woodland (roughly 8%, 30% and 60% of the total upland area, respectively) (Table 4-1). There are also limited riparian woodlands on preserves with stream corridors.

Data on occurrences of special-status species were available for all preserves (Table 4-2). Special-status species are documented on all of the preserves, with federal- or state-listed species reported on all but Preserve E. Vernal pool fairy shrimp (*Branchinecta lynchi*) is documented on six preserves, and vernal pool tadpole shrimp (*Lepidurus packardi*) is documented on three preserves with co-occurrence on two preserves. California fairy shrimp (*Linderiella occidentalis*) a species tracked by the California Department of Fish and Game (DFG) in the California Natural Diversity Database is documented on three preserves.

Western spadefoot (*Spea hammondii*), a native toad and California species of special concern, is documented on three of the preserves. No other special-status amphibian species, such as California tiger salamander (*Ambystoma californiense*), have been documented at any of the preserves.

Federally listed or state-listed plant species are documented at five of the preserves. Two preserves support Sacramento Orcutt grass (*Orcuttia viscida*), two support slender Orcutt grass (*O. tenuis*), one supports Boggs

Lake hedge-hyssop (*Gratiola heterosepala*), and one supports Contra Costa goldfields. All of these species occur individually at different preserves except slender Orcutt grass and Boggs Lake hedge-hyssop, both of which are present in Preserve A. All of the preserves that support listed plants also support other special-status plants (CNPS List 1B or 2 species). Two additional preserves (D and K) support special-status plants but no listed plants.

Interestingly, only one preserve (A) supports both listed large branchiopods and listed plant species. Five preserves support both special-status wildlife and plant species (including both listed and non-listed special-status species).

Ten preserves were established as mitigation to preserve or create vernal pools. However, several were also established to preserve occurrences of special-status species. Four of the preserves were established to conserve populations of listed or other special-status plant species as a priority component. These species included Sacramento Orcutt grass (two sites), pincushion navarretia (*Navarretia myersii* ssp. *myersii*), Contra Costa goldfields, Boggs Lake hedge-hyssop, and legenere (*Legenere limosa*). Of these, the first four are extremely rare species within only a limited number of highly localized occurrences. The status and trends of these populations are addressed in Section 5.2, "Ecological Conditions and Trends."

5.1.3 RECOMMENDATIONS

- Regulatory agencies should consider the potential value of small preserves in preserving occurrences of extremely rare and highly localized special-status species, especially when such species are restricted to areas subject to high development pressure and habitat fragmentation.

5.2 INFRASTRUCTURE, PUBLIC USE AND SURROUNDING LAND USE

5.2.1 KEY FINDINGS

- Only two of 10 preserves near populated areas had sufficient fencing to prevent trespass or otherwise control public access.
- Preserves with inadequate fencing or control/facilitation of public access generally had significant to extensive disturbance or damage due to unplanned trails, domestic animal (pet) use, and trash accumulation, especially those near areas with heavy residential development.
- The predominant surrounding land use type was residential development.
- Preserves adjacent to residential development were more likely to sustain high public use and associated disturbances, as well as less obvious disturbances, including altered hydrology due to run-off from adjacent yards and the spread of invasive plants from adjacent landscaping.
- The preserve with a well-developed public use program that included established trails, attractive signage, and trash containers that facilitated and directed public use and resource concern had low levels of trash, vandalism, and habitat disturbance.

5.2.2 DISCUSSION

INFRASTRUCTURE

All preserves were at least partially fenced by post-and-cable, chain-link, or barbed-wire fences. Although most fences were in good condition, only two of the 10 sites near populated areas were sufficiently fenced to effectively deter trespassing or otherwise control access (Table 4-3). The remaining site was not near a populated area, had no recreational use, and thus did not require secure fencing. Preserve fences adjacent to residential

development frequently suffered vandalism in the form of cutting or bending of fences to allow public access (Photos 6-7, Appendix D). Trespassing did not appear to have taken place frequently in preserves with high, intact fencing and cattle grazing; however, even high-quality intact fencing did not appear to dissuade domestic animals (pets) from intruding on the sites. Trails were dug under the fences by pets from adjacent backyards, and many sites had extensive trail networks leading from these openings. These trails often extended throughout the preserves.

At least nine of the sites had some form of signage, ranging from simple "no trespassing" or "preserve" signs to extensive informational signage describing the biological resources on the site. Only one site had comprehensive signage intended for public education. These signs included descriptions and photographs of the vernal pools on-site. This preserve also included extensive signage regarding appropriate animal control and designated sensitive areas. This site was open to the public, with minimal fencing, and appeared to have relatively little trash and human disturbance even though it was adjacent to heavy residential development.

Established trail systems existed on two of the preserves intended for public access. Three other sites had fairly well-established trails created by public trespassing. These unauthorized trails often cut through sensitive habitats, and in one site presented extensive threats to vernal pool hydrology and vegetation. Poorly planned trail systems can disturb the hydrologic functionality of the site, either by berming pools and increasing inundation periods or by cutting through the edge of pools and facilitating premature drainage.

Public Use (Authorized and Unauthorized)

Authorized public access is only allowed on three of the preserves, with access to two of these sites unrestricted and apparently frequent and access to the third site infrequent and by permission only (Table 4-3). Of the remaining sites, four had signs of unauthorized trespass and recreational use (trails, motorized-vehicle tracks, and trash). Sites directly adjacent to dense residential development appeared to be used especially heavily (both authorized and unauthorized access), with the exception of a well-fenced site near a large public park. Sites near residential areas appeared to be used mainly for recreational activities, such as dog-walking and biking, and to be treated to some degree as neighborhood parks. Only four sites appeared to have few to no signs of recreational public use. These sites were either well-fenced or not near populated areas.

All preserves showed some degree of human disturbance of habitat, especially sites near residential areas where trespass occurred frequently (Photos 8-9, Appendix D). The site with established trails, signage, and trash containers that facilitated and directed public use had low levels of trash, vandalism, and habitat disturbance. Sites with the highest levels of disturbance were those that were located in residential areas with inadequate fencing to prevent access but no facilitated public access. These sites had consistently vandalized fencing, which may suggest local desire for open space or parks. The most damaging types of disturbance included the creation of trail systems through pools and swales. This disturbance was mitigated on sites with authorized and facilitated public access by establishing well-marked trail systems away from sensitive resources.

The assessment of damage from public use was based on an evaluation of existing site conditions as observed during site visits. The level of observed damage did not appear to be correlated with age of the preserve (reflecting cumulative impacts). Correlations between level of damage and level of management and/or monitoring are addressed in Sections 5.4 and 5.5 below.

Surrounding Land Uses

Six different land use types were identified surrounding the preserves (within 1,000 feet) (Table 4-4). The predominant type was residential development, which averaged 38% of the acreage of land uses surrounding the preserves (Photos 10, Appendix D). Nine preserves were adjacent to residential development (many of the preserves were established as on-site mitigation for these developments). These preserves were more likely to sustain high public use and associated disturbances, as discussed above. Adjacent residential development also

facilitated less obvious disturbances, including altered hydrologic systems and the spread of invasive plants from landscaping. The four preserves surrounded by public parks also suffered from similar sorts of disturbances.

The second most predominant land use was native or naturalized habitats (e.g., grasslands, open space preserves, and riparian and creek systems), which averaged 30% of the acreage of land uses surrounding preserves. Often the preserves formed transitional areas between these large expanses of habitat and residential or commercial developments, because they were established as on-site preserves to mitigate the effects of the developments on habitat. Some of these areas were preserved open space, but many were not. Future development of these areas could further isolate these preserves from natural habitats. These open spaces connect many of the preserves to additional wildlife habitat and more intact hydrologic systems. One site is surrounded by residential development on two sides and a an open grassland that is being developed on the other two sides.

The remaining surrounding land uses included intensive agriculture (annual or perennial croplands) and commercial and industrial development (along with parks and disturbed fields, which occupied smaller amounts of acreage). Many of these preserves provide the last remaining vernal pool habitat in these areas. For example, Preserve K is 40 acres of remnant vernal pool habitat surrounded by agriculture in an area that was historically covered in extensive pools and swales. Preserve I is surrounded on three sides by commercial/industrial development and was preserved as some of the last local habitat for a very rare, listed vernal pool plant species (Photo 11, Appendix D).

Nine of the eleven preserves border a paved road (Photo 12, Appendix D). The proximity of such a road increases the ability of humans and invasive species to access the site and can decrease the site's suitability and accessibility for wildlife species. The two sites not adjacent to a paved road (but that were also remote from residential areas) showed little sign of trespassing, public use, or infrastructure vandalism.

5.2.3 RECOMMENDATIONS

- Small preserves should be provided with adequate fencing to prevent or significantly deter public access if the management goal is to exclude public access.
- Where this is not feasible or where public access is desired, preserves should be provided with appropriate fencing to control or direct access, planned trails, signage describing site resources and the importance of their protection, trash containers and other infrastructure that will promote responsible public use.
- Facilitated public use should especially be considered for preserves near dense residential development where trespass is often the most common and damaging if not controlled or directed.

5.3 PRESERVE ESTABLISHMENT AND FUNDING

5.3.1 KEY FINDINGS

- Protection of vernal pools as well as specific special-status species drove the establishment of the preserves with nine established for on-site mitigation, one for off-site mitigation and one for simple conservation.
- The preserve owners include a variety of entities including state and local government agencies (5 sites), non-profit land trusts (3 sites), and the developers responsible for site establishment (3 sites).
- For all sites except one, the owner is also the preserve manager, which is rarely the case for mitigation banks; this points to a potential vulnerability since there is no third-party oversight; the study did not, however, include enough preserves where land owners and managers differ so a comparison of the two situations cannot be made.

- Six of the preserves have endowments, four of which are considered large enough to be 'non-wasting'; two are funded through municipal sources that appear sufficient; three have no funding sources.

- Older preserves tend to be protected through deed restrictions or fee simple ownership and have insufficient funding; more recent preserves tend to be protected through permanent conservation easement and have sufficient, 'non-wasting' endowments; these conditions reflect improving regulatory guidelines and oversight related to preserve establishment and funding.

5.3.2 DISCUSSION

The preserves in the study were established between 1964 and 2007 (Table 4-5). The oldest preserve was a donation to a conservation group for conservation purposes and was established before mitigation requirements for wetlands or special-status species were developed. All the other small preserves were established to provide mitigation for development projects. Of the 10 preserves established as mitigation, nine were on-site preserves and one was an off-site preserve.

Vernal pools were a key resource driving establishment of all the preserves, but the presence of special-status species was also a key to establishment of many preserves. Five of the preserves protect occurrences of listed or very rare plant species, including Sacramento Orcutt grass, slender Orcutt grass, Contra Costa goldfields, and pincushion navarretia (Table 4-2 and Table 4-12).

The preserve owners include state and local government agencies (5 sites), non-profit land trusts (3 sites), and the developers responsible for site establishment (3 sites) (Table 4-5). For all sites except Preserve C, the owner is also the preserve manager and is responsible for the endowment or other funding source, which is rarely the case for mitigation banks. All of the sites owned and managed by state or local agencies are protected through a deed restriction or fee simple ownership rather than a conservation easement. The two preserves owned and managed by land trusts that were established as mitigation are protected through conservation easements. These preserves were both transferred to land trusts by the developers after establishment. The donated site owned and managed by a land trust (Preserve K) is owned fee simple. Of the two sites owned and managed by developers, both are under deed restrictions. The remaining site (owned by a developer, managed by a land trust) is protected by a conservation easement.

A variety of funding sources may be used to pay for the management and maintenance of habitat preserves. Possible sources of funding include: endowments; taxes, special assessments, and similar funds; and, donations. The majority of preserves examined in this study (6 of 11) relied on endowments for funding. Municipal funding sources were used to pay for maintenance and management at two preserves, and three of the study preserves had no source of funding. Endowment amounts were variable and ranged from $3,750 and $900,000.

Based on experiences of project team members managing similar vernal pool preserves, four of the six endowment-funded preserves are considered to have sufficiently large endowments to minimize erosion of the endowment principal (i.e., to use endowment interest earnings, rather than endowment principal, to pay for annual management and maintenance expenses in most years). Two endowment-funded preserves had very small endowments that would only be sufficient to pay for a minimal level of preserve oversight or that would be expected to be exhausted over time. Capitalization rates (i.e., the assumed annual rate of endowment return less inflation) for endowments associated with preserves in this study ranged from 3% to 6%, with higher rates typically associated with older preserves. Again, based on past experiences and observations of the project team, endowment capitalization rates generally exceeding 5% are uncommon and reflect a belief that either long-term inflation rates will be very low (e.g., approximately 3% annually or less) or that long-term annual endowment returns will, on average, exceed 8% or 9% of the endowment principal.

It is noteworthy that all of the preserves with conservation easements also have sufficient non-wasting endowments and are owned and/or managed by a third-party land trust. In addition, these preserves were all

established in the past few years. This reflects the evolving requirements of the regulatory agencies for preserve establishment and funding. While older preserves may have been protected through deed restrictions or fee simple ownership and provided with a minimal, often insufficient endowment, current standards generally require that preserves are protected through permanent conservation easements and are provided sufficient, non-wasting endowments or other sufficient sources of funding.

5.3.3 RECOMMENDATIONS

- As discussed in the next sections, preserves that lacked endowments or other funding sources were not managed or monitored; future small preserves should be protected through conservation easements and provided with non-wasting endowments or other sufficient funding sources to ensure permanent protection and adequate long-term management.

- Endowment amounts should be determined considering the particular management challenges and higher per acre management costs associated with small versus large preserves related to higher levels of human trespass and impacts, thatch management, and invasive plant control (see discussions in Section 5.4 below).

- Conservation easements and endowments should be held by entities approved by the regulatory agencies to ensure appropriate oversight.

- Regulatory agencies should provide clear oversight on mitigation preserves where the land owner also serves as the preserve manager and/or endowment holder to ensure some level of third-party review.

5.4 PRESERVE MANAGEMENT

5.4.1 KEY FINDINGS

- Nine of the 11 preserves have existing management plans prepared by consultants (Table 4-6); none of the plans have been updated nor are there provisions for having them updated even though some are more than 10 years old; management plans for five of the preserves were obtained and reviewed for this study and found to be adequate to robust.

- On-going management activities are being conducted on eight of the 11 preserves; the six preserves with a dedicated endowment reported moderate to robust management activities (Table 4-7); the two preserves using 'public funds' as the funding source reported minimal management activities; the three remaining preserves lacked endowments or other funding sources and reported no active management.

- Reported management activities included general site maintenance (infrastructure maintenance, trash removal, etc.), thatch management through grazing, invasive plant control, and habitat restoration.

- Thatch removal, through grazing or mowing, is a critical element for maintaining the ecological health of vernal pools and non-native grasslands and can also help control the infestation and spread of invasive plants (Marty 2005, Pollak and Kan 1998; Tu et al. 2001); yet, thatch removal takes place on only three sites, through grazing (1 site) or a combination of grazing and mowing (2 sites).

- Significant infestations of invasive plants were observed in eight of the preserves; efforts to control invasive plants were reported from six of these preserves and were generally conducted on a sporadic basis; there were no reported efforts to permanently remove or seriously reduce invasive plants from any of the sites.

- Minimal habitat restoration is being conducted on the preserves with only three preserves reporting any restoration activities.

5.4.2 DISCUSSION

Preserve management involves developing a management plan at the time of preserve establishment, updating the management plan periodically to address changing site conditions, and conducting the actual management activities prescribed by the management plan (Table 4-6 and 4-7). These management activities are separate from monitoring activities, which involve site inspections, assessments, and surveys used to inform the management activities. Monitoring is addressed in the next section.

DEVELOPMENT AND UPDATE OF MANAGEMENT PLANS

Nine of the 11 preserves have existing management plans. Preserve K is a donated easement established for conservation with no endowment and no management plan. Preserve J also does not have a management plan. This site had a 5-year monitoring requirement for created vernal pools with no on-going management requirement once the pools met success criteria. It is unclear why no long-term management plan was prepared for this site.

All management plans were prepared by consultants. These plans were prepared between 1999 and 2007 though several were prepared many years after the preserve was established (no information was provided to explain the delay). According to the preserve managers, none of the plans have specific requirements for updating, nor have they been updated even though some are more than 10 years old. Three of the nine plans were developed following guidelines from the DFG or USACE.

The management plans for Preserves A, B, G, H and I were obtained and reviewed for this study. In general, these plans were found to be adequate to robust, providing sufficient guidance and detail for long-term site management, maintenance, and monitoring. These plans included most or all of the following components:

- descriptions of the physical, cultural, and biological components of the preserve;
- management goals and tasks;
- provisions for monitoring and adaptive management;
- summaries of required operations and maintenance;
- descriptions of recreation, education, and habitat restoration targets;
- lists of preserve personnel;
- agency notification requirements;
- lists of prohibited activities within the preserve;
- requirements for preserve inspections and reporting; and
- ownership and funding mechanisms.

MANAGEMENT ACTIVITIES

The reported types and frequency of management activities conducted on the preserves are summarized in Table 4-7. Management activities are conducted by a range of individuals that includes staff from the agencies or land trusts responsible for managing the preserves, as well as hired consultants.

As shown, some level of management was reported from eight of the 11 preserves. Not surprisingly, all of these preserves have both a management plan and a dedicated funding source. Three of the preserves have no management. Two of these (Preserves J and K) lack both management plans and funding sources. The third, Preserve I, has a management plan but no dedicated funding source and is owned and managed by the developer that established the preserve as on-site mitigation. Upland portions of the preserve are disked annually for fire management, but this constitutes more of a disturbance than a beneficial management activity. The specific management activities conducted on the eight preserves that are managed are discussed below.

General Site Maintenance

All of the eight managed preserves reported general maintenance activities on an as-needed to regular basis. These activities included fence and sign maintenance, trash and debris removal, some trespassing patrol (four sites) and some feral animal control (three sites).

Thatch Management

Thatch removal, through grazing or mowing, is a critical element for maintaining the ecological health of vernal pools and non-native grasslands (Photo 2, Appendix D). Grazing and mowing reduce accumulated non-native grass thatch and also help maintain ponding duration in pools (Marty 2005). Grazing and mowing can also help control the infestation and spread of invasive plants (Pollak and Kan 1998; Tu et al. 2001).

Despite these benefits, thatch removal takes place on only three sites (through grazing) (Preserves A, C and D) (Table 4-14). Goats graze on one of these sites for approximately three months per year, and cow-calf pairs graze on the other two sites for approximately six months per year. The grazing rights are leased to local ranchers. Both preserves where cattle graze use monitoring data to help guide grazing intensity. The site with goat grazing reported that data were not used to determine grazing intensity. Mowing was reported from two of the preserves where grazing takes place; these sites were mowed either annually or infrequently.

Grazing operators often pay a small sum to lease the grazing rights from the preserve owner. Often an agreement will be drafted between the preserve and lessee outlining acceptable grazing practices, standards, and expectations. This agreement can also designate responsibility for infrastructure maintenance and associated grazing management activities to either party. No information was available for this study on agreements between preserve owners and lessees.

Invasive Plant Control

Invasive plant species can threaten the quality of habitat in the preserves. Significant infestations of invasive plants were observed in eight of the preserves (Table 4-8 and Table 4-13). The most common invasive species were medusahead (*Taeniatherum caput-medusae*) and yellow star-thistle (*Centaurea solstitialis*), common grassland invasive plants often established on sites with poor or inconsistent grazing or past disturbance (Photo 4, Appendix D).

Other invasive plant species noted in the information provided by preserve managers included: Himalayan blackberry (*Rubus discolor*), prickly lettuce (*Lactuca serriola*), Italian thistle (*Carduus pycnocephalus*), bull thistle (*Cirsium vulgare*), tamarisk (*Tamarix* sp.), goatgrass (*Aegilops* sp.), Chinese tallow tree (*Sapium sebiferum*), Callery pear (*Pyrus calleryana*), tree of heaven (*Ailanthus altissima*) and Catalpa tree (*Catalpa* sp). Occurrences of these species were generally sporadic or isolated, often in association with some type of disturbance, such as a road edge or graded area.

Efforts to control invasive plants were reported from seven preserves. Most of these preserves reported that invasive plant management takes place sporadically. One site reported that control measures are implemented quarterly; however, no invasive species are yet reported from this site. There did not appear to be any intensive, focused efforts to remove or seriously reduce invasive plants from any of the sites.

Methods for control that were being utilized included grazing, mowing, hand removal, prescribed burning and herbicide treatments. Goat grazing and mowing were reported from one site for removal of yellow star-thistle and medusahead. Mowing was reported from a second site as the main treatment for prickly lettuce. Hand removal of Italian thistle, bull thistle, and yellow star-thistle was reported from one site. Prescribed burning has been conducted at one site to target populations of yellow star-thistle.

Herbicide use was reported from two sites with glyphosate (Roundup or Rodeo) used in both cases. At one site, cut-stump application was used on Himalayan blackberry and tamarisk and spray application was used on yellow star-thistle, which was also manually removed. Herbicides were used at the second site on tree of heaven. Cut-stump application is planned at a third site for Chinese tallow tree, callery pear, and catalpa tree.

Habitat Restoration

Only three sites reported habitat restoration as a management activity. All three sites reported that habitat restored activities are conducted annually. One site reported rebuilding vernal pool edges by hand after they were damaged by unauthorized motorcycle trails. The other activities were not specified in the information provided by the preserve managers.

5.4.3 RECOMMENDATIONS

- Preserves should be established with a dedicated and sufficient funding source to ensure on-going site management; use of 'public funds' not specifically dedicated to the management of a specific preserve or set of preserves should be avoided since these funds may become unavailable or redirected, especially during economic downturns.

- Management plans should be carefully prepared by qualified individuals since they provide the central guidance for on-going site management and maintenance; also, management plans should include a provision for periodic review and update (every five to ten years).

- The most important components of preserve management to ensure long-term site maintenance and ecological health include thatch management, invasive plant control, prevention or minimization of destructive public use, and regular removal of trash and other debris; management plans for small preserves should specifically address these issues and endowments should be sufficient to support these activities in the context of the specific small preserve being managed.

- Some form of thatch management (grazing, mowing and/or burning) should be conducted annually and consistently on all small preserves to control thatch and reduce competition from non-native annual grasses within both the vernal pools and the adjacent uplands (the only exception may be preserves with thin or infertile soils not conducive to dense grass growth or thatch build-up); this is perhaps the single most important management activity yet, as indicated by this study, it is rarely achieved on small preserves; it is acknowledged that consistent grazing is difficult to achieve on small preserves due to the difficulty and high cost of bringing cattle into such small sites that are often bordered by residential areas and have high public use; use of goats, sheep or mowing should be considered as viable alternatives; burning is generally not an option since most small preserve are in close proximity to residential areas.

- Management plans should include clear provisions for invasive plant control and preserves should be sufficiently endowed to provide for the level of effort required to control invasive plants; invasive plant infestations, especially on sites that lack grazing or other thatch management, can significantly compromise ecological health within small preserves; small preserves may be more susceptible to invasive plant infestations due to the large edge to area ratio and frequent proximity to adjacent weedy areas that can serve as a source of infestation; eradication or even control of invasive plants within annual grasslands is difficult to achieve and generally requires a consistent, focused multi-year effort; as indicated by this study, this is rarely achieved on small preserves and more effort should be directed towards this effort.

- Public use should be controlled or facilitated as described in Section 5.2 above and Section 5.7 below.

- Management activities should include regular patrols (annually or more frequent) to remove trash and other debris and repair damage to site infrastructure or habitats from destructive public use.

5.5 PRESERVE MONITORING

5.5.1 KEY FINDINGS

- Nine of the 11 preserves have existing monitoring plans (included as part of the management plan); none of the plans have been updated nor are there provisions for having them updated even though some are more than 10 years old.

- Some level of monitoring was reported from eight of the 11 preserves (Table 4-8); the six preserves with dedicated endowments reported moderate to robust monitoring; the two preserves using 'public funds' as the funding source reported minimal (inadequate) monitoring activities; the three remaining preserves lacked endowments or other funding sources and reported no active monitoring.

- The most common types of monitoring being conducted include general site inspections (condition of infrastructure, trash/debris levels, evidence of vandalism, etc.), general wildlife and vegetation surveys, vernal pool vegetation, listed shrimp, and rare plant surveys, and invasive species surveys (Table 4-8); thatch monitoring was also commonly conducted through photopoint monitoring, RDM sampling or general vegetation or upland plant surveys.

- The types of monitoring being conducted on the six preserves with moderate to robust monitoring generally targeted the key management parameters for small vernal pool preserves including thatch level, invasive species, general site condition (trash, public use), and status of special-status species.

- Five of nine preserves indicated that monitoring results are 'frequently' used to inform management activities.

5.5.2 DISCUSSION

Preserve monitoring involves conducting site inspections, assessments, and surveys to evaluate the effectiveness of management efforts, status of sensitive resources, and overall functionality of the preserve. Nine of the 11 preserves have monitoring plans, included as part of the management plan. Preserve K is a donated easement established for conservation with no endowment and no management or monitoring plan. Preserve J also does not have a management plan. Monitoring of created vernal pools was conducted for five years following establishment but there is no on-going monitoring.

Some level of monitoring was reported from eight of the 11 preserves (Table 4-8); the six preserves with dedicated endowments reported moderate to robust monitoring; the two preserves using 'public funds' as the funding source reported minimal monitoring activities; the three remaining preserves lacked endowments or other funding sources and reported no active monitoring. The annual cost of monitoring at these preserves was reported to range from $1,900 to $6,700.

The most common types of monitoring being conducted at the preserves, as reported by the managers, are general site inspections (e.g., checks of fencing, trash/debris levels, vandalism) and general wildlife and vegetation surveys. Other monitoring is being conducted at several of the preserves for vernal pool vegetation; surveys for special-status plants, large branchiopods, and amphibians and thatch and invasive-plant assessments are also being conducted. The types and frequency of monitoring activities conducted on the preserves, as reported by managers, are summarized in Table 4-9.

Monitoring results are often compiled into annual or quarterly reports intended to inform managers, regulators, and site owners of any need to adapt current management activities to changing site conditions. Five of nine preserves responded that monitoring results are "frequently" used to inform management activities. The other four that answered the question reported that they are not used. As described above, ecological conditions were reported as declining at several of the preserves despite on-going management and monitoring activities.

Three of the preserves have no reported monitoring activities. Two of these (Preserves J and K) lack both management plans and funding sources. The third, Preserve I, has a management plan but no dedicated funding source. Preserves I and J have created vernal pools. Monitoring of the created pools was conducted for 5 years after pool creation but was discontinued after pool success criteria were met. The specific monitoring activities being conducted on the eight preserves with monitoring are discussed below.

DEVELOPMENT AND UPDATE OF MONITORING PLANS

Nine of the 11 preserves have existing management plans, each of which includes a monitoring component. The monitoring components include the required or recommended frequency and methods of monitoring activities. Many of the plans also identify remediation thresholds or monitoring results that mandate management actions. These thresholds often apply to listed or sensitive species populations targeted in preserve establishment, which are often the focus of monitoring activities. If population sizes drop below a designated critical number, the plan specifies that management actions must be taken.

All of the existing plans were prepared by consultants. According to the preserve managers, none have specific provisions for updating, nor have any been updated since originally prepared. Three of the plans were developed following guidelines from DFG or USACE.

MONITORING ACTIVITIES

Monitoring is being conducted by a variety of entities—consultants, government agency staff members, and land trust staff members. No information was provided on the qualifications of monitors.

General Site Inspections

Six of the eight monitored preserves reported conducting general site inspections annually or more frequently. General site inspections are conducted by walking the site and visually inspecting the condition of preserve infrastructure, levels of trash accumulation, and looking for indications of trespassing or vandalism, fire hazards, unauthorized use by motor vehicles, or any other signs of disturbance. In contrast to other monitoring activities, the site inspections do not have to be conducted by a specialist (e.g., biologist, range manager, or hydrologist), and inspections are less expensive than biological surveys or hydrological studies. For that reason, this monitoring activity is the one most commonly implemented at preserves.

Thatch Assessments

Thatch assessments can be made by conducting a visual inspection, establishing photopoints, or measuring RDM at specific sampling points. The assessments are generally conducted by a biologist or rangeland specialist in late summer.

Photopoints and RDM monitoring were reported from three of the preserves, two of which are actively grazed (Preserves A and C) (see Table 4-7). Preserve A is also mowed. The remaining site where grazing and mowing take place (Preserve D) is not assessed for thatch levels through photopoints or RDM monitoring but is subject to ‘general vegetation’ monitoring as are two other sites.

If thatch monitoring is not conducted, as is the case for at least six of the 11 sites, the preserve manager may be less able to gauge the risk of fire hazard, threats posed to native plants by thatch accumulation or assess the appropriateness of current grazing.

Invasive Plant Species Monitoring

Seven sites reported monitoring for invasive plant species, anywhere from infrequently to quarterly. Invasive plants were reported as observed on an additional three sites that are not currently monitored. Monitoring

activities include assessing the current extent of known infestations, evaluating the effectiveness of invasive-plant treatments on managed populations, and checking for new infestations.

Many invasive plants, such as medusahead and goatgrass, can become quickly naturalized and complete eradication is generally considered impractical. Often, monitoring for these species is designed to assess their general extent and density to ensure that populations are maintained at a reasonable level. Other species, such as many escaped ornamentals (e.g., Catalpa tree or Callery pear), can be targeted for complete eradication, and presence/absence may be implemented to ensure these species do not become reestablished after removal.

Without regular monitoring, the establishment and spread of invasives may remain undetected and pose a much greater ecological threat than a quickly detected new occurrence.

Wildlife Monitoring

Five sites reported monitoring for wildlife (Photo 13, Appendix D). These surveys are conducted annually to quarterly and consist of simply noting the presence of bird, mammal, and other easily detectable wildlife species on-site. These general surveys are conducted by biologists and do not require permitting by any regulatory agency.

Five preserves reported more specialized wildlife surveys, including annual or biannual listed large branchiopod monitoring. The two preserves with listed large branchiopods that are not monitored have no endowments and were established before the listing of the species present on the site. These surveys require authorization from USFWS, must follow USFWS survey protocols, and can only be conducted by a permitted biologist. These surveys can be more costly than more general surveys because they require the employment or contracting of a USFWS-permitted biologist.

The only special-status amphibian species reported from the preserves is western spadefoot, which has been documented at three preserves (Preserves A, H, and K) (Table 4-2). Surveys for western spadefoot and other vernal pool amphibians are conducted at two preserves (A and B). Preserve K is not monitored because of a lack of funding or monitoring plan. It is unclear why Preserve H is not monitored for amphibians.

Vegetation and Special-status Plant Monitoring

General vegetation surveys are conducted at five preserves. These surveys, consisting of general inspections of species composition and cover, are conducted annually to quarterly.

Five of the preserves (Preserves A, C, G, H, and I) support listed species (Table 4-2). All five of these preserves, plus two additional preserves (Preserves D and K), support non-listed special-status plants as well. Special-status plant monitoring is conducted at four of the preserves, with Preserves A, G and H reporting listed plants and Preserve B reporting no special-status plants. No surveys are conducted at Preserve I, which has a monitoring plan but no endowment. Surveys are conducted either as needed or annually by a botanist or personnel trained to identify target species.

Monitoring prescriptions for special-status plants, as described in two of the management plans reviewed for this study, include establishing photopoints, mapping the presence and extent of target species, estimating population size, identifying and eradicating threats from invasive plant species, noting changes or impacts on vernal pool habitats, and monitoring climate conditions that relate to populations, such as rainfall data. If an identified threshold value is reached, prescribed management actions include determining the cause of population decline and acting accordingly to address the issue (e.g., by removing invasive plant species observed in the pools).

Hydrology Monitoring

Hydrology monitoring is conducted at seven of the preserves, either infrequently or annually. The monitoring involves measuring the depth and duration of ponding in vernal pools and is typically conducted in conjunction with other surveys. This level of hydrologic monitoring can be conducted by trained personnel and does not require a hydrologist. More substantial hydrology studies have been conducted at two preserves and involve assessing the impacts of surrounding residential and recreation development and runoff on pool hydrology. These studies were conducted by hydrologists and are not repeated annually.

APPLICATION OF MONITORING TO MANAGEMENT

Preserve managers reported that monitoring results were frequently used to improve preserve management at six of the preserves. Monitoring is designed to assess the status of the preserve's general site and biological conditions. If monitoring indicates that the preserve is functioning adequately to support targeted species and habitats, management adjustments are not required. However, if monitoring indicates a declining status of targeted resources, management adjustments are required.

5.5.3 RECOMMENDATIONS

- All small preserves should have a well-conceived monitoring plan that include straightforward, easy-to-implement monitoring activities that focus on key elements important for small pool preserve management especially thatch management, invasive plant management, status of public use and general site condition, and status of the sensitive resources on the preserve; monitoring plans should be periodically reviewed and updated (every five to ten years).

- Several key monitoring activities should be conducted annually on all small preserves: general site inspections to assess levels of disturbance by humans and domestic animals and accumulation of trash and other debris; thatch assessments (through residual dry matter sampling or visual assessments) to ensure that thatch levels are being appropriately managed; invasive plant monitoring; and photopoint monitoring of key features or resources; this combination of activities is inexpensive and easy to implement (the activities can be completed together in a single day in the late spring or summer) and will provide site managers with key information on the site's ecological conditions and management requirements.

- Additional monitoring should be conducted periodically (every three to five years) for composition and cover of vernal pool and upland plant species, presence and abundance of special-status species, and other conditions relevant to management of the preserve.

- Preserve managers and management plans should ensure there is a strong link that uses monitoring results to inform and improve site management through an adaptive management process.

5.6 ECOLOGICAL CONDITIONS AND TRENDS

5.6.1 KEY FINDINGS

- No preserves were reported to have an overall improvement in ecological conditions since establishment; of the eight preserves that are actively managed and monitored, conditions were reported to be declining at five, stable at two and unknown at one; the three remaining sites likely have declining conditions due to a lack of management.

- The most common causes of reported declines in ecological conditions on the preserves appear to be no or inadequate thatch management and/or invasive plant control. Other apparent causes of decline include

disturbance from excessive, often unauthorized human and domestic animal (pet) use and lack of general site maintenance resulting in accumulation of trash and debris and other cumulative impacts.

- Managers generally reported declines or no change (but no improvement) for various individual parameters within preserved vernal pools and upland annual grasslands as summarized in the following five bullet points.

    - Of seven sites providing data, three reported a decrease in ponding duration and native plant cover and an increase in non-native grass/invasive plant cover since preserve establishment; one additional site also reported an increase in non-native grass and invasive plant cover through no decrease in ponding duration or native plant cover; the remaining sites reported no change or no data available.

    - Of five sites providing data, none reported a change in large branchiopods or special-status amphibian occurrence (presence) since preserve establishment.

    - Of six sites providing data, two reported a decrease in the abundance of special-status plants, one reported the apparent extirpation of a listed plant (Contra Costa goldfields) from the preserve, and two reported no change since preserve establishment.

    - Of the ten sites visited for the study, six were estimated to have high mean thatch levels (+2,500 lbs/acre) and four were observed to have moderate mean thatch levels (1,500–2,500 lbs/acre). The sites with moderate thatch levels were either grazed or had thin or infertile soils.

    - Of the seven sites providing data, four reported an increase in cover and three reported no change in cover of upland invasive plants since preserve establishment.

5.6.2 DISCUSSION

'Ecological conditions' refers to a broad set of habitat parameters within a preserve reflecting its overall ecological status and health. These parameters may include general site conditions in terms of accumulated trash and level of human or domestic animal impacts, general condition of site vegetation including thatch level, presence and abundance of native wildlife and plant species, status of rare wildlife or plant species, and presence and abundance of invasive weeds.

Tables 4-9 through 4-14 present information on ecological conditions and trends within the 11 preserves included in the study as reported by preserve managers. In general, these assessments should be regarded as fairly qualitative and potentially subjective in nature, based on a combination of manager review of monitoring data and general knowledge and experience of the preserve through on-going management and monitoring activities. Information was provided on overall ecological conditions and trends as well as more specific conditions and trends within vernal pools and upland vegetation, respectively, as presented below.

GENERAL SITE CONDITIONS

No preserves were reported to have overall improvement in ecological conditions since establishment (**Table 4-9**). The eight preserves that are actively managed and monitored reported declining (5 sites), stable (2 sites), or unknown change (1 site) in overall conditions. These trends (especially declining trends) are occurring in spite of the fact that six of these preserves report that monitoring results are 'frequently' or 'always' used to inform and improve site management. Preserves that are not managed or monitored are difficult to assess, although field visits indicated that these sites are subject to a variety of disturbances and neglect and are likely declining. The most common causes of reported declines in ecological conditions appear to be no or inadequate thatch management and/or invasive plant control as discussed further below. Other apparent causes of decline include disturbance from excessive, often unauthorized human and domestic animal (pet) use and lack of general site maintenance resulting in accumulation of trash and debris, and other cumulative impacts.

VERNAL POOL CONDITIONS

Preserve managers provided information on conditions and trends of various parameters related to vernal pools including hydrology, vegetation, and special-status species.

Hydrology

Fifteen of the 58 pools surveyed during the site visits for this study showed signs of decreased or increased hydrology from 'natural' conditions. These pools were present at 10 of the 11 sites visited. Signs of decreased inundation periods included a high cover (greater than 50%) of non-native annual grasses in pools and disturbed pool topography, including damage to edges or trail systems through pools. Signs of increased inundation periods included indications of runoff from adjacent areas into preserve pools and blocking of site drainage or pool berming caused by road or field edges.

Marty (2005) has shown that lack of grazing or other thatch removal from pools and pool margins allows non-native grasses to intrude into the pools and results in a significant reduction in ponding duration through increased evapotranspiration or other means. Of the seven sites with available data, three reported a decrease in ponding duration and four reported no change within preserved pools (Table 4-10). Three of these sites also had created pools, all of which reported no change in ponding duration. Grazing and mowing is not conducted at any of the sites with a decrease in ponding duration (Tables 4-7 and 4-10), but is conducted at two of the sites with stable ponding duration. The decrease in ponding duration at the three sites is likely due to a lack of thatch management and an increase in the cover of non-native annual grasses in pools. A 'high' cover of non-native grasses within vernal pools was reported or observed at six of the 10 sites with available data (Table 4-11), also indicating a general lack of adequate thatch management among the preserves. Only one of these sites (Preserve D) is grazed.

Vegetation

All of the preserves that reported a decrease in ponding duration also reported a decrease in native plants and an increase in non-native grass and invasive plant cover within vernal pools (Table 4-10). One other site (Preserve D) also reported an increase in non-native grass and invasive species cover but no decrease in native plant cover or ponding duration within both preserved and created pools. As with ponding duration, the decrease in native cover and increase in non-native cover is likely related to insufficient thatch management for the reasons discussed above (Photo 5, Appendix D). The increase in non-native cover may also be related to invasion by small mannagrass as discussed in the following paragraph.

Dominant non-native grass species observed within vernal pools during the site visits were soft chess (*Bromus hordeaceus*), Bermuda grass (*Cynodon dactylon*), Mediterranean barley (*Hordeum marinum* spp. *gussoneanum*), Italian ryegrass (*Lolium multiflorum*), rabbit's-foot grass (*Polypogon monspeliensis*), and medusahead. In addition, small mannagrass (*Glyceria declinata*) was observed or reported from four sites and observed in six of the 58 surveyed pools, ranging from 1% to 30% cover. This species is an especially problematic invasive grass for vernal pools because it is an obligate wetland plant that can occur throughout pools, unlike most other invasive species that typically inhabit only the margin.

Observations made during site visits generally corroborated the information provided by preserve managers. The two preserves with the highest levels of non-native grasses and other invasive plants in preserved pools were Preserves I and K, where neither grazing nor mowing takes place. The preserved pools at Preserves G and H (where grazing and mowing also do not take place) appeared to be in good condition despite a lack of thatch removal (Photo 15, Appendix D). This may be attributable to the soil type, which is fairly thin and infertile, characteristics that seem to discourage heavy colonization by non-native grasses and invasive plants.

As a general observation, the deeper pools at all sites better resist invasion by non-native grasses than shallow pools because they have longer ponding periods that tend to exclude non-native grasses. In general, the created

pools appeared to be more resistant to invasion by non-native grasses even when neither grazing nor mowing took place at the site. This condition is likely attributable to a combination of thinner, less well-developed soils in the pool basins and relatively deep created maximum ponding depths.

Special-status Species

Managers reported that occurrences of special-status large branchiopods and amphibians (western spadefoot) in preserved and created vernal pools have remained constant since preserve establishment for the five sites where information was provided (Photo 4-12, Appendix D). In reality, it is very difficult to detect changes in abundance of these species except when the species has become absent. The number of individuals in a given pool can fluctuate widely from year to year and during different times of the sampling season. What this information does convey is that special-status large branchiopods and amphibians are persisting on these preserves with no reported cases where they have become extirpated.

Managers reported a decrease in abundance or occurrence of special-status plants at three preserves (G, H, and I) and no change at three preserves (A, B, and D) for the six sites where information was provided. The management plans for the two preserves with Sacramento Orcutt grass (Preserves G and H) identified threats as being "primarily derived from public use in an urban setting." Listed problems include altered hydrology and water contamination from runoff, herbicide input, and foot traffic and littering from extensive public use of the one preserve that is open to the public. The second preserve is closed to the public, but reportedly is also threatened by the above-listed threats (except foot traffic). This preserve is also threatened by adjacent landowners who dispose of refuse and yard waste within the preserve. Accumulation of thatch does not appear to be a significant contributing factor to the decline of Orcutt grass in these preserves in spite of a lack of grazing or mowing. Both preserves have relatively thin or infertile soils that appear to discourage dense non-native grass growth. Preserve I, which supports Contra Costa goldfields, is not being actively managed, and the preserved pool in which the species was documented appears to be filling in with non-native grasses and other invasive plants. It appears that ponding duration has greatly declined and bare soil is reduced to less than 2% cover. Contra Costa goldfields have not been observed in this pool since 2002 or 2003.

The persistence of special-status large branchiopods, amphibians, and plant species could be affected if the ponding duration of pools were to decrease. Preserves A, C, and D are the only sites with reported grazing or mowing. Preserves G, H, I, and K all had reported or observed decreases in ponding duration, which over time may negatively affect populations of special-status species that occur at these sites.

UPLAND VEGETATION CONDITIONS

Of the 10 preserves visited for the study, six were observed to have high mean thatch levels (+2,500 lbs/acre) and four were observed to have moderate mean thatch levels (1,500-2,500 lbs/acre) The sites with moderate thatch levels were either grazed or had thin or infertile soils. These levels were visually estimated by the report authors, both of whom are experienced with measuring and estimating RDM. As described above, high thatch levels pose a threat to the biodiversity and hydrology of vernal pools (Marty 2005). Additionally, high thatch levels can increase site fire hazards and can promote an increase in invasive plants (Photo 14, Appendix D).

Of the seven preserves that provided data on upland invasive plants, four reported an increase in cover and three reported no change in cover since preserve establishment. Invasive plants pose many threats to natural communities and can alter the hydrology, stature, microclimates, and plant composition of a site. The distribution of invasive species has steadily increased throughout California. Small preserves may be especially vulnerable when subject to edge effects of adjacent development and high impacts of human use and disturbance. Active management of invasive species is often necessary to prevent population expansion. Four preserves reported that invasive species were increasing across the site despite active management.

5.6.3 RECOMMENDATIONS

- The long-term maintenance or improvement of ecological conditions within a small preserve requires focused management and monitoring efforts directed towards the specific issues or problems characteristic of the preserve; common problems with small preserve management include no or inadequate thatch management and/or invasive species control, destructive use by humans and domestic animals (pets), and lack of regular site maintenance; see Sections 5.4 and 5.5 above for more detailed discussions and recommendations related to the management and monitoring small preserves to maintain or improve long-term ecological conditions.

5.7 EDUCATION AND OUTREACH

5.7.1 KEY FINDINGS

- The majority of preserves did not have an educational or outreach component.
- The preserve with comprehensive public education and outreach showed minimal disturbance in comparison to the preserves without.

5.7.2 DISCUSSION

Four of the preserves reported conducting educational or community outreach activities, three annually and one continuously. One additional preserve is scheduled to receive funding from recently approved state propositions that will support the development of "minimal interpretive facilities, such as interior boardwalk paths [and] self-guided interactive displays." This site is already used for such activities as bird-watching and hiking.

Preserve H, the most well-developed site in terms of public education and outreach, had a large signs posted at the preserve entrance, with color photographs and descriptions of vernal pool habitats and associated species. The signs were appealing and well placed. The trails throughout the preserve were well marked, and signs were posted to remind users to keep dogs on leashes. The preserve appeared to be well used by the community but had a notably low level of apparent habitat impacts from human or pet use. It is unclear what activities were conducted on the other three sites with reported educational outreach.

As discussed in Section 5.2, "Infrastructure, Public Use and Surrounding Land Use", many preserves in populated areas have sustained minor to moderate disturbance from unauthorized public use, including recurring trespassing through pools and other sensitive habitats. It is possible that opening selected sites to public use, with an emphasis on education, might actually reduce human impacts. The site described in the preceding paragraph, which was intended for public use and featured an established trail system and educational signs, appeared to suffer relatively low levels of disturbance compared with the sites that are closed to the public.

Additionally, these preserves often represent some of the only remaining intact vernal pool habitat in highly developed, populated areas. If educating the public about vernal pools and their associated sensitive species were deemed a priority, these sites could provide a valuable, easily accessible educational resource.

5.7.3 RECOMMENDATIONS

- Preserve managers should carefully consider the value of allowing managed public access and developing an education and outreach program for small preserves; an education/outreach program can increase public appreciation of the preserve and its resources.
- Also, managed access combined with a well-designed education and outreach program may actually be more effective in protecting site resources versus attempting to exclude the public, especially on preserves near

dense residential areas with high potential public use or trespass; it also may be less expensive to develop and implement such a program than to construct and maintain fencing which effectively excludes public access.

5.8 REGULATORY COMPLIANCE AND OVERSIGHT

5.8.1 KEY FINDINGS

- Those preserves with both a management plan and funding source generally appeared to meet regulatory compliance requirements through on-going management, monitoring, and reporting.
- Little to no evidence was apparent of agency action or follow-up to ensure that required management and monitoring activities are being conducted for the preserves in this study.

5.8.2 DISCUSSION

USACE and USFWS are the two agencies most commonly involved in the permitting and oversight of small vernal pool preserves. USACE oversees impacts on vernal pools considered to be jurisdictional wetlands and determines the mitigation required for impacts, typically in the form of restored or created vernal pools. USFWS becomes involved if the affected vernal pools support federally-listed wildlife or plants and determines the required mitigation, typically in the form of a combination of both preserves and restored or created vernal pools that provide habitat for the affected species. The RWQCBs and DFG may also become involved if resources regulated by these agencies are affected (e.g., state water-quality issues or impacts to state-listed species).

Each small vernal pool preserve established as mitigation is typically required to prepare a management plan as part of the permit package and must submit on-going monitoring reports in accordance with the schedule and detail defined in the management plan. All of the small preserves participating in this study that were established as mitigation consulted with either USACE or an RWQCB as part of preserve establishment. Consultations with USFWS were completed only for those preserves established after the associated special-status species had been listed. Several of the preserves support listed species that were documented after the preserves were established and that were documented incidentally within vernal pools preserved or created in response to USACE regulations.

This study did not specifically assess the compliance of small preserves with agency reporting requirements, nor did it assess the level of agency involvement in prescribing management actions for listed species. However, through the course of this study it did become apparent that the three preserves that lack endowments or other funding sources have populations of listed species that are neither being managed nor monitored. At two of these sites, monitoring requirements for constructed pools were fulfilled within five years of preserve establishment and no additional monitoring has been conducted. This implies that USFWS is no longer involved in overseeing the status of these preserved occurrences of federally listed species, and would not be aware of any serious decline or extirpation. Also, at one of the preserves, annual monitoring reports indicating a significant decline in a listed plant population were submitted to USFWS, yet (to the knowledge of the study team) USFWS neither responded to the report nor required that site management practices be adjusted. Little or no evidence of on-going agency oversight and compliance monitoring of the small vernal pool preserves in this study was apparent.

5.8.3 RECOMMENDATIONS

- Agencies should consider strengthening their oversight to ensure that small preserves meet regulatory requirements and maintain the resources, especially listed species, that they were established to protect.

6.0 REFERENCES

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APPENDIX A

Brief Narratives of Study Preserves

PRESERVE A

Preserve A is a 53-acre on-site preserve with an extensive network of natural vernal pools and swales. This site was established in 2006 as a mitigation preserve for a large adjacent residential development. A conservation easement was placed on the site at the time and is currently held by a land trust. No vernal pools were created or restored on this site. The preserved pools at the site support several listed plant and wildlife species, including slender Orcutt grass (*Orcuttia tenuis*), vernal pool fairy shrimp, and vernal pool tadpole shrimp. The site is surrounded by residential development and a disturbed field.

Cattle graze at Preserve A, which is managed and monitored. Fences on this site are well-maintained to ensure that cattle do not disrupt the neighboring residences. Areas of historic disturbances and established populations of invasive species have been targeted for restoration and are being managed. Thus far, trespassing and vandalism appear to be minimal, although it is possible this will increase when surrounding residential developments are completed. This preserve is relatively new, but it appears that overall ecological conditions are remaining constant for the vernal pools, and may have improved in the uplands with thatch and invasive species management.

The endowment for this preserve is substantial and provides for intensive active management and monitoring. The increase in surrounding development may present additional challenges and disturbances. Despite the potential edge effects, this site represents intact vernal pool habitat with numerous occurrences of several rare species. As the surrounding area continues to develop, Preserve A will provide an opportunity for public education and preservation of remnant local populations of these species.

PRESERVE B

Preserve B is a 6-acre on-site preserve supporting approximately 0.02 acre of vernal pools. This site was preserved in 2007 as mitigation for impacts of a nearby residential development. A permanent conservation easement was placed on this site, which is now held by a land trust. Preserve B has an endowment for thorough monitoring and management. The site is surrounded by residential development and open grasslands and supports vernal pool fairy shrimp and vernal pool tadpole shrimp (*Lepidurus packardi*).

This preserve is relatively new and is currently managed and monitored. Neither grazing nor mowing takes place at this site, and dense annual grass cover was observed during the site visit. Very little bare ground was observed across the preserve; the wetlands were difficult to locate. This site is too small for grazing by cattle, and thus mowing would likely be the most appropriate management tool for thatch reduction. Invasive species are not yet an issue on the site. Signs of trespassing and vandalism were minimal, if present at all. This site is well fenced and does not appear to be accessed by the public. This preserve is slated to be surrounded by a housing development.

Thatch management and potential hydrologic runoff from current and future residential development will likely be a large management issue in the future. Additionally, trespassing and use of the site by domestic animals may increase with future development. The very small size of Preserve B makes the site highly vulnerable to edge effects. This preserve is preserved in perpetuity; monitoring is required in perpetuity as well.

PRESERVE C

Preserve C is 15 acres, with a large restored vernal pool covering the entire site. This preserve was established in 2007 as an off-site mitigation preserve for a residential development project. The site has a permanent conservation easement held by a land trust and is surrounded mainly by open grasslands and a small amount of development. The restored pool is reported to support slender Orcutt grass, legenere (*Legenere limosa*), and vernal pool tadpole shrimp.

This preserve is relatively new and was not visited during this study. This site is actively managed and monitored, and has an endowment to continue these activities. Cattle graze on the fenced preserve and in surrounding areas. Thus far, no management challenges have been reported from this site, nor are invasive species established on the preserve. Because monitoring activities have only been conducted for 1 year, no ecological trends have been reported on this site. Preserve C is located in an area that may face development pressures, which could reduce the local existing vernal pool habitat for the special-status species preserved on the site.

PRESERVE D

Preserve D is a 48-acre site with 0.87 acre of preserved pools. This site was set aside as an on-site preserve in 1990 as partial on-site mitigation for impacts on jurisdictional wetlands, including vernal pools, caused by an adjacent residential development project. Approximately 10.12 acres of vernal pools were created on-site between 1990 and 1995. Creating these pools increased the cover of vernal pools on-site to nearly 25%, a very high cover rarely observed in natural landscapes. Deed restrictions were recorded in 2000 and an endowment was established for management and monitoring. This site is surrounded by residential, commercial, and industrial development, as well as open grassland, preserved open space, and recreational areas (a golf course). Created pools were inoculated with topsoil collected from existing pools. Currently, 10 created pools on-site support vernal pool fairy shrimp or California fairy shrimp, and two support dwarf downingia (*Downingia pusilla*).

Short-term, high-intensity goat grazing is conducted at this site to control thatch and invasive species, including yellow star-thistle and medusahead. Grazing was first implemented in 2007. Areas of the preserve have also been mowed to control populations of yellow star-thistle. Mowing is also utilized to maintain a fire break between the preserve and the adjacent residential community. Permanent fencing has not yet been established around the entire site, but will be once adjacent areas are developed further. Current fences have been vandalized and trespassing takes place on the preserve. Trails, "bike jumps," and signs of domestic animals were noted throughout the site during a site visit. This site is actively managed and monitored. A management plan was developed in 2000.

The following issues were cited by the questionnaire respondent as major concerns for Preserve D:

> The primary concerns within this small Preserve are invasive non-native plant species and thatch management due to the lack [of] grazing or wildfire. However, in 2007 the Preserve was grazed, leading to a decrease in thatch and will likely result in a decrease in invasive non-native plant species. Additionally, the Preserve manager must balance the need to honor a pre-existing utility easement that transects the Preserve with the requirement to protect the created pools against accidental impacts.

PRESERVE E

Preserve E encompasses 36 acres of jurisdictional wetlands set aside in 1993 as on-site mitigation of impacts on vernal pools caused by the development of a business park and associated infrastructure in the surrounding area. As required by the Section 404 permit, six pools were created on the site in 1993, totaling 0.88 acre. No natural or restored pools are present on the site. However, 1.04 acres of seasonal, non–vernal pool wetlands were preserved. A deed restriction was recorded on the site in 1999. The site was officially established as a preserve in 2002 and began receiving funding for management through a service district, in the form of a tax dividend among participating parcels. This site is mostly surrounded by commercial and residential development and is adjacent to an approximately 160-acre open space preserve. No listed species are documented as being present on this site, although the pools were created as habitat for vernal pool fairy shrimp (*Branchinecta lynchi*). California fairy shrimp (*Linderiella occidentalis*) was documented in two of the six created pools in 1998.

Grazing and mowing do not currently take place at Preserve E, and the uplands are composed of dense non-native annual grasses, specifically medusahead (*Taeniatherum caput-medusae*) and barbed goatgrass (*Aegilops triuncialis*). Extensive populations of invasive yellow star-thistle (*Centaurea solstitialis*) also grow in these uplands. Additionally, a high cover of upland annual grass species grows in the basins of many of the created pools. This site is actively managed and monitored, and habitat restoration has been implemented to compensate for vandalism to the site. A management plan was prepared by a private consulting firm in 2000. Monitoring reports are prepared annually.

Vandalism and trespassing were reported as the major concerns for this site. Managers report a history of illegal dumping and off-highway vehicle use in the preserve. Fences around the preserve have been continuously vandalized and breached to allow access to the site by motorized vehicles. Trails developed for use by off-highway vehicles have damaged pool topography and hydrology. Restoration activities were undertaken to recontour pool topography, using hand tools. A history of illegal dumping is reported from the site and managers have conducted extensive trash cleanups. Managers identify thatch reduction and management of invasive species as integral to future management of Preserve E.

PRESERVE F

Preserve F is a 33-acre parcel that is part of a larger 135-acre preserve system. Nonetheless, this parcel is disconnected from other preserved parcels and functions as an isolated preserve. This area was set aside as an on-site mitigation preserve in 1988; a deed restriction was recorded in 2000 as part of the larger preserve system created as mitigation for impacts on 5.8 acres of jurisdictional wetlands, including vernal pools. As part of the mitigation, 211 pools totaling 0.69 acre were created on the site. An additional 0.99 acre of preserved pools exists on the preserve. Many of the pools created on-site are very small, constructed by building sets of rock berms along small swales. Management and monitoring of this site is funded through a service district. On-site mitigation was selected when this preserve was established because of the unique nature of the Mehrten Formation substrate on the site and the lack of existing mitigation banks in the area. This preserve is surrounded by commercial, residential, and recreational (golf course) development and a small area of preserved open space. This site supports vernal pool fairy shrimp; however, this species was not listed when the preserve was established and thus was not part of the mitigation agreement.

Neither grazing nor mowing takes place at this site. However, the vernal pools at Preserve F are not as heavily invaded by upland grasses as the pools at some of the other small preserves in the study (such as Preserves I and K). The pools at Preserve F are on the Mehrten Formation, with fairly thin soils underlain by volcanic lahars. These soil conditions appear to limit overgrowth and pool invasion by non-native annual grasses on the site. Invasive species, including escaped ornamentals from adjacent landscaped residential development, are present within the preserve. Treatment for invasive species has been on-going, with additional treatments scheduled. There are also problems along the preserve's perimeter with irrigation-water runoff from surrounding development. This site is actively managed and monitored. A management plan was developed for Preserve F in 1999.

The questionnaire respondent cited the following as the major concerns for Preserve F:

> The primary concerns in this particular small Preserve area are accidental impacts from adjacent uses. As the surrounding area has been in a state of construction for over 15 years, the risk of construction related impacts to the Preserve is higher. The City has attempted to minimize any unauthorized stormwater discharges from adjacent construction sites, and [e]nsure that site plans direct all post-construction runoff to pre-approved discharge locations as to not alter the hydrology of the Preserve area; however, due to the inherently lower permeability of the surrounding built-out areas, the Preserve does receive higher flows and unseasonal discharge from landscape areas. Additionally, the non-native plant species and thatch accumulation are a constant battle, and can easily threaten the ecological balance of the Preserved areas. Ultimately, an appropriate grazing regime and maintenance of hydrological integrity are integral to the long-term success of the Preserve.

PRESERVE G

Preserve G is an 8-acre on-site preserve managed in conjunction with Preserve H, although the sites are not connected and have very different histories of use and disturbance. Like Preserve H, this site was preserved as mitigation for impacts of nearby residential development in 1979. This site is currently managed by a public agency and was acquired to preserve populations of Sacramento Orcutt grass (similar to Preserve H). Preserve G is not open to the public and is completely surrounded by residential development. No endowment was established for this site, but other dedicated funding is available for some management and monitoring activities.

Disturbance from trespassing by the public was not evident at this site. The site is completely fenced on all sites and is extremely difficult to access. Even though disturbance from trespassing was not evident, other historic disturbance from the adjacent residential development has been reported since preserve establishment. This includes disturbances to site hydrology. The transformation of surrounding grasslands to paved, residential development has altered the flows of surface water and groundwater onto the site. Hydrologic studies have indicated that the pools at both Preserve H and Preserve G have been adversely affected by these changes. Additionally, it has been reported that neighboring residences have discharged water onto the site.

Grazing does not take place at Preserve G and, unlike Preserve H, the upland thatch at this site was moderate to dense. Some of the smaller, shallower pools showed moderate levels of intrusion by annual grasses. It is unclear why this site has apparently denser growth of annual grasses and pool intrusion than Preserve H. Like Preserve H, Preserve G provides an important ecological function, preserving some of the last remaining vernal pool habitats and populations of Sacramento Orcutt grass in the local area.

PRESERVE H

Preserve H is a 15-acre on-site preserve established in 1979. The preserve supports extensive natural vernal pools and swales that support multiple special-status species, including some of the only remaining occurrences of Sacramento Orcutt grass (*Orcuttia viscida*). These 15 acres are managed separately from an adjacent open-space area developed as a recreation park with high public use. The preserve was established specifically to conserve some of the last remaining vernal pool habitat in the area for public interest and to conserve Sacramento Orcutt grass. The preserve is managed by a public agency in cooperation with multiple government agencies.

A large, informative, and attractive educational sign is posted at the entrance to the preserve. The sign presents information about vernal pool ecology and protection and includes numerous photographs of vernal pool wildlife and plant species present on the site. The site also includes environmentally friendly paved public-access trails. These trails are well maintained and clearly marked. Signs indicating sensitive areas and proper etiquette for using the preserve are posted throughout the trail system. Grazing does not take place on this site; however, the pools have minimal annual grass intrusion. The site is on the Laguna Formation, with fairly thin, infertile soils that appear to discourage dense upland growth and pool invasion by annual grasses. Historically, site hydrology was significantly altered by irrigation runoff from adjacent residential development. This impact has been well studied and site managers have taken action to address this issue. Currently, populations of Sacramento Orcutt grass appear to be intact and not disturbed by public use. However, the invasive species small mannagrass (*Glyceria declinata*) was observed in pools on-site. This plant can invade the pool bottoms and lower margins, presenting a distinct threat to vernal pool plants.

Preserve H is actively managed and monitored. Although this preserve does not have an endowment, these activities are supported through dedicated public funds. Invasive species, including yellow star-thistle, are present throughout the site. Additionally, signs of runoff from neighboring residences are noticeable along portions of the perimeter. Preserve H provides an invaluable educational resource, and for 30 years has managed to preserve one of the last populations of the rare Sacramento Orcutt grass.

PRESERVE I

Preserve I is a small, 10-acre on-site preserve with six natural vernal pools and other seasonal wetlands; eight created vernal pools; an occurrence of Contra Costa goldfields, which is federally listed as endangered, and occurrences of saline clover (*Trifolium depauperatum* var. *hydrophilum*), a special-status species. The wetlands have a cumulative area of 3–4 acres. The site is protected through a deed restriction. Preserve I was established in 1998 to mitigate impacts on vernal pools, other seasonal wetlands, and a small stand of Contra Costa goldfields on adjacent lands. Saline clover was not known to occur on the site when the preserve was established but has incidentally colonized several of the created pools. This site is surrounded by industrial development and open grasslands. Additional industrial development is proposed for the site and will largely surround the site and increase threats to the preserve in the future. The landowner is attempting to develop additional land surrounding the preserve. This may adversely affect a portion of the established preserve, such as filling the pool that has supported Contra Costa goldfields. This new impact would be mitigated off-site.

This site is not being currently managed or monitored. A site management plan was prepared in 1998, and the created vernal pools were monitored for several years after construction. Monitoring was discontinued in 2003 or 2004, before the constructed pools met success criteria, because of a lack of follow-through on the part of the landowner. Since then, no monitoring has taken place. The monitoring documented a serious decline in the on-site occurrence of Contra Costa goldfields, caused by a lack of grazing or other thatch management; yet there have been no efforts by the landowner to improve the ecological conditions of the site. During the site visit, it was observed that the preserved vernal pool that has supported Contra Costa goldfields had been heavily intruded upon by non-native upland grasses and forbs, which had seriously reduced ponding depth and duration and generally eliminated suitable habitat for Contra Costa goldfields. The site management plan states that actions must be taken if there is a decline in goldfields occurrence, but the landowner has done nothing to remedy this situation. The invasive wetland species perennial pepperweed (*Lepidium latifolium*) is established in a couple of the created pools on the site. Between 1999 and 2003, efforts were made to control the pepperweed through manual removal, but the species persists. The uplands on the site are disked annually for fire management, which seriously disturbs upland habitat conditions.

The occurrence of Contra Costa goldfields at Preserve I faces a real threat of extirpation because the preserve lacks an endowment for management and monitoring, any management efforts, and a conservation easement; and because of a current proposal to fill the main pool supporting Contra Costa goldfields as part of expanded site development.

PRESERVE J

Preserve J is a 37-acre on-site mitigation preserve with approximately 14 preserved pools totaling 0.54 acre and 27 created vernal pools totaling 4.8 acres. This site was set aside in 1992 as mitigation for impacts on jurisdictional wetlands, including vernal pools, caused by the construction of residential development in adjacent areas. The created pools were constructed in 1992. These pools were inoculated from existing wetlands, and in 1997 approximately 65% of the created pools supported vernal pool fairy shrimp. California fairy shrimp was also reported to occur at this site in 1997. Preserve J is owned by a service district. All monitoring requirements of created pools were fulfilled in 1997, and no endowment or funding exists for current management or monitoring. The site is surrounded by residential development and open grasslands. It is disconnected from adjacent grasslands by a paved road. The current status of vernal pool fairy shrimp on the site is unknown.

This site is not actively managed or monitored. Grazing or other thatch management does not take place on-site. During the site visit in October 2008, the uplands appeared to be dominated by dense annual grasses. However, many of the created pools did not appear to have heavy intrusion by annual grasses. Most of the created pools are fairly deep, with fairly steep sides around their edges (steeper than most natural vernal pools). These conditions appear to limit intrusion of annual grasses into the pools by creating a fairly sharp break between upland and pool hydrology. Shallower pools, with less steep sides around their edges, appeared to be more overgrown with annual grasses and upland species. Signs of runoff from residential areas were observed in two main locations within the preserve. These areas had dense cover of perennial wetland species, including one edge pool dominated by Bermuda grass (*Cynodon dactylon*). No management plan exists for this site.

Residents surrounding the preserve reported observing (and enjoying) numerous wildlife species at the preserve, including frogs, egrets, hawks, and coyotes. Human impacts appeared relatively low on this site, with the exception of hydrologic runoff. Low levels of trash were observed, but signs of trespassing were minimal despite the lack of substantial fencing across most of the preserve. The lack of on-site monitoring greatly complicates attempts to assess the status and trends of sensitive resources and overall conditions of Preserve J.

PRESERVE K

Preserve K is a 40-acre site that was donated for conservation purposes in 1964. This site has extensive natural vernal pools and swales, as well as multiple reported occurrences of listed and other special-status plant and wildlife species: vernal pool fairy shrimp, western spadefoot (*Spea hammondii*), heartscale (*Atriplex cordulata*), vernal pool smallscale (*A. persistens*), and recurved larkspur (*Delphinium recurvatum*). The site has no created or restored pools and historical disturbance has been minimal. The surrounding area has been completely converted to agriculture (corn and other row crops). The preserve has no endowment and is not actively managed or monitored, although it is owned by a land trust.

The site does have some occurrences of invasive species, and it has been burned. Grazing does not take place on this preserve. Data collected during the site visit indicate that moderate levels of thatch occur throughout the uplands, which are dominated by annual grasses. Additionally, many of the smaller, shallower pools are significantly compromised by annual grasses. The larger and deeper pools Figured fewer signs of intrusion by annual grasses. Despite the degradation of the pools from lack of management, Preserve K provides some of the last vernal pool habitat in the region and still supports significant stands of vernal pool indicator plants (within the deeper pools). This site also has extensive mima mounds and ground-squirrel burrows, which provide important habitat for a wide variety of wildlife species.

Preserve K is an important regional preserve but could greatly benefit from thatch reduction and monitoring. The preserve also offers an important educational component to understanding vernal pool ecosystems in an area that has almost entirely lost this habitat.

APPENDIX B

Survey Questionnaire

PLACER LAND TRUST

QUESTIONNAIRE FOR SMALL VERNAL POOL EFFECTIVENESS STUDY

Placer Land Trust (PLT) is a non-profit land trust based in Auburn (Placer County), California. PLT is conducting a study of the ecological effectiveness of 'small' vernal pool preserves that are 60 acres or less in total area. The purpose of the study is to assess the particular successes and problems associated with the establishment and management of such small preserves and the ways in which management can be improved. This five-page questionnaire was developed by PLT's project team to gather the specific types of information to be assessed as part of the study. The questionnaire is for the owners or managers of small preserves and may be filled out and emailed back to PLT or completed through an interview with a PLT team member.

Please note that all information to be gathered and published through this study will remain anonymous with regards to individual preserve sites and the owners and/or managers of these preserves. While the final published report will discuss the cumulative findings and trends in small preserve effectiveness, it will not identify specific preserve locations or specific conditions on an individual preserve.

PLT thanks you in advance for your participation in this study.

PRESERVE NAME:	
NAME/TITLE OF INDIVIDUAL PROVIDING INFORMATION:	
NAME OF INTERVIEWER:	

1. PRESERVE BASICS

a. What is the name of the Preserve?

b. What is the total acreage of the Preserve?

c. When was the Preserve established?

d. In which County is the Preserve located?

e. If you wish, please provide more specific location information.

f. Can you provide a site map of the Preserve?

g. Who owns the Preserve land?

h. Who manages the Preserve?

i. What type of interest is held on the Preserve? (Fee Simple, Conservation Easement, Management Agreement, Lease, Other) Is the Preserve permanently protected? (conservation easement, deed restriction)

j. What are the surrounding land uses, by estimated percent area, of the Preserve?

Open Grassland/Grazing:	Confined Animal Pastures:	Irrigated Pasture:
Disturbed Field:	Annual Crops:	Vineyards:
Orchards:	Paved Road:	Residential:
Commercial:	Industrial:	Other (List):

k. Does the Preserve border a paved road?

l. Why was the Preserve established (Conservation or Mitigation, please provide details)?

2. SENSITIVE RESOURCES ON THE PRESERVE

a. What special-status species occur on the Preserve (please list all)?

b. What is the total acreage of preserved (existing) wetlands?

c. What is the total acreage of preserved (existing) vernal pools?

d. What is the total number of preserved (existing) vernal pools?

e. What percent (%) or number (#) of the preserved vernal pools support:

1. Federally-listed large branchiopods?

2. CTS breeding?

3. Western spadefoot breeding?

4. Special-status plants?
f. Are there any restored or created vernal pools? If yes, please answer the four questions below.
1. Total acreage of restored pools?
2. Total number of restored pools?
3. Total acreage of created pools?
4. Total number of created pools?
g. What year were the restored or created pools constructed?
h. Were the restored or created pools inoculated with cysts/seeds from an existing pool?
i. Were the restored or created pools constructed to provide habitat for special-status species? If yes, which species?
j. What percent (%) or number (#) of the restored or created pools currently support:
1. Federally-listed large branchiopods?
2. CTS breeding?
3. Western spadefoot breeding?
4. Special-status plants?
3. MITIGATION ELEMENTS OF THE PRESERVE (Complete this section if Preserve was established as mitigation for another project)
a. What was the type of project that required mitigation (residential housing, commercial development, road construction, etc.)?
b. What sensitive habitats and special-status species were involved in the Preserve mitigation agreement (please list all)?
c. Is the Preserve an on-site or off-site preserve?
d. If off-site, what is the approx. distance between the development project and the Preserve?
e. Why was a small preserve selected for mitigation rather than other options such as purchase of mitigation bank credits or payment of in-lieu fees?
4 FINANCIAL ENDOWMENT
a. Is there a financial endowment to pay for on-going management and monitoring costs?
b. Is it non-wasting?
c. What is the approximate amount?
d. What is the capitalization rate?
e. What is the approximate annual amount of available funding from the endowment?
f. What is the annual funding you feel is required for good site management and monitoring?
g. Are there other sources of funding for site management/maintenance? If yes, what are they?

5 PRESERVE MANAGEMENT

a. Is there a Management Plan for the Preserve?

b. Can we get a copy of the Plan?

c. When was it prepared?

d. Are there provisions to have it updated? How often?

e. Who prepared the Plan (in-house or subconsultant)?

f. Was the Plan prepared following any federal or state guidelines?
If yes, please list.

g. Based on 2080 work hrs/yr, how many hours on average are required per for management?

h. What is the average annual cost for Preserve management (excluding monitoring)?

i. What proportion of these costs are paid to employees rather than subconsultants?

j. Please indicate type and frequency of all management activities that occur on the Preserve.
N = Activity is not required for site management
0 = Activity is not conducted
1 = Activity occurs on an infrequent or as-needed basis (less than once per year)
2 = Activity occurs annually (once per year)
3 = Activity occurs biannually
4 = Activity occurs quarterly
5 = Activity occurs continuously or at numerous times throughout the year

Grazing:	Prescribed Burning:	Mowing:
Trash/Debris Clean Up:	Trespass Patrol:	Fence Maintenance:
Signage Maintenance:	Weed Control:	Habitat Restoration:
Erosion Control:	Feral Animal Control:	Education/Outreach:
Other (List):	Other (List):	Other (List):

k. Grazing Information:

1. Is there grazing on the Preserve?
2. What type of livestock? If cattle, cow-calf or stocker?
3. What is the typical grazing period?
4. How many animals are grazed annually (stocking rate)?
5. Is the grazing operation leased to an outside operator?
6. What is the period of the lease in years?
7. For how many years has the current lessee grazed the site?
8. Did the current lessee graze the site prior to Preserve establishment?
9. What is the typical grazing intensity on the Preserve? (1 = none; 2 = light (2,000+ RDM); 3 = moderate (1,000–2,000 RDM); 4 = heavy (500–1,000 RDM); 5 = very heavy (<500 RDM):
10. Is the grazing generally consistent from year to year?
11. Is RDM or other grazing monitoring data used to adjust grazing intensity?

l. Is the Preserve entirely fenced? What type of fencing?

m. Weed Control Information:

1. Are noxious weeds a problem on the Preserve?
   If yes, which species?

2. What are the primary control methods (herbicides, manual weeding, mechanical weeding, grazing, prescribed burning, mowing)?

3. What herbicides have been used on the Preserve?

n. What have been the primary management challenges on the Preserve? (examples: undergrazing, overgrazing, vandalism, trespass, invasive weeds, feral animals, trash dumping, collecting, wildfire, pesticide drift, water pollution):

6 PRESERVE MONITORING

a. Is monitoring conducted on the Preserve?

b. Are Monitoring Reports prepared?
   How frequently?

c. Can we get copies of past Monitoring Reports?

d. Based on 2080 work hrs/yr, how many hours on average are required per year for monitoring?

e. What is the average annual cost for Preserve monitoring?

f. What proportion of these costs are paid to employees rather than subconsultants?

g. Please indicate type and frequency of all monitoring activities that occur on the Preserve.
   N = Activity is not required for this Preserve
   0 = Activity is not conducted
   1 = Activity occurs on an infrequent or as-needed basis (less than once per year)
   2 = Activity occurs annually (once per year)
   3 = Activity occurs biannually
   4 = Activity occurs quarterly
   5 = Activity occurs continuously or at numerous times throughout the year

General Site Condition:	VP Large Branchiopods Surveys:	Photopoint:
General Wildlife:	VP Amphibians Surveys:	RDM:
General Vegetation:	VP Rare Plant Surveys:	Noxious Weeds:
Trash/Debris:	Wetland Hydrology:	Feral Animals:
Fencing:	VP Plant Spp Composition:	Other (List):
Erosion:	Upland Plant Spp Composition:	Other (List):

h. Are the results of monitoring used to improve Preserve management?
   (1 = never; 2 = infrequently; 3 = sometimes; 4 = frequently; 5 = always):

7 PRESERVE CONDITIONS AND TRENDS

a. Based on your assessment, would you say that the overall ecological conditions of the Preserve have: significantly declined (1), remained the same (2), or significantly improved (3) since the Preserve was established?

b. Please indicate the ecological trends in Preserve habitats and species.
   N = Not present or of concern on this Preserve
   0 = Previously present but now extirpated
   1 = Significantly decreased
   2 = Remained constant
   3 = Significantly increased

Overall VP Ecological Conditions:	Preserved:	Restored/Created:
VP Ponding Duration:	Preserved:	Restored/Created:
VP Native Plant Cover/Diversity:	Preserved:	Restored/Created:
VP Non-native Grass Cover:	Preserved:	Restored/Created:
VP Noxious Weed Cover:	Preserved:	Restored/Created:
VP Large Branchiopod Abundance/Diversity:	Preserved:	Restored/Created:
VP Amphibian Abundance/Diversity:	Preserved:	Restored/Created:
VP Rare Plants Abundance/Diversity:	Preserved:	Restored/Created:
Overall Upland Ecological Conditions:		
RDM Level:		
Upland Native Forb Cover/Diversity:		
Upland Native Grass Cover/Diversity:		
Upland Noxious Weed Cover/Diversity:		

8. CONCLUSION

a. What do you consider to be the biggest challenges to maintaining, in perpetuity, the conservation values that the preserve was established to protect?

b. What are your primary recommendations for insuring appropriate management and monitoring of small preserves?

c. Can we visit the Preserve to collect additional information?

d. If offered, how can we coordinate with you to obtain a site map, Management Plan, and Monitoring Reports?

Thank you for your time and interest in this project!

APPENDIX C

Site Visit Data Form

Site: **Date:** **Surveyor:**

General Preserve Characteristics:					
Surrounding Land Use, Estimated % Area:					
Adjacent[1]	*1,000 ft*[2]	*Adjacent*	*1,000 ft*	*Adjacent*	*1,000 ft*
Open Grassland:		Animal Pastures:		Irrigated Pasture:	
Disturbed Field:		Annual Crops:		Vineyards:	
Orchards:		Paved Road:		Residential:	
Commercial:		Industrial:		Other (List):	

Intensity Within Preserve:[3]		*Wildlife and Habitat Notes:*
Paved/Non-Paved Roads: L M H	Paved/Non-Paved Trails: L M H	
Trespassing/Vandalism: L M H		
Trash/Pollution: L M H		
Erosion:	Water Run-off/Hydro:	
Feral/Domestic Animals:		
Fences/Gates/Signs: Type:	Condition:	
Mowing/Grazing: L M H Type: Stocker/ Cow-Calf		
Bioturbation: L M H Type: Vole/ Gopher/ Ground Squirrel		
Historical Disturbance:		

Community:[4]	**RDM Level**[5]	**Dominant Species (% Cover), include Bare, Thatch**
	VL L M H	
	VL L M H	
	VL L M H	
	VL L M H	
	VL L M H	
	VL L M H	
	VL L M H	

Invasive Sp	**Stand Size/% Cover**	**Location/ Disturbance/Mgt**

Geophytes	**Stand Size/% Cover**	**Tarweeds/Annuals**	**Stand Size/% Cover**

Additional Notes:

1. Adjacent Land Use: Percent area directly adjacent to Preserve
2. 1,000 ft: Percent area nonadjacent, but within 1,000 ft of Preserve
3. L=Low, M=Medium, H=High
4. Community: Vegetation type and location dominant in area of specified RDM (ex. 'Oak Woodland', 'Inter-Mound Upland')
5. RDM Level: Very Low (<600 lbs/acre), Low (600–1,000), Med (1,000–2,500), High (>2,500)

Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			

Preserve: ______________________________ Date: __________ Surveyor: ____________________ Page ____/_____

Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			
Pool #:	Location: Preserve Edge / Interior	Est. Max. Depth:	Hydrology: Intact / Altered Hydro Notes:
Dominant Sp. and % Cover:			
% Cover Bare Ground:	% Cover Litter:	% Thatch: Thatch Depth:	% Cover Bioturbation: Type:
Disturbance: Altered Hydro / Roads / Trails / Trash / Pollution / Other:			
Habitat Notes:			

Preserve: ______________________ Date: __________ Surveyor: ______________________ Page ____/_____

APPENDIX D

Representative Small Preserve Photographs

Photo 1. Example of urban interface with a vernal pool preserve
(Source: Photograph taken by Vollmar Consulting in 2009)

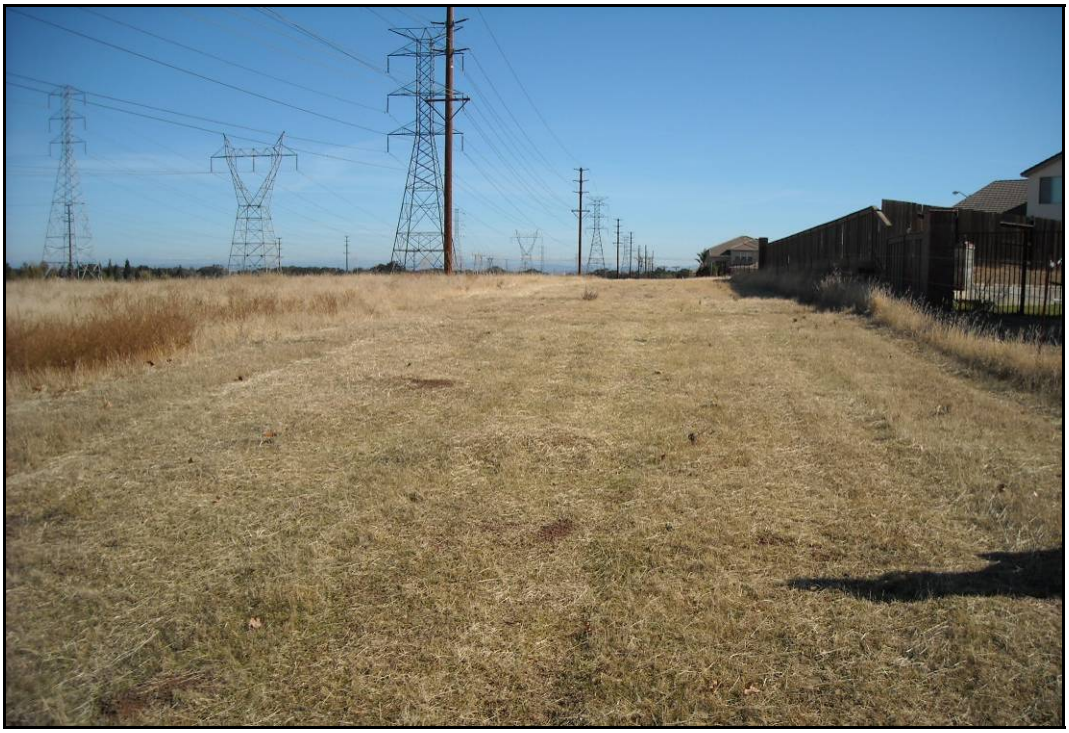

Photo 2. Perimeter of preserve mowed to reduce fire hazard for adjacent residential development. *(Source: Photograph taken by Vollmar Consulting in 2009)*

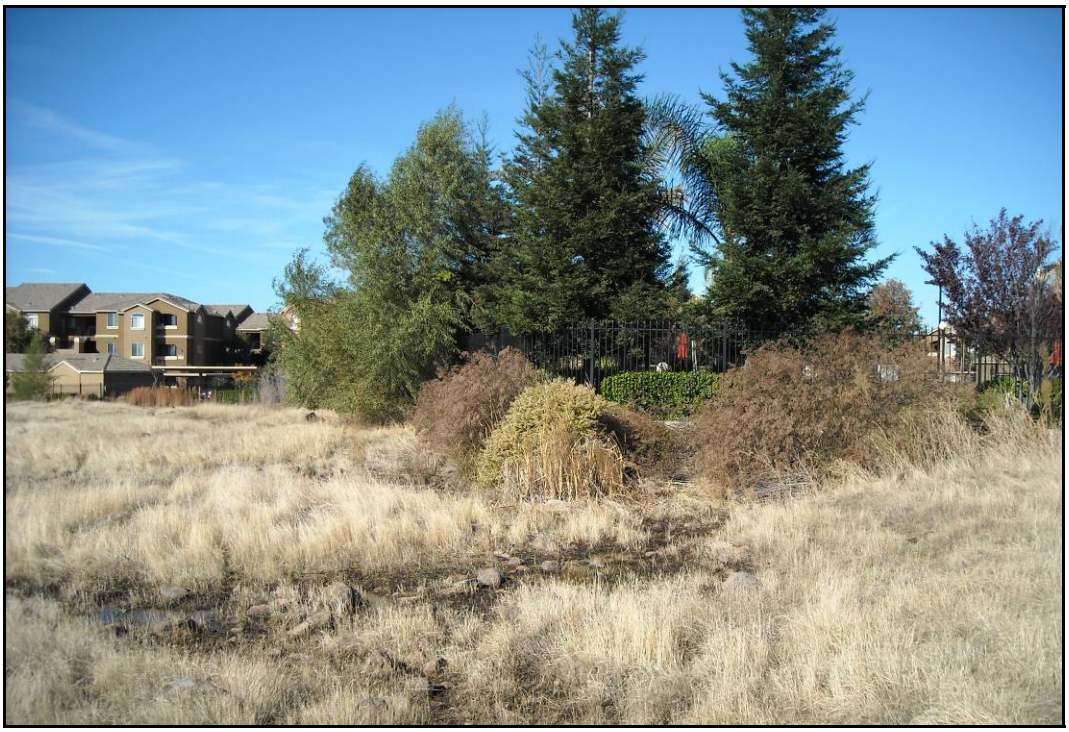

Photo 3. Example of ornamental plants spreading onto a preserve
(Source: Photograph taken by Vollmar Consulting in 2009)

Photo 4. Example of unmanaged upland with yellow-star thistle throughout and dense annual grasses invading pools
(Source: Photograph taken by Vollmar Consulting in 2009)

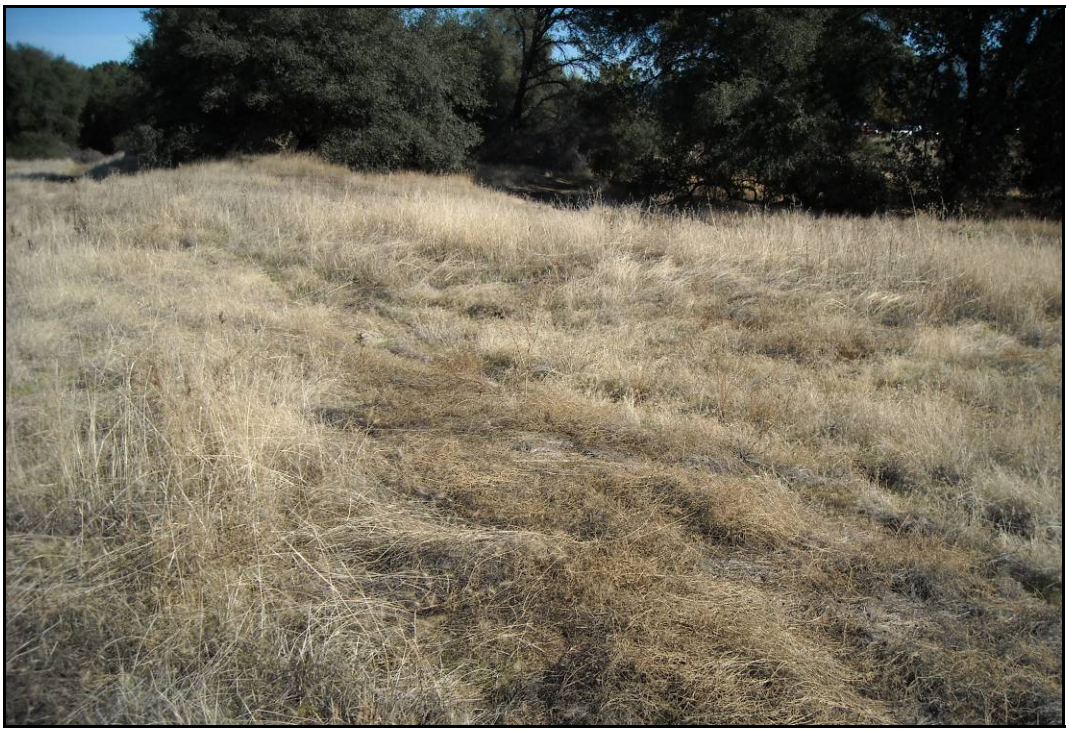

Photo 5. Preserve dominated by high levels of nonnative annual grass thatch
(Source: Photograph taken by Vollmar Consulting in 2009)

Photo 6. Vandalized fence and renegade trail on preserve not open to public
(Source: Photograph taken by Vollmar Consulting in 2009)

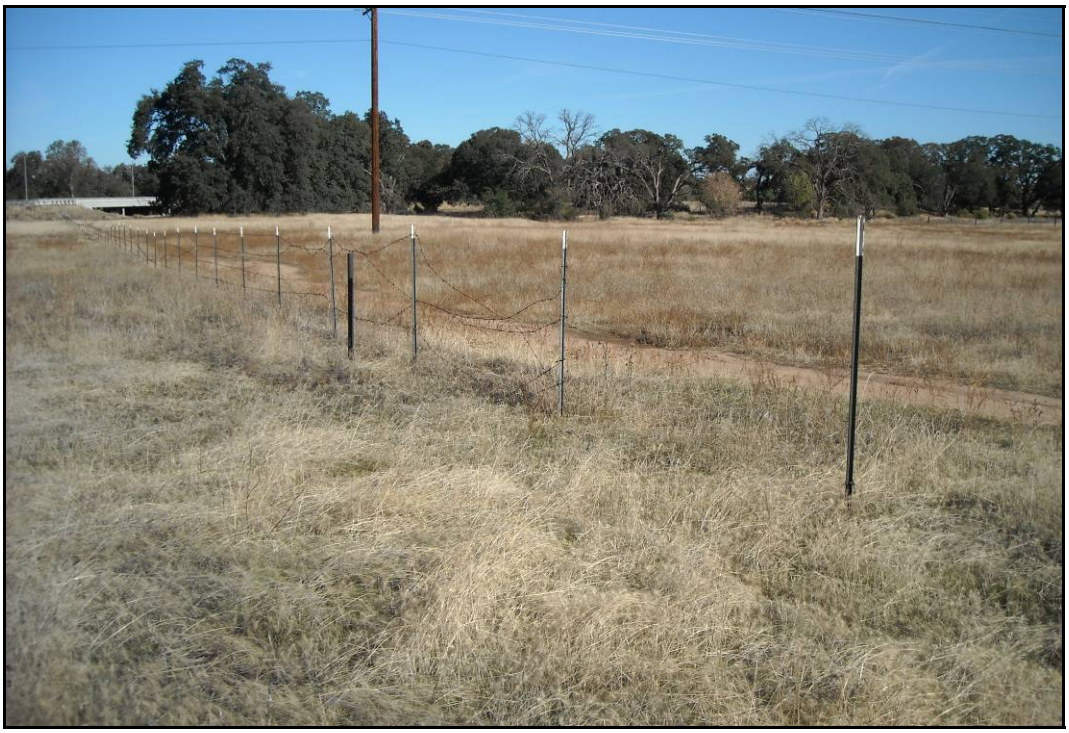

Photo 7. Example of damaged fencing surrounding a vernal pool preserve
(Source: Photograph taken by Vollmar Consulting in 2009)

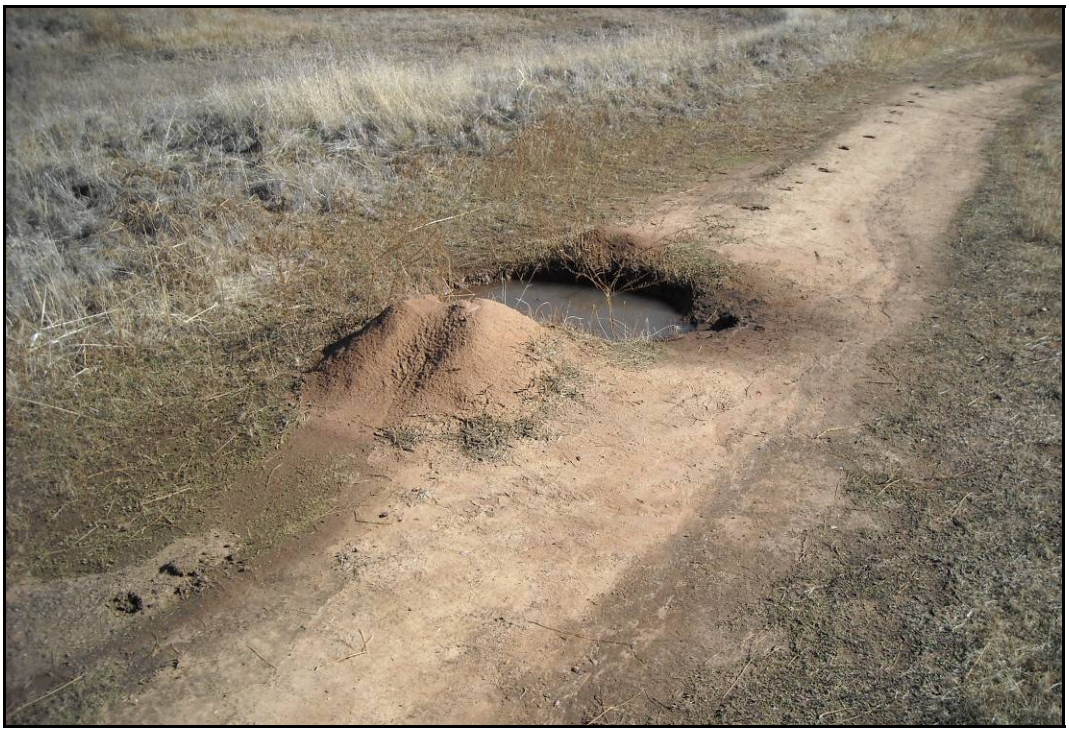

Photo 8. Heavy pedestrian, bicycle, and domestic animal use observed within a preserve closed to public access *(Source: Photograph taken by Vollmar Consulting in 2009)*

Photo 9. Unauthorized trails and vehicle tracks through vernal pool habitat
(Source: Photograph taken by Vollmar Consulting in 2009)

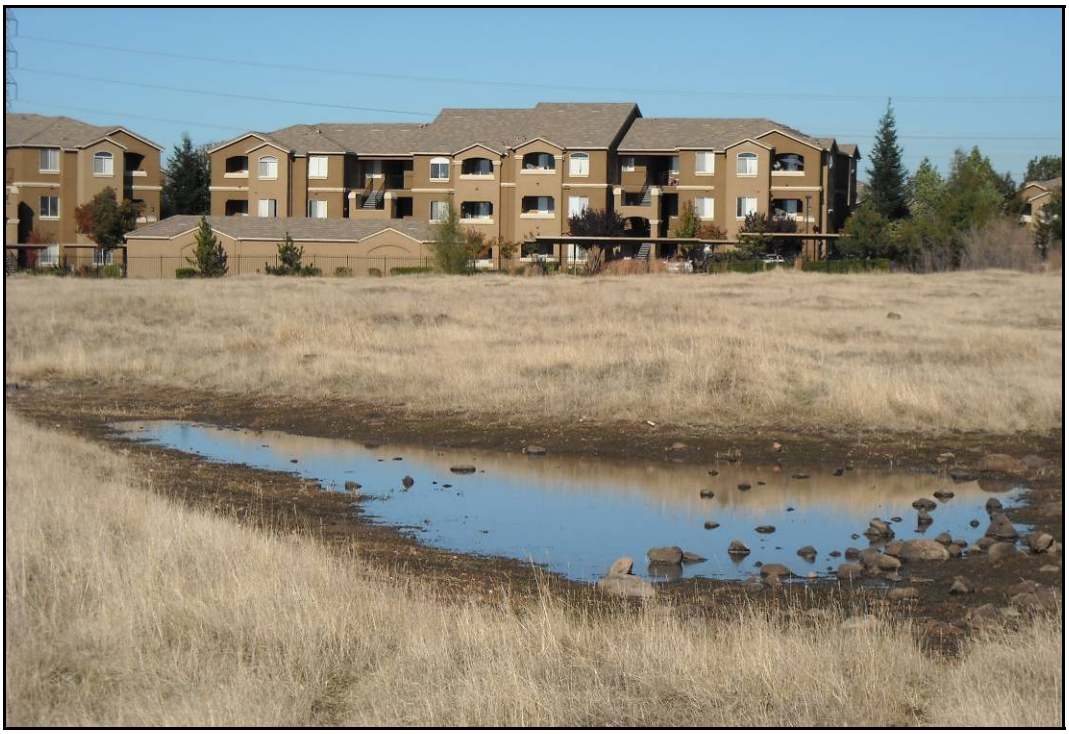

Photo 10. Example of preserve adjacent to high-density development
(Source: Photograph taken by Vollmar Consulting in 2009)

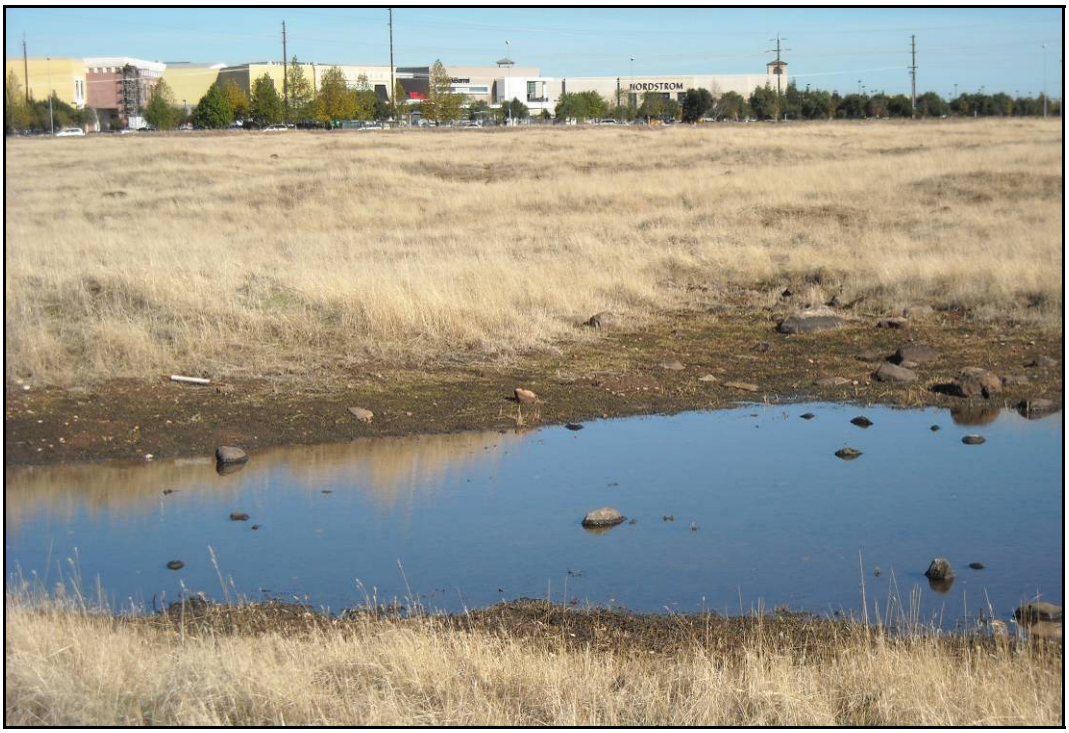

Photo 11. Remnant vernal pool habitat within urban landscapes.
(Source: Photograph taken by Vollmar Consulting in 2009)

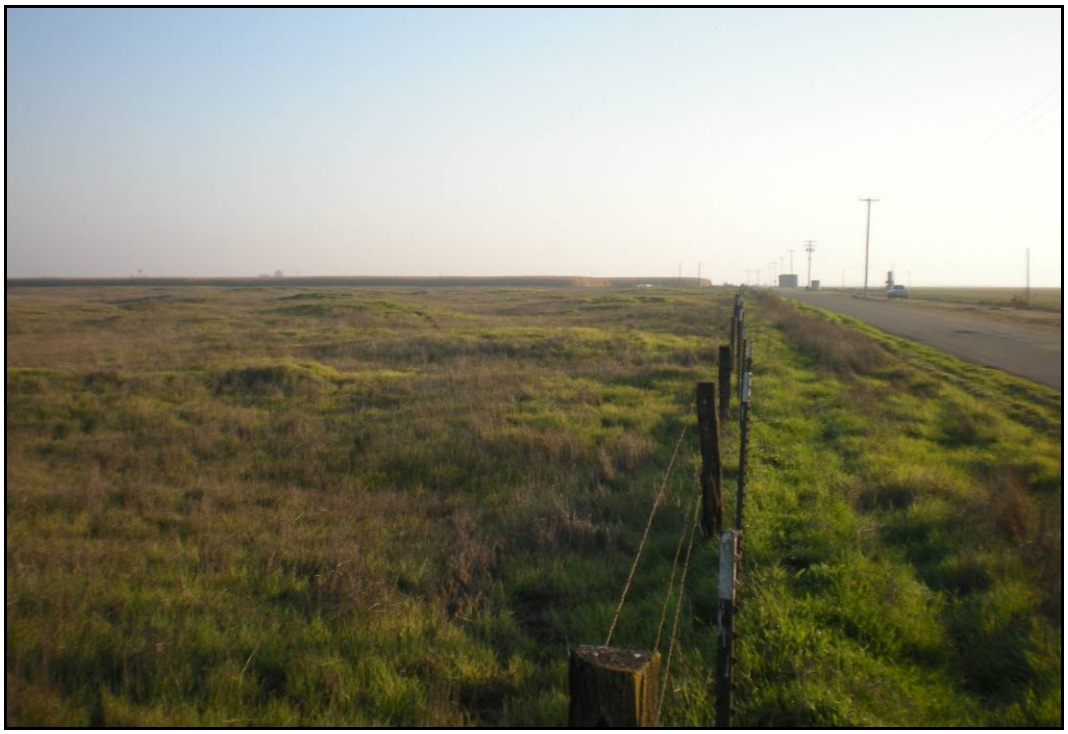

Photo 12. Nearly all preserves border a paved road
(Source: Photograph taken by Vollmar Consulting in 2009)

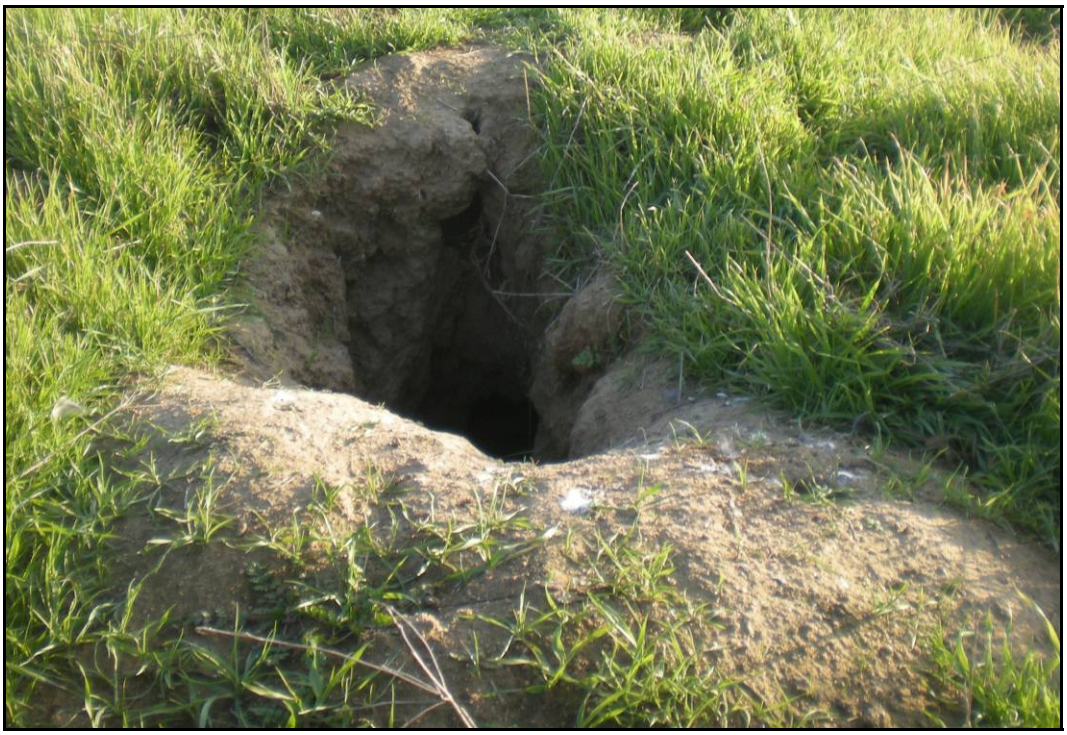

Photo 13. Vernal pool preserves can provide habitat for a variety of wildlife
(Source: Photograph taken by Vollmar Consulting in 2009)

Photo 14. Vernal pool dominated by upland grasses
(Source: Photograph taken by Vollmar Consulting in 2009)

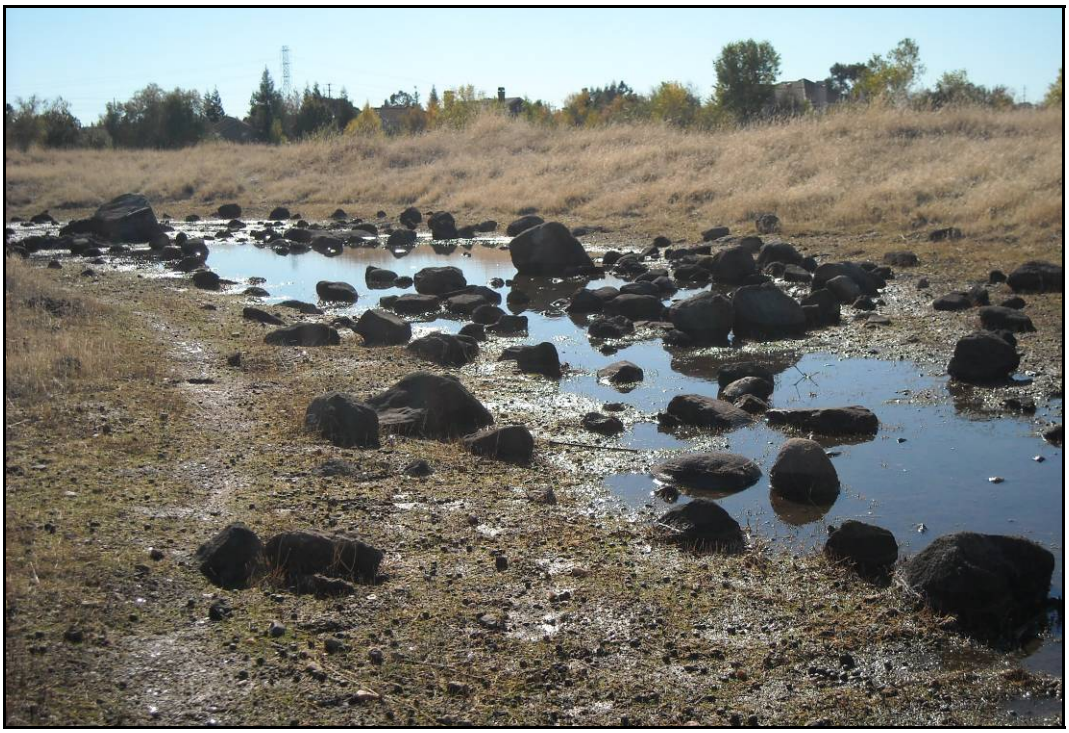

Photo 15. Vernal pool with obvious transition from pool bottom to upland grasses
(Source: Photograph taken by Vollmar Consulting in 2009)