Final
Conservation Strategy
for the
UC Merced Project

Prepared for:

University of California, Merced
Physical Planning, Design, and Construction
P.O. Box 2039
Merced, CA 95344
Contact: Brad Samuelson
209/228-4333

Prepared by:

ICF Jones & Stokes
630 K Street, Suite 400
Sacramento, CA 95814
Contact: Mike Rushton
916/737-3000

October 2008

ICF Jones & Stokes. 2008. *Conservation Strategy for the UC Merced Project*. October. Final. (J&S 01549.01/05650.05.) Sacramento, CA. Prepared for: University of California, Merced, Physical Planning, Design, and Construction, Merced, CA.

Contents

Tables

Figures

Follows Page

Acronyms and Abbreviations

BA	Biological Assessment
BMPs	best management practices
BO	Biological Opinion
CDF	California Department of Forestry and Fire Protection
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CNR	Campus Natural Reserve
County	County of Merced
CRT	California Rangeland Trust
CST	Cyril Smith Trust
CWA	federal Clean Water Act
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESA	federal Endangered Species Act
FR	Federal Register
GAP	Gap Analysis Project
GIS	geographic information systems
HCP	habitat conservation plan
LRDP	Long-Range Development Plan
MPCL	*Management Plan for Conservation Lands and the Adjacent Campus Buildout Lands for the University of California Merced*
NEPA	National Environmental Policy Act
O&M	operations and maintenance
RDM	residual dry matter
Regents	UC Board of Regents

RMP	*Resource Mitigation Plan for Federally Listed Species that May Be Affected by the Establishment of the University of California, Merced*
SNRI	Sierra Nevada Research Institute
SR	State Route
the Corps	U.S. Army Corps of Engineers
TNC	The Nature Conservancy
UC	University of California
UCLC	University of California Land Company
UCP	University Community Plan
USFWS	U.S. Fish and Wildlife Service
VELB	Valley elderberry longhorn beetle
Vernal Pool Recovery Plan	*Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon*
VST	Virginia Smith Trust
WCB	Wildlife Conservation Board

Chapter 1
Introduction and Background

The University of California (UC) proposes to construct a major research university (UC Merced Campus) on an approximately 815-acre site within the sphere of influence of the City of Merced (Figure 1-1). The UC Merced Campus would be located south and east of Lake Yosemite Regional Park and a portion of Lake Road in eastern Merced County. The UC Merced Campus would eventually accommodate 25,000 full-time equivalent students and approximately 6,200 faculty and staff. An adjacent residential community to support the UC Merced Campus (referred to as the University Community) that was approved by the County of Merced (County) in 2004, but requires an amendment to the General Plan, has also been proposed. The community would be composed of residential and commercial uses.

This Conservation Strategy has been developed to meet the requirements of a Final Biological Opinion (BO) issued by the U.S. Fish and Wildlife Service (USFWS) on August 19, 2002, in connection with an application for incidental take authorization for the University's Proposed Project. The current Proposed Action (also referred to as the project) is the culmination of over 20 years of planning and agency consultation. This chapter presents:

- A historical overview and the components of the Proposed Action,
- The environmental setting, and
- The elements of the Conservation Strategy.

Project History

In 1988, UC initiated planning for an additional campus in the San Joaquin Valley to accommodate projected growth in student enrollment. UC completed its site selection process in 1995, choosing a site in Merced County as the optimal location for the new campus and associated University Community. This location was near the center of the Virginia Smith Trust (VST) property, approximately 2 miles northeast of Lake Yosemite (referred to as the "Lake Yosemite site"). Shortly thereafter, UC and the County initiated discussions with state and federal regulatory agencies regarding the need for a federal Clean Water Act (CWA) Section 404 permit from the U.S. Army Corps of Engineers (the Corps) and related federal and state approvals for the project. These discussions focused on the potential impacts on biological resources at the Lake Yosemite site.

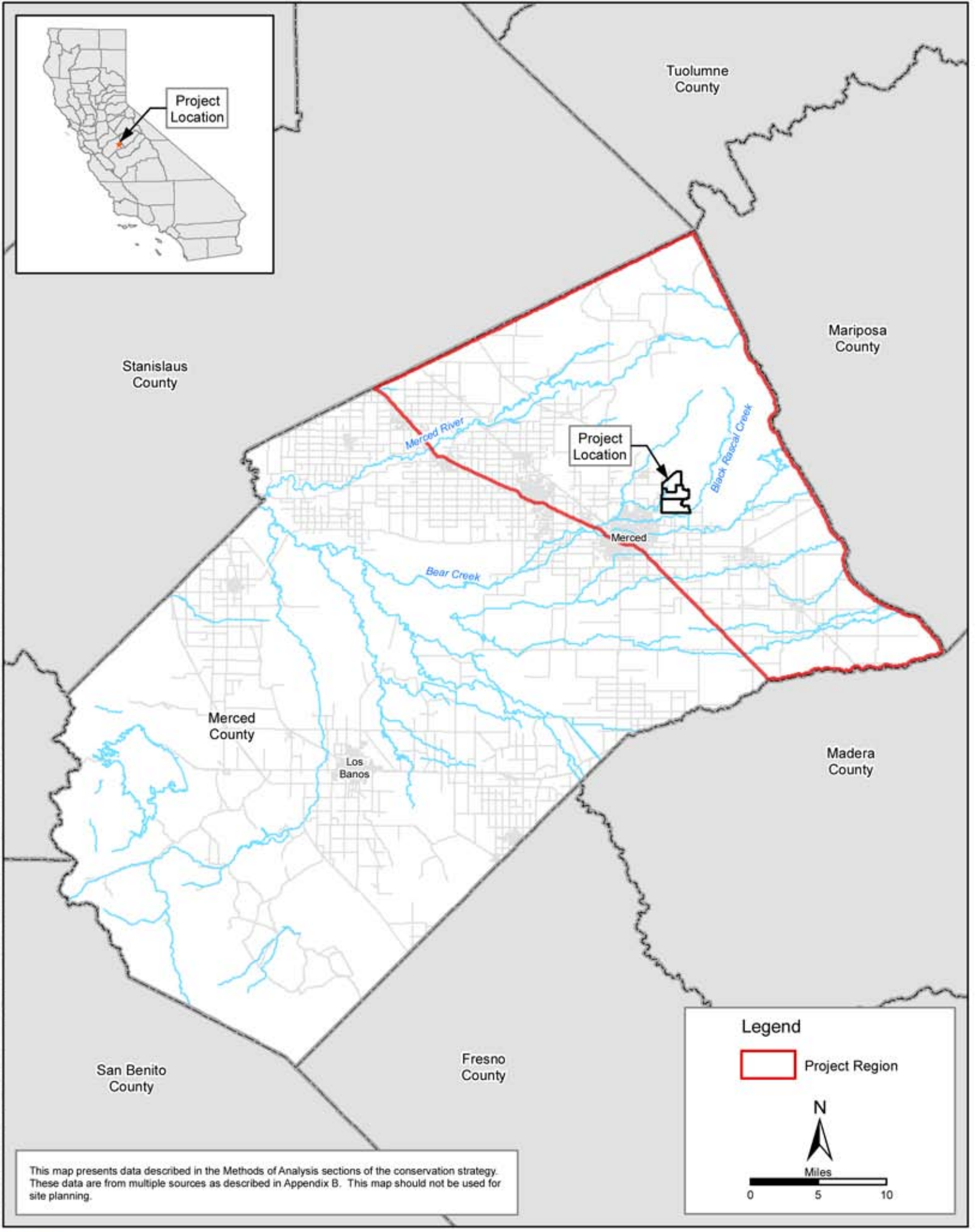
In late 2000, in response to agency input and public concerns regarding the potential direct and indirect impacts on biological resources at the Lake Yosemite site, UC began exploring an alternate location for the project. Shortly thereafter, UC relocated the proposed site of the UC Merced Campus and the University Community from the Lake Yosemite site to an adjacent site (the 2002 Proposed Project site). This change substantially reduced impacts on wetlands and biological resources.

UC commenced long-range planning and environmental review processes for the project at the new location. Concurrently, the County commenced the planning process to develop a University Community Plan (UCP) (as an amendment to the Merced County General Plan) for development of a supporting community adjacent to the UC Merced Campus.

In February 2001, UC and the County initiated environmental review and planning processes for the 2002 Proposed Project site. UC circulated the proposed Long-Range Development Plan (LRDP) (UC Merced 2001) and the associated LRDP Draft Environmental Impact Report (EIR) (URS Corporation 2001a) for public review and comment. The County circulated the Draft UCP (EIP Associates 2001a) and a Draft EIR (EIP Associates 2001b). The public review and comment periods for both EIRs concluded on October 7, 2001; on January 7, 2002, UC published the LRDP Final EIR (URS Corporation 2002a). On January 17, 2002, the UC Board of Regents (Regents) certified the LRDP Final EIR (URS Corporation 2002a) and approved the LRDP for the UC Merced Campus (UC Merced 2002). In December 2004, the County certified the Final EIR for the UCP (EIP Associates 2004a) and approved the UCP (EIP Associates 2004b).

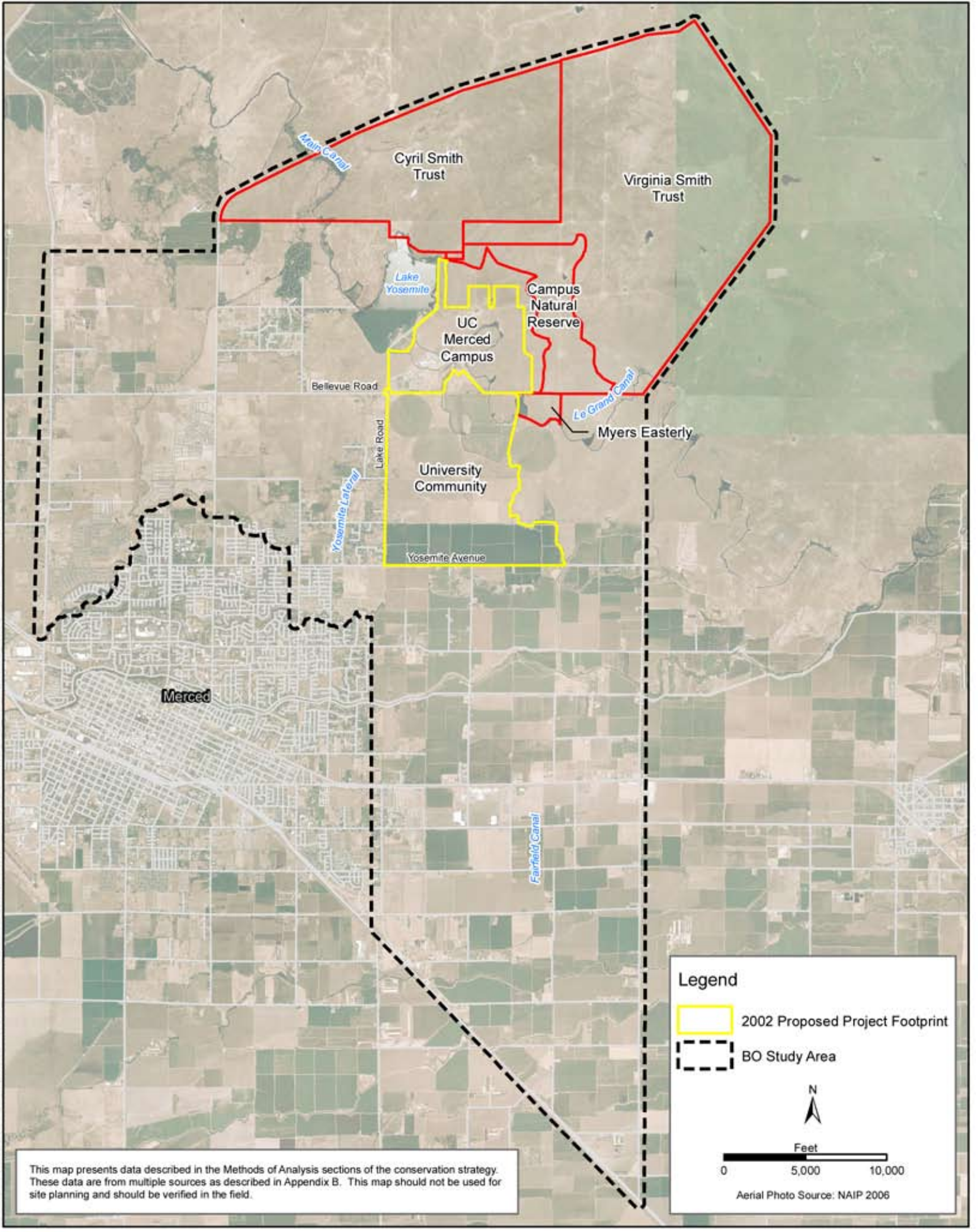
The Corps submitted the 2002 Biological Assessment (BA) (EIP Associates 2002a) to USFWS on February 25, 2002, and USFWS initiated formal consultation under Section 7 of the federal Endangered Species Act (ESA). The 2002 BA (EIP Associates 2002a) was submitted to USFWS on February 25, 2002. UC submitted a supplement to the BA (Jones & Stokes 2002a) to the Corps and USFWS on July 8, 2002. On August 19, 2002, USFWS issued its 2002 BO to the Corps.

Both USFWS and the Corps recognized that the environmental review process under the National Environmental Policy Act (NEPA) for the CWA Section 404 permit (consideration of alternatives) could result in modification of the proposed UC Merced Campus and University Community footprint. Therefore, the BO (U.S. Fish and Wildlife Service 2002) did not address the current project specifically, but instead evaluated the 2002 Proposed Project within a broader *study area* that included the 2002 Proposed Project. The *study area* for the BO, an approximately 2-mile zone around the 2002 Proposed Project site (Figure 1-2), comprises a combination of agriculture lands, developed lands, and undeveloped natural lands. The BO also addressed the related installation of roads and other public infrastructure (the Infrastructure Project) and the 2,000-acre University Community as interrelated projects.



ICF Jones & Stokes

Figure 1-1
Project Location



ICF Jones & Stokes

Figure 1-2
UC Merced Study Area

During consultation with USFWS, UC and the County agreed to a set of project *Parameters* that were incorporated into the BO (U.S. Fish and Wildlife Service 2002). The Parameters describe commitments that UC and the County agreed to adopt for additional planning, analysis, and actions that would be conducted in response to the final selection of a preferred alternative through the NEPA and Section 404(b)(1) processes. The BO also included *Conservation Measures*—a set of measures relating to compensation, campus design, construction, operations and maintenance, and other elements—that are designed to avoid, minimize, and compensate for potential effects of the Proposed Actions on listed species.

The Parameters and their accompanying Conservation Measures provided the foundation for subsequent consultation under the ESA and project planning. Parameter 1 specifies the requirement to prepare this Conservation Strategy.

To meet the requirements of the Parameters and Conservation Measures, UC initiated a substantial replanning effort for the UC Merced Campus and University Community. The effort involved extensive coordination with a number of agencies and organizations, including USFWS, the Corps, the U.S. Environmental Protection Agency (EPA), California Department of Fish and Game (DFG), the County, and environmental organizations. Consequently, UC submitted a revised CWA Section 404 permit application (February 2008) that included a substantially revised footprint for the UC Merced Campus and University Community (see *Project Components* below) and has prepared a revised version of this Conservation Strategy for review to comply with Parameter 1 of the BO (U.S. Fish and Wildlife Service 2002). These changes in the UC Merced Campus and University Community footprint require an amendment of the 2002 LRDP (to reflect the new configuration and land use plan). This revision is in process.

Proposed Action

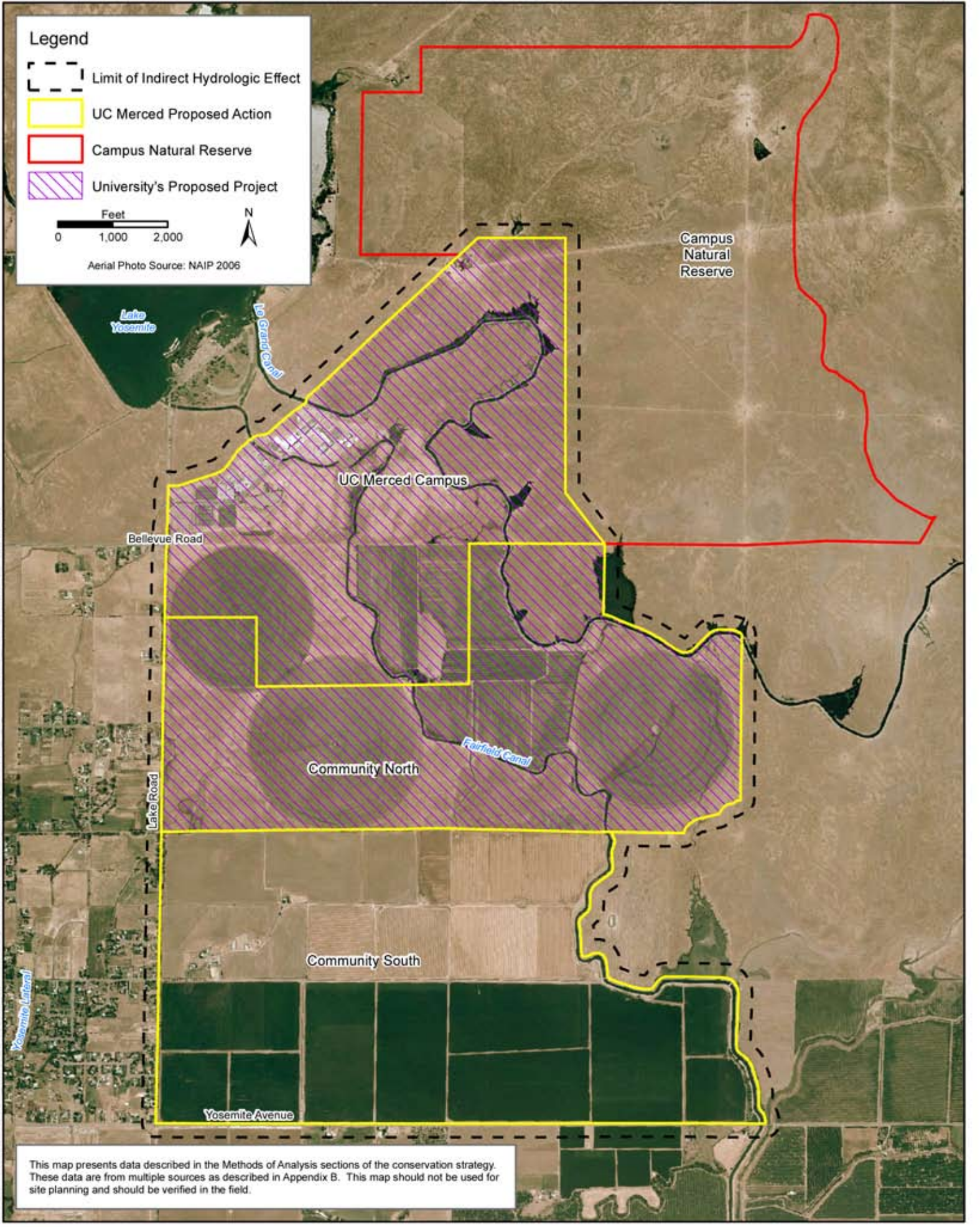
Project Components

The *Proposed Action* consists of development of the UC Merced Campus and the contiguous University Community, as well the acquisition and management of Conservation Lands to compensate for the potential adverse effects on sensitive biological resources that would result from construction and operation of the campus and community. The University Community would be developed by two separate entities, University of California Land Company (UCLC) and LWH Farms, as described below. The components of the Proposed Action are as follows.

- *UC Merced Campus* (Corps permit # 199900203) is being developed in four phases. The USFWS has determined that development of Phase 1 of the UC Merced Campus was not likely to adversely affect federally listed species. The Phase 1 Campus is partially constructed and operating. The remainder of the UC Merced Campus, referred to as *campus buildout* (Phases 2 through

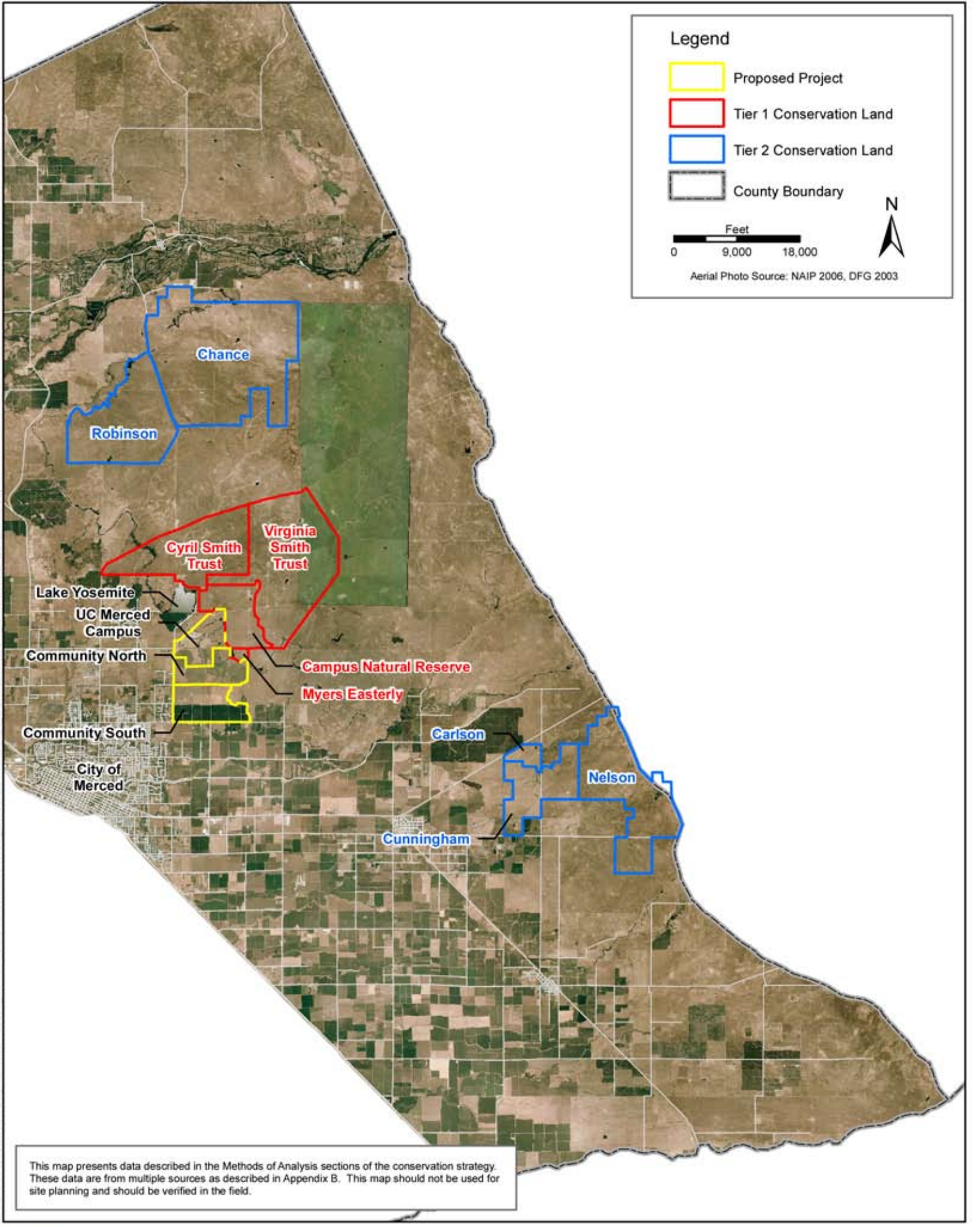
4), is scheduled for phased development. The UC Merced Campus would encompass 815 acres and would comprise the academic core, support services, student and faculty housing, parking, circulation, recreation, and open space. The amended LRDP for the UC Merced Campus identifies a Campus Natural Reserve (CNR) associated with the campus. This 1,307-acre area is dedicated to open space, conservation, scientific research, and related uses (Figure 1-3).

- *Community North* is the northern portion of the University Community located adjacent to and immediately south of the UC Merced Campus. The Community North would be developed by the UCLC—a partnership between UC and the VST. This approximately 833-acre development is adjacent to the UC Merced Campus on lands owned by UCLC and has been planned to provide housing, retail, a research park, entertainment venues, schools, park space, and other services to serve the student, faculty, and staff populations (Figure 1-3).
- *Community South* is the southern portion of the University Community immediately south of Community North. The Community South area is approximately 1,118 acres in size. The property is owned by LWH Farms. LWH Farms has not filed a Corps application to fill wetlands. Community South is included in this Conservation Strategy because it is an interdependent and interrelated action that ultimately will result in the loss of habitat and other open space uses.
- C*onservation Lands* are lands acquired specifically to mitigate impacts resulting from implementation of the University's Proposed Project (defined below). UC and the Wildlife Conservation Board (WCB) have already conserved more than 26,000 acres of land in the project region (Table 1-1, Figure 1-4). The Conservation Lands are generally divided into two categories: Tier 1 properties (the VST Preserve, Cyril Smith Trust [CST] property, Myers Easterly, and CNR) and Tier 2 properties (Robinson, Chance, Cunningham, Carlson, and Nelson properties). Tier 1 properties are owned in fee title by UC Merced, The Nature Conservancy (TNC), and UCLC. Tier 1 properties are adjacent to the proposed UC Merced Campus. Most of the Tier 1 properties (except CST) are subject to adaptive management and monitoring activities. Tier 2 properties consist of Conservation Lands that have been placed under conservation easements held by either the California Rangeland Trust (CRT) or TNC. All of the conservation properties are permanently protected from future development.



ICF Jones & Stokes

Figure 1-3
UC Merced Proposed Action and University's Proposed Project



ICF Jones & Stokes

Figure 1-4
Conservation Lands Associated with the UC Merced Project

Table 1-1. UC Merced Associated Conservation Lands

Property	Total Area (acres)
Tier 1 Properties	
Virginia Smith Trust Preserve	5,030
Cyril Smith Trust Property	3,070
Campus Natural Reserve	1,307
Myers Easterly	91
Subtotal	*9,498*
Tier 2 Properties	
Robinson	3,595
Chance	7,619
Cunningham	1,761
Carlson	305
Nelson	3,861
Subtotal	*17,141*
Total	**26,639**

Terminology

Because of the complexity of the project in terms of history, ownership, and managing entities, several terms have been developed with very specific meanings to help clarify these issues. These terms are defined below.

- The *Proposed Action*, also referred to as the project, comprises the UC Merced Campus, the University Community, and the Conservation Lands.
- The *project footprint* is the footprint of three project components (the UC Merced Campus, Community North, and Community South).
- The *University's Proposed Project* comprises only the UC Merced Campus and Community North.
- The *project area* includes the project footprint and associated Conservation Lands (Figure 1-4).
- The *study area* is defined in the BO as an approximately 2-mile zone around the 2002 Proposed Project site (Figure 1-2).
- The *project region* comprises the approximately 580 square miles east of State Route (SR) 99 in Merced County (Figure 1-1).

Project Setting

Project Location

The project area is located in eastern Merced County, a transition area between the Sierra Nevada foothills to the east and the flat San Joaquin Valley floor to the west. The project footprint is located 2 miles northeast of the city limits of Merced, immediately southeast of Lake Yosemite Regional Park (Figure 1-4).

Environmental Setting

Habitat types in the project area include annual grassland, agricultural land, vernal pool ecosystems and associated swales, seasonal wetlands, stock ponds, and seasonal freshwater marsh. Annual grassland habitats are the most common habitat in the project area, comprising over half of the UC Merced Campus and Community North and most of the Conservation Lands. Annual grasslands in the project area are dominated by nonnative Mediterranean grasses but retain a component of native plant species.

The annual grasslands provide habitats capable of supporting a number of sensitive wildlife species, including nesting habitat for northern harrier (*Circus cyaneus*) and western burrowing owl (*Athene cunicularia hypugea*) and potential foraging habitat for white-tailed kite (*Elanus leucurus*), merlin (*Falco columbarius*), prairie falcon (*Falco mexicanus*), northern harrier, Swainson's hawk (*Buteo swainsoni*), golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), burrowing owl, short-eared owl (*Asio flammeus*), mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanus*), California horned lark (*Eremophila alpestrisis actia*), loggerhead shrike (*Lanius ludovicianus*), tricolored blackbird (*Agelaius tricolor*), and numerous common raptors and other migratory birds.

Annual grasslands also provide habitat for a variety of mammals, including potential denning and dispersal habitat for San Joaquin kit fox (*Vulpes macrotis mutica*) and prey species such as the California ground squirrel (*Spermophilus beecheyi*) and California vole (*Microtis californicus*) for kit fox and other predators.

Annual grasslands in the project area also provide habitat for the California tiger salamander (*Ambystoma californiense*) and other reptiles and amphibians.

Agricultural lands in the project area occur primarily within the UC Merced Campus and University Community on lands that were historically annual grasslands containing vernal wetland habitats. Agricultural lands within the project footprint consist of center-pivot irrigated pasture used for grazing and hay production and cultivated row crops. These habitats provide potential dispersal habitat for San Joaquin kit fox as well as foraging habitat for special-status raptors and other migratory birds.

Vernal pool, swale, and clay slope wetlands are natural seasonal wetland habitats that occur primarily within grasslands within the UC Merced Campus, Community North, and Conservation Lands. These are sensitive habitats that support several special-status plant species: succulent owl's-clover (*Castilleja campestris* var. *succulenta*), Hoover's spurge (*Chamaesyce hooveri*), Colusa grass (*Neostapfia colusana*), San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), hairy Orcutt grass (*Orcuttia pilosa*), Hartweg's golden sunburst (*Pseudobahia bahiifolia*), and Greene's tuctoria (*Tuctoria greenei*). Several special-status invertebrates occupy these habitats: conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp (*B. lynchi*), midvalley fairy shrimp (*B. mesovallensis*), and vernal pool tadpole shrimp (*Lepidurus packardi*). Two special-status amphibians also occur in vernal pool ecosystems in the project area: California tiger salamander and western spadefoot (*Spea hammondii*).

Seasonal wetlands and artificial stock ponds in the project area consist primarily of artificially created or modified wetland habitats that may support special-status vernal pool plants and crustaceans, depending on ponding depth and duration, and may provide potential habitat for California tiger salamander and western spadefoot.

Seasonal freshwater marsh habitat in the project area is primarily the result of human-induced topographic and hydrologic modification associated with irrigation canals, stock ponds, and the enhancement of flows in seasonal streams. This vegetation type is found along the levees of the Le Grand and Fairfield Canals and in seepage areas adjacent to the canals. Seasonal freshwater marsh also occurs along the northernmost portion of Cottonwood Creek in the UCP area. Seasonal freshwater marsh provides potential habitat for western pond turtle (*Emys marmorata*), giant garter snake (*Thamnophis gigas*), and tricolored blackbird.

Conservation Strategy

In 2002, analyses were conducted for effects on wetland ecosystems and the above-identified special-status species. Based on the 2002 BA and Supplemental BA, Parameter 1 of the 2002 BO required the development of a Conservation Strategy that would be designed to provide a comprehensive strategy for the conservation of certain species and their habitats as set forth below.

1. *Development of Conservation Strategy*

    a. *The Applicants will prepare and implement, in coordination with USFWS and the California Department of Fish and Game (DFG), a comprehensive strategy for the conservation of San Joaquin kit fox, vernal pool branchiopods and plants and other protected species to guide the development and implementation of specific conservation for the Proposed Actions and as needed to assure that other development within the Study Area is consistent with the Conservation Strategy as described in Parameter 1b, below.*

    b. *The Conservation Strategy will include monitoring and adaptive management measures and be consistent with and intended to implement the Recovery Plan*

for Upland Species of the San Joaquin Valley, California, and any future federal recovery planning effort.

This Conservation Strategy has been developed to achieve the following aims, as stated in the BO (U.S. Fish and Wildlife Service 2002):

- Provide guidance for developing and implementing conservation measures to conserve wildlife and plant species affected by the Proposed Action.
- Summarize UC's implementation of this strategy and describe the role of the strategy in regional conservation.
- Assess the potential effects of the Proposed Action on state and federally listed species and sensitive habitats (San Joaquin kit fox, vernal pool ecosystems, and associated vernal pool crustaceans and plants), and other special-status species (defined in Chapter 4, *Other Special-Status Species*) in the project region.

Based on the extensive analyses conducted for effects on wetland ecosystems and special status species associated with the project, this Conservation Strategy includes all required construction and mitigation requirements to address biological resources effects associated with the Proposed Action and as further discussed in the 2008 BA Supplement. Table A-1 in Appendix A presents the complete list of 2002 BO requirements and relates these requirements to the Parameters in the BO (U.S. Fish and Wildlife Service 2002). All of these requirements are addressed in the following chapters of the Conservation Strategy.

To satisfy the Parameters, this Conservation Strategy presents an analysis of data collected on biological resources in the project region, including lands acquired as mitigation for the University's Proposed Project, and describes a strategy for resource conservation (Chapter 5) that addresses protection and mitigation needs for development within the study area. The strategy focuses on the ecology of, distribution of, and threats to 13 federally listed species of highest conservation concern in the project region.

- The species addressed in the Conservation Strategy include those identified as species of high conservation concern, based on analyses presented in the 2002 BA (EIP Associates 2002a), the 2002 BA Supplement (Jones & Stokes 2002a), and the 2002 BO and also through discussion with USFWS, DFG, and other entities. The following federally listed species are addressed in this Conservation Strategy:
- Succulent owl's-clover,
- Hoover's spurge,
- Colusa grass,
- San Joaquin Valley Orcutt grass,
- Hairy Orcutt grass,
- Hartweg's golden sunburst,
- Greene's tuctoria,

- Conservancy fairy shrimp,
- Vernal pool fairy shrimp,
- Vernal pool tadpole shrimp,
- California tiger salamander, and
- San Joaquin kit fox.

The midvalley fairy shrimp, which was proposed for listing in 2002, is also addressed, although USFWS determined in 2004 that the species did not warrant listing (Federal Register [FR] 69 3592–3598).

This page intentionally left blank.

Chapter 2

San Joaquin Kit Fox in the Project Region

This chapter addresses the capability of habitats in the project region to support San Joaquin kit fox, and the potential effects of the Proposed Action on kit fox and kit fox habitats.

Species Account

Populations of San Joaquin kit fox exhibit slightly varying ecological characteristics in different portions of the subspecies' range. The kit fox conservation strategy presented in this document is based on the characteristics associated with populations in the central portion of the range, defined in the *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Upland Species Recovery Plan), as Kings, Tulare, Fresno, Madera, San Benito, Merced, Stanislaus, and Monterey Counties (U.S. Fish and Wildlife Service 1998). Ecological information pertaining to the southern and northern populations is also presented in this chapter to engender a broader understanding of the taxon, as well as to facilitate assessment of the strategy's potential applicability for use in other regions.

Ecology

San Joaquin kit fox is one of two subspecies of kit fox (*V. macrotis*), the smallest canid species in North America. General physical characteristics of kit fox include a small, slim body; relatively large ears set close together; narrow nose; and a long, bushy, black-tipped tail tapering slightly toward the tip. The tail is typically carried low and straight. The coats of kit fox vary geographically and seasonally but are generally tan or yellowish-gray. The black-tipped guard hairs on the back give the dorsal coat a grizzled appearance.

San Joaquin kit fox are opportunistic feeders whose diets vary geographically, seasonally, and in concert with annual variations of species composition and abundance. In the central portion of the range, fecal samples have indicated that the preponderance of prey comprises the following species, listed in descending quantitative order: white-footed mice (*Peromyscus* spp.), insects, California ground squirrels (*Spermophilus beecheyi*), kangaroo rats (*Dipodomys* spp.), San

Joaquin antelope squirrels (*Ammospermophilus nelsoni*), black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (U.S. Fish and Wildlife Service 1998). Kangaroo rats, pocket mice, white-footed mice, and other nocturnal rodents are the chief prey species in the southern portion of the range; ground squirrels comprise the bulk of the diet in the northern portion of the range. Kit fox are predominantly nocturnal, but sometimes exhibit diurnal activity in early spring and summer, particularly when preying on ground squirrels (a diurnal species) (U.S. Fish and Wildlife Service 1998).

Kit fox home ranges vary from less than 1 square mile up to approximately 12 square miles. Kit fox may use a number of different dens in a year within their home range. They may move between dens four or five times during the summer months and one or two times during the pup-rearing season. Kit fox may construct their own dens, but it is commonly believed that in areas of heavier soils they more often enlarge the burrows of California ground squirrels into suitable dens.

Throughout the range, natal and pupping dens tend to be larger than temporary cover dens, with openings 8–10 inches in diameter that are generally taller than they are wide. In the central portion of the range, natal and pupping dens may have several of these openings; some may have a dirt apron in the form of a long tailing ramp of dirt with a runway down the middle. In the southernmost portion of the range, natal dens typically have from 2 to 18 entrances, some of which have from 3- to 6-foot ramp-shaped mounds of dirt in front. In the northern portions of the range, dens are generally placed higher than the surrounding terrain, for example on the lower portions of slopes, and lack the runways characteristic of dens in the central and southern portions of the range. In western Merced County, most dens are found on slopes of less than 10º, though a few are found on slopes of up to 55º. In the southern portion of the range, 95% of hillsides where kit fox dens are found have a slope of less than 40º, but natal and pupping dens are found on flatter ground with slopes of about 6º (U.S. Fish and Wildlife Service 1998).

Kit fox are believed to be monogamous and can, but generally do not, breed during their first year of adulthood. The breeding season begins during September and October when adult females begin to clean and enlarge natal or pupping dens. Mating and conception occur between late December and March. Gestation is 48–52 days, and litters of two to six pups are born sometime between late February and late March (U.S. Fish and Wildlife Service 1998).

Individual foxes may live to be more than 8 years old, but such longevity is rare. In a population of kit fox on the Naval Petroleum Reserve-1 in California, animals younger than 1 year old outnumbered older foxes 2.8:1. The annual adult mortality of kit fox has been estimated to be approximately 50%. Juvenile mortality rates are usually higher, approaching 70% (U.S. Fish and Wildlife Service 1998).

Limited data on dispersal are available for this taxon. However, studies of various fox species (including San Joaquin kit fox) reveal a relationship between dispersal distances and availability of unoccupied suitable habitat. When

unoccupied suitable habitat is available near natal habitat, dispersal distances tend to be short; when it is not, they tend to be longer. Kit fox in Utah (*V. m. macrotis*) have been known to disperse up to 40 miles, portions of which included unsuitable mountainous habitat. San Joaquin kit fox have been documented moving 54 miles between Camp Roberts Military Reservation in the Salinas Valley and the Carrizo Plain, some of which distance was through habitat unsuitable for long-term occupation; and moving 30 miles between Camp Roberts and Fort Hunter Liggett in the interior Coast Ranges. Moreover, although San Joaquin kit fox occur in areas of relatively flat topography in most of their range, they occur and have bred in areas of up to 30% slope in foothill habitats in the northern portion of their range (Orloff et al. 1986; EIP Associates 1993).

Distribution

Although the precise historical range of San Joaquin kit fox is unknown, it is believed to have extended from Contra Costa and San Joaquin Counties in the north to Kern County in the south. By the 1930s, the range had been reduced to the southern and western portions of the Central Valley. Surveys conducted between 1969 and 1975 extended the known range back into portions of its historical range in the northern San Joaquin Valley, including Contra Costa, Alameda, and San Joaquin Counties. In addition, kit fox were found in three counties outside the originally defined historical range: Monterey, Santa Clara, and Santa Barbara (Orloff et al. 1986).

The current known range of San Joaquin kit fox extends from central Contra Costa County south through Kern County and to the northeastern edge of Santa Barbara County (Figure 2-1). Three distinct core areas support the largest known extant populations: the Carrizo Plain Natural Area in San Luis Obispo County, natural lands in western Kern County, and the Ciervo-Panoche Natural Area of western Fresno and eastern San Benito Counties. Other areas that either support San Joaquin kit fox populations or have the potential to support them include the Salinas-Pajaro River watersheds (San Benito and Monterey Counties); Camp Roberts and Fort Hunter Liggett in Monterey County; western Madera County; western, central, and eastern Merced County; eastern Stanislaus County; northern Kings County; western Tulare County; and around the Bakersfield metropolitan area in Kern County (U.S. Fish and Wildlife Service 1998).

An extensive review of the distribution of San Joaquin kit fox in the project region revealed five reported occurrences in the last 30 years. Only one of these records involved multiple individuals; this observation of two juveniles and a single adult, reported from Atwater in the early 1980s, is the only evidence of reproduction in the project region. Two observations of single individual kit fox have been reported in the study area; both occurred in the Black Rascal Creek watershed at the eastern boundary of the study area, one in 1999 and the other in 2001.

Habitat Use

In the central portion of the range, San Joaquin kit fox is associated with the following natural vegetation communities: Valley Sink Scrub, Interior Coast Range Saltbush Scrub, Upper Sonoran Subshrub Scrub, Annual Grassland, and the remaining native grasslands. Kit fox in the central region also use grazed nonirrigated grasslands, tilled or fallow fields, irrigated row crops, and orchards and vineyards—presumably because of the predominance of these cover types in the region (U.S. Fish and Wildlife Service 1998).

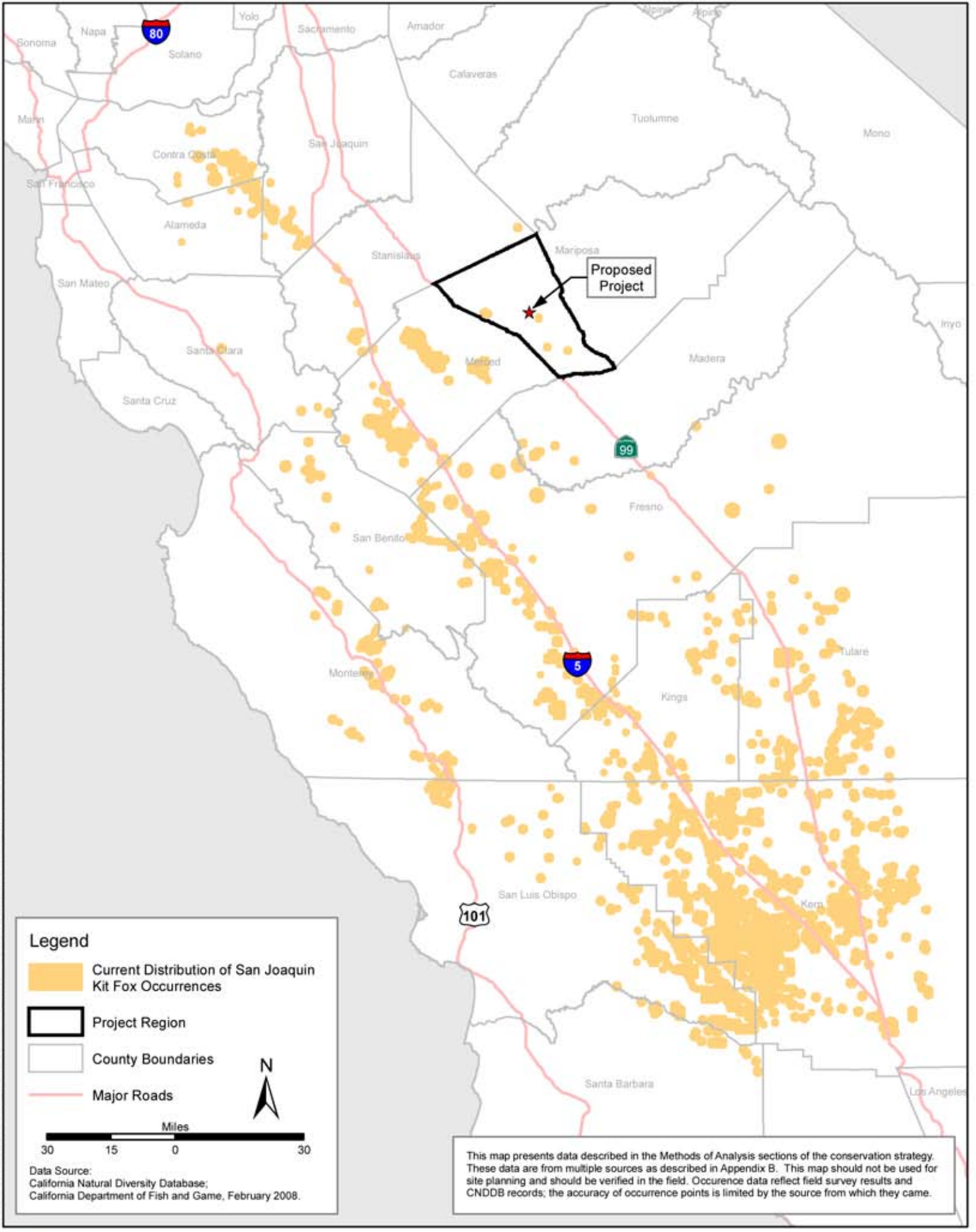
Kit fox prefer loose-textured and deeper soils, but have been found on a wide range of soil types. Dens are usually scarce in areas with shallow soils, impenetrable hardpan layers, and high water tables. Where soils make digging difficult, foxes frequently use and modify burrows built by other animals, particularly those of California ground squirrels. Structures such as culverts, abandoned pipelines, and well casings also may be used as den sites (U.S. Fish and Wildlife Service 1998).

Threats

Throughout the subspecies' range, San Joaquin kit fox populations have declined substantially during the twentieth century. The 1983 recovery plan (U.S. Fish and Wildlife Service 1983) estimated the pre-1930 population of adult San Joaquin kit fox at 8,667–12,134 individuals. By 1975, the estimated population had declined to 6,961 adults, representing a 20–43% decline. The present number of kit fox across the range is unknown, but abundance has probably continued to decline (U.S. Fish and Wildlife Service 1983).

San Joaquin kit fox are vulnerable to predation by large raptors, coyotes, domestic dogs, and bobcats. Nonnative red fox (*Vulpes vulpes*) and native grey fox (*Urocyon cinereoargenteus*) are potential competitors. However, the single largest threat to the subspecies is habitat loss, particularly from conversion of natural lands to cropland. By 1979, an estimated 6.7% of the original natural lands comprising the floor of the San Joaquin Valley south of Stanislaus County remained untilled and undeveloped. The resulting reduction and isolation of populations can result in inbreeding, loss of genetic diversity, and susceptibility to stochastic events. Other threats include diseases of wildlife and domestic species, pesticide toxicity (either through direct exposure or through secondary poisoning from consuming contaminated prey), shooting, poisoning, electrocution, and collisions with motor vehicles.

From the 1950s to the 1970s, extensive ground squirrel control was practiced in foothill rangelands to reduce competition for livestock forage. For example, ground squirrels in Contra Costa County were essentially eliminated during this period by comprehensive poisoning campaigns. It is likely that this led to a decline in the San Joaquin kit fox population in that area because of direct toxicity and the removal of the chief prey base (Orloff et al. 1986). Because little work has been done on the apparent remnant population of kit fox in eastern



ICF Jones & Stokes

Figure 2-1
Distribution of San Joaquin Kit Fox Occurrences in California

Merced County and other east-side valley-foothill grasslands, it remains unclear whether low kit fox abundance in these areas reflects natural conditions (e.g., unfavorable soil conditions, high water table, shortage of summer water), the results of past land use and mortality factors (especially rodent control), or conditions related to current land uses.

In the project region, potential linkage corridors of natural lands that connect core populations with satellite populations are under heavy threat from land conversion. In particular, the potential linkage corridor along Sandy Mush Road is threatened by agricultural conversion, private development projects, and potentially illegal deep ripping. In 2005 and 2006, over 3,500 acres of suitable dispersal habitat in eastern Merced County was impacted by unauthorized actions (Jones pers. comm.). The majority of these actions occurred in the vicinity of Buchanan Hollow Road and the Chowchilla River. Potentially illegal actions such as deep ripping pose a significant threat to San Joaquin kit fox dispersal and breeding habitat because they often precede conversion to incompatible agricultural development (i.e., vineyards, orchards, and other permanent or semi-permanent crop types) or urban development.

Methods of Habitat Analysis

To develop a conservation strategy for San Joaquin kit fox, it was necessary to assess the distribution and abundance of habitats in the project region capable of supporting both residence (i.e., breeding) and dispersal activities. The analysis was based largely on data collected during several studies conducted on behalf of UC and the County, and was largely funded through interagency agreements with DFG. These studies of the project area and other lands within the project region are summarized below.

- Surveys for special-status animals (EIP Associates 1999a, 2001c, 2001d, 2001e; URS Corporation 1999, 2000; Helm and Vollmar 2002; Laabs et al. 2002; Laabs and Allaback 2002; Orloff 2002a, 2002b; Pierson and Rainey 2002).
- Studies estimating effects or making management recommendations (URS Corporation 2001b; EIP Associates 2002a; Jones & Stokes 2002a; Noss et al. 2002; Robins and Vollmar 2002; U.S. Fish and Wildlife Service 2002).

The data from these studies were compiled by DFG into geographic information systems (GIS) datasets using ArcInfo software (ESRI Corporation, Redlands, CA). The metadata for these data sources are included in Appendix B; the methodologies of the analyses are described below.

Modeling Residence and Dispersal Habitat in the Project Region

A habitat suitability model for San Joaquin kit fox was developed to assess the distribution, abundance, and relative suitability of lands in the project region. Habitats were categorized as suitable for residence (i.e., denning), suitable for dispersal, or unsuitable. The classification was based primarily on land cover type but also took into account the suitability of adjacent land cover types. Slope also was evaluated as a potential discriminator of habitat capability, but virtually the entire project region is in a slope class that is considered suitable as kit fox residence habitat. It should be noted that habitat suitable for residence is also suitable for dispersal. Unsuitable habitat is unsuitable for both residence and dispersal.

Land cover data were assembled from a composite of datasets for eastern Merced County representing the most current land use data available: the California Department of Water Resources (DWR) Land Use/Land Cover, Department of Conservation Important Farmlands Mapping Program, DFG/Ducks Unlimited California Central Valley Wetland and Riparian, California Department of Forestry and Fire Protection (CDF) Hardwoods, Gap Analysis Project (GAP) vegetation, and CDF CALVEG2000.

All lands within the project region were assigned to one of the following eight land cover categories: grassland, agricultural field, seasonal wetland, oak woodland, riparian, open water, urban, and other developed and disturbed lands. The extent of vernal wetlands present in grassland habitats was not quantified for this assessment, despite evidence that suitability of habitat for kit fox residence may decrease as the extent of vernal wetlands increases (U.S. Fish and Wildlife Service 1998); consequently, in some areas, the analysis may overestimate the value of grassland habitats.

The effects of adjacent land cover types on kit fox habitat were incorporated into the model by assuming that lands within 200 meters of unsuitable land cover types were significantly degraded. The conservative buffer distance of 200 meters (656 feet) was used because specific distances from unsuitable land uses that preclude either dispersal or residence have not been established for this species.

Suitability Ratings

Grassland is considered the preferred land cover type. Oak woodland and riparian land cover types are unsuitable as residence habitat because kit fox tend to avoid areas with extensive tree cover but may use dens in wooded area temporarily during dispersal. The frequent ground disturbance and low prey availability associated with agricultural fields (row crops, orchards, and vineyards) makes them more suitable for dispersal than residence; kit fox sometimes den in areas of natural cover close to cultivated areas. Urban areas

are considered unsuitable, despite evidence of localized use of urban areas in the vicinity of Bakersfield (U.S. Fish and Wildlife Service 1998). Suitability ratings based on land cover types are shown in Table 2-1.

Table 2-1. Suitability Ratings of Land Cover Types for Residence and Dispersal of San Joaquin Kit Fox

	Suitability Rating		
Variable	Residence	Dispersal	Unsuitable
Land cover	Grassland	Agricultural field Seasonal wetland Oak woodland Riparian	Open water Urban Other developed and disturbed lands

Note: The association of land cover types with habitat categories was based on published and unpublished literature, Jones & Stokes file data, discussions with the U.S. Fish and Wildlife Service regarding the effect of slope attributes, and professional judgment based on field experience.

Key references consulted were Hall 1983; Berry et al. 1987; Reese et al. 1992; EIP 1993; Orloff et al. 1986; U.S. Fish and Wildlife Service 1998; Warrick and Cypher 1998; Koopman et al. 2000.

Effects of the Proposed Action

Effects of the Proposed Action were evaluated at both a local and a regional scale. The evaluations of effects at the local scale are presented for both the University's Proposed Project and the Proposed Action.

Local Effects of the University's Proposed Project and the Proposed Action

Construction of the University's Proposed Project would result in conversion of approximately 1,414 acres of kit fox habitat, comprised of approximately 804 acres of residence habitat and 610 acres of dispersal habitat (Table 2-2). In addition, the project would result in degradation of approximately 555 acres of kit fox habitat, comprised of approximately 489 acres of residence habitat and 66 acres of dispersal habitat (Table 2-3).

Construction of the Proposed Action (i.e., the University's Proposed Project and Community South) would result in conversion of a total of approximately 2,444 acres of kit fox habitat, comprised of approximately 823 acres of residence habitat and 1,621 acres of dispersal habitat (Table 2-2). In addition, the Proposed Action would result in degradation of approximately 872 acres of kit fox habitat, comprised of approximately 531 acres of residence habitat and 341 acres of dispersal habitat (Table 2-3).

These habitat losses would occur within lands identified in the recovery plan as part of a contiguous band of potential habitat that should be maintained in suitable land cover types (U.S. Fish and Wildlife Service 1998).

Table 2-2. Direct Local Effects of the University's Proposed Project and the Proposed Action on Habitat Capable of Supporting San Joaquin Kit Fox (acres)

Suitable Habitat Affected	University's Proposed Project			Proposed Action	
	UC Merced Campus	Community North	Total	Community South	Total
Residence	430	374	804	19	823
Dispersal	175	435	610	1,011	1,621
Total habitat	605	809	1,414	1,030	2,444

Table 2-3. Indirect Local Effects of the University's Proposed Project and the Proposed Action on Habitat Capable of Supporting San Joaquin Kit Fox (acres)

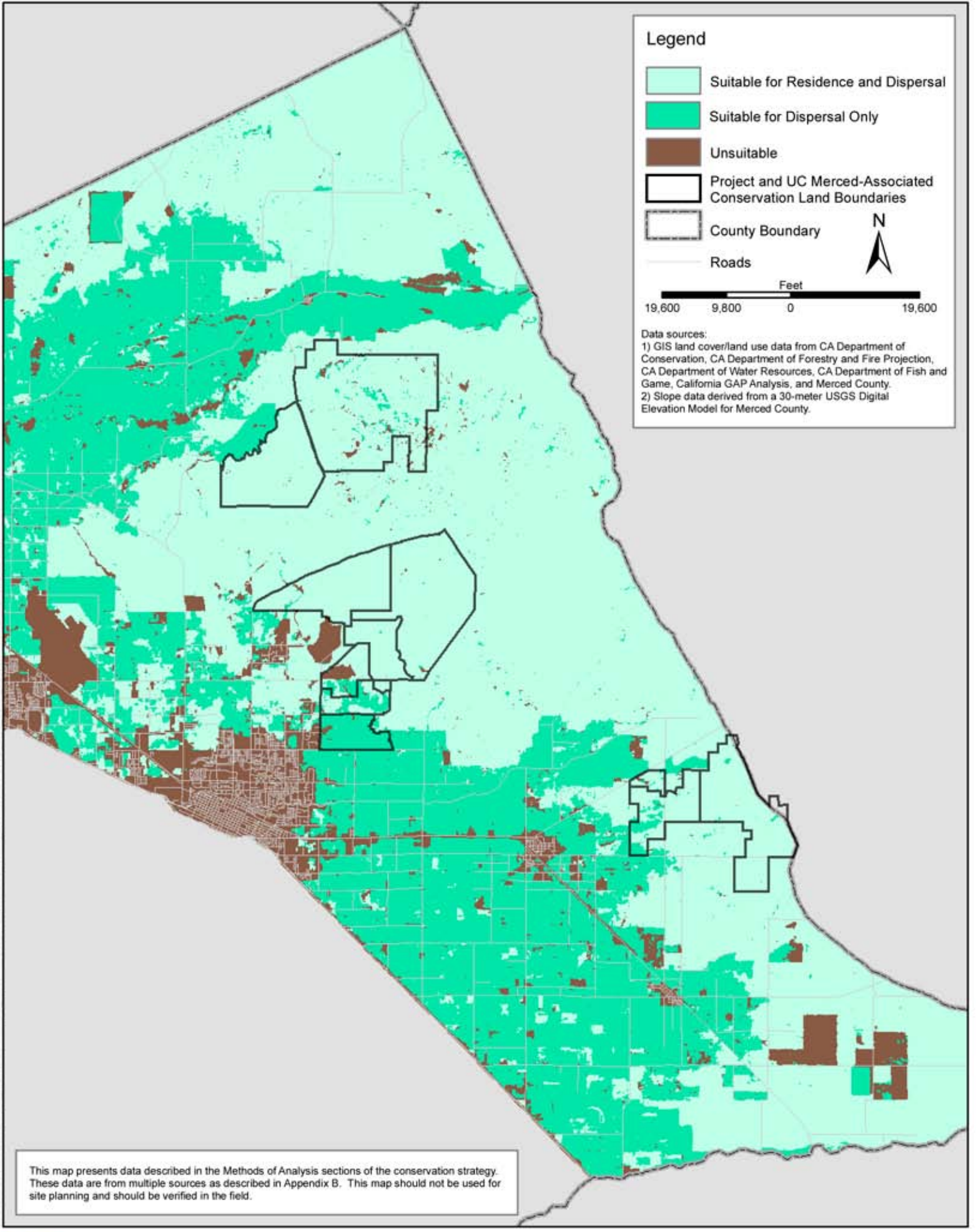
Suitable Habitat Affected	University's Proposed Project			Proposed Action	
	UC Merced Campus	Community North	Total	Community South	Total
Residence	290	199	489	42	531
Dispersal	21	45	66	275	341
Total habitat	311	244	555	317	872

However, these losses would be offset by the permanent conservation of approximately 25,900 acres of kit fox habitat, the majority of which are comprised of residence habitat (Table 2-4). Compensation lands permanently conserve over 7.5 times the amount of habitat converted or degraded by construction and operation of the Proposed Action.

Regional Effects of the University's Proposed Project and the Proposed Action

Of the approximately 378,491 acres in the project region, 48% (180,431 acres) are in habitats capable of supporting San Joaquin kit fox. An additional 150,644 acres (41%) are capable of supporting kit fox dispersal. Currently, only about 40,418 acres (11%) of the project region is unsuitable for San Joaquin kit fox. The distribution of residence, dispersal, and unsuitable habitats in the project region are depicted in Figure 2-2.

As noted above, construction of the Proposed Action would result in conversion of approximately 2,444 acres of kit fox habitat, and degradation of an additional



ICF Jones & Stokes

Figure 2-2
Habitat Suitability for San Joaquin Kit Fox in the Project Region

872 acres of habitat. These losses represent approximately 1% of the total suitable habitat (i.e., residence and dispersal habitat) in the project region.

Table 2-4. Acres of Residence and Dispersal Habitat for San Joaquin Kit Fox on Conserved Lands of the Proposed Action (acres)

	Type of Habitat Conserved		
Conserved Lands	Residence	Dispersal	Total
Tier 1 Properties			
Campus Natural Reserve	1,291 (135 acres degraded)	12	1,303
Cyril Smith Trust	2,997	30	3,027
Virginia Smith Trust	4,933	52	4,985
Myers Easterly	91 (52 acres degraded)	0	91
Subtotal	*9,312*	*94*	*9,406*
Tier 2 Properties			
Carlson	229	52	281
Chance	6,265	832	7,097
Cunningham	1,350	395	1,745
Nelson	3,730	115	3,588
Robinson	3,508	36	3,544
Subtotal	*15,082*	*1,430*	*16,512*
Total	**24,394**	**1,524**	**25,918**

The nearest documented breeding population of San Joaquin kit fox occurs approximately 20 miles southwest of the project area along Sandy Mush Road; it appears likely that individuals dispersing from this population or other localized breeding areas could use portions of the project region as a movement corridor to reach grassland habitat to the north and east (Figure 2-2). Because agricultural and developed lands are concentrated in the western half of the project region, potential San Joaquin kit fox dispersal corridors are most likely restricted to the eastern portion of the project region. Potential dispersal corridors are at least 1 mile wide throughout, and 4–5 miles wide north and east of Lake Yosemite.

USFWS has identified areas where potential dispersal corridors should be established through acquisition and management of conservation easements and incentive programs to preserve suitable habitat through zoning, acquisition, and other mechanisms (U.S. Fish and Wildlife Service 1998). These corridors would connect the remaining habitat on the valley floor with habitat in the foothills surrounding the San Joaquin Valley (Figure 2-3). One such identified corridor is

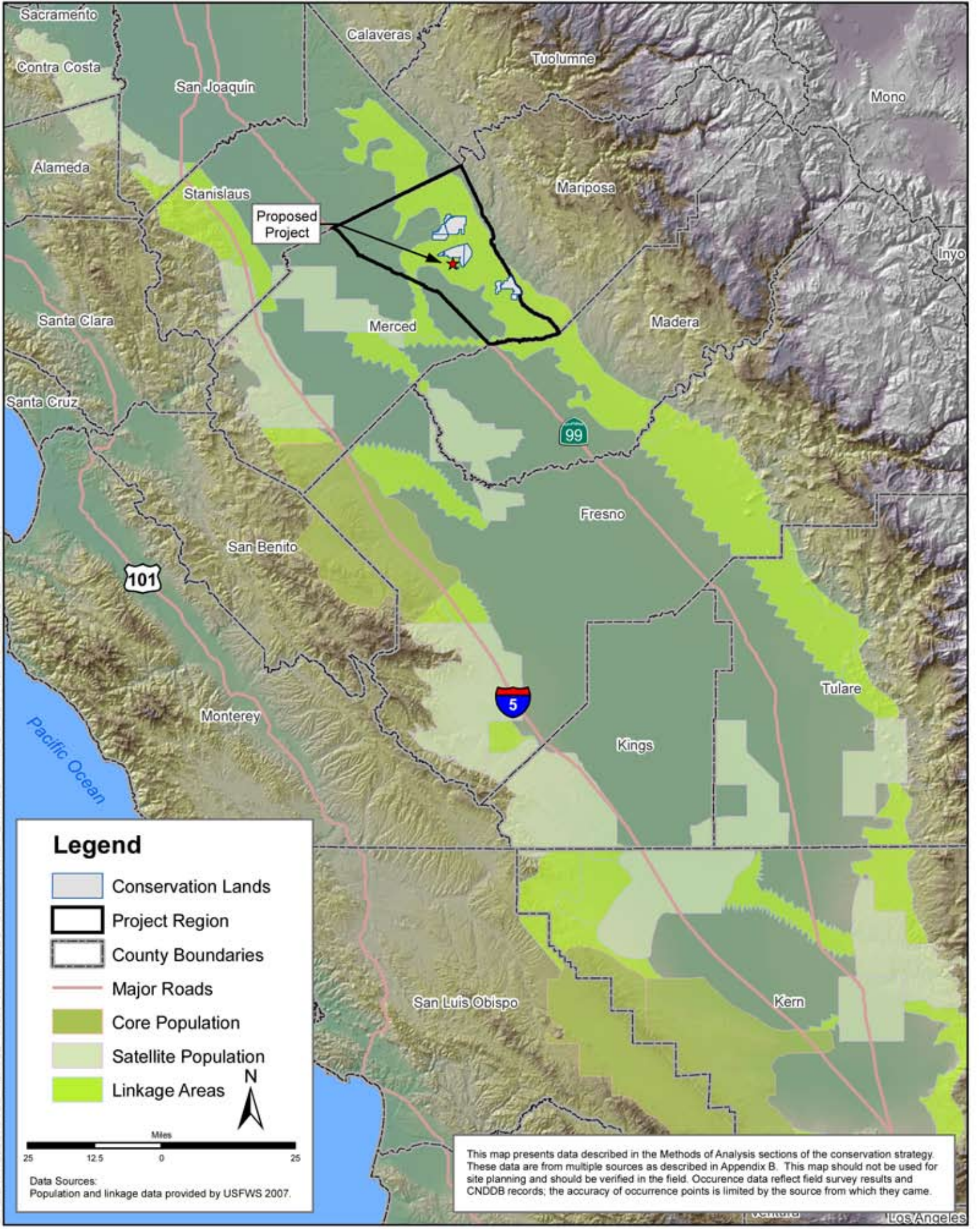
in the vicinity of Sandy Mush Road in Merced County. Another potential corridor has been identified running north to south from west of Merced to Sandy Mush Road. These corridors would connect the national wildlife refuges and state wildlife areas in Merced County with the northeastern edges of the San Joaquin Valley and with natural areas farther south in Madera and Fresno Counties (Figure 2-3). In conjunction with the linkage corridors, USFWS has identified the natural lands and compatible farmlands in eastern Merced County as areas that should be maintained and preserved for San Joaquin kit fox dispersal habitat. These areas encompass a variety of habitats, including grasslands, vernal pool systems, wetlands, oak woodlands, and farmlands.

The Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998, pg. 183) includes generalized recovery criteria for the kit fox, including:

- Secure and protect specified recovery areas from incompatible uses,
- Approve and implement management plans for recovery areas that include survival of the species as an objective, and
- Population monitoring in specified recovery areas shows stable or increasing populations in core and satellite areas during one precipitation cycle.

The recovery plan also includes site-specific protection requirements to meet delisting criteria. For the kit fox in the eastern Merced County region (part of the northern range and valley edges identified in the recovery plan), the protection level is set at 80% of existing potential habitat (U.S. Fish and Wildlife Service 1998, pg. 188). More specific guidance regarding the maintenance of linkage areas around the San Joaquin Valley edge (Recovery Task 5.3.1) specifies that 90% of existing natural lands should be preserved and that grazing and other compatible land uses should be maintained (U.S. Fish and Wildlife Service 1998, pg. 223).

Although implementation of the Proposed Action would eliminate 2,444 acres of kit fox habitat on the valley edge, this acreage is equivalent to less than 1% of the natural lands remaining in the northeast valley edge identified in the Upland Species Recovery Plan. However, implementation of the Proposed Action also will result in permanent protection of approximately 25,661acres of suitable kit fox habitat, or about 7% of the natural lands remaining in the northeast valley edge. These lands contain high-quality kit fox habitats, are permanently protected, and are managed for habitat values; they therefore contribute to meeting the recovery criteria identified in the Upland Species Recovery Plan.



ICF Jones & Stokes

Figure 2-3
Core and Satellite Populations of San Joaquin Kit Fox and Potential Linkage Corridors Identified by the USFWS in Relation to the Project Region

Chapter 3

Vernal Pool Ecosystems and Associated Special-Status Species in the Project Region

This chapter examines the existing conditions in the project area and region as they pertain to vernal pool ecosystems and the dependent special-status species that were addressed in the 2002 BO. It also analyzes the effects of the Proposed Action on these biological resources.

Vernal Pool Ecosystems

Description and Regional Distribution

Vernal pool ecosystems are seasonally wet areas that form in topographic depressions and fill with rain water each winter. A typical vernal pool can be characterized by standing water in winter, colorful plants and flowers in spring, and dry conditions through summer. Vernal pool ecosystems that occur in the project region include vernal pools, swales, and clay playas—each of which has its own distinctive characteristics and supports a particular group of plants and animals. Many species that are adapted to this annual cycle of wet and dry periods are found only in vernal pools and are therefore sensitive to the destruction or degradation of these unique ecosystems. Vernal pool ecosystems once were widely distributed throughout the Central Valley (Figure 3-1); however, habitat conversion for agricultural and urban development is responsible for the destruction of an estimated 97% of the historical extent of these habitats (Holland 1998).

Nine geologic formations comprise the geomorphic surfaces on which most of the project region's vernal pools, swales, and clay playas occur. The vernal pools, swales, and clay playas on each of these formations represent different ecosystem types in the Bainbridge (2002) geomorphic classification of vernal pools. Relationships between species distributions and these formations have been suggested (Platenkamp 1998; Helm and Vollmar 2002). The analysis of species distribution across geologic formations conducted in support of this Conservation Strategy indicated that—although some species distributions were correlated with geologic formations—all species occur on more than one

formation, and vernal pools on any formation represent potential habitat for vernal pool species (Appendix C).

The formations in the project region differ in the properties of the soils and wetlands that develop on them (Vollmar 2002) and in the density of vernal pools, swales, and clay playas they support. The formations also differ in the degree to which their historical wetlands have been converted or degraded. The distribution and conservation status of vernal pool ecosystems (i.e., the acreage of historically present vernal pool ecosystems that have been converted or degraded, or that remain intact) across geologic formations, is presented in Table 3-1 and depicted in Figures 3-2a and b and 3-3a and b.

The density of vernal pools is much greater on North Merced Gravels and the Riverbank Formation (52 and 35 acres of vernal pools per thousand acres, respectively) than on other soil types (7–24 acres per thousand acres). Similarly, the density of clay playas is much greater on the Mehrten Formation (52 acres of clay playa per hundred acres) than on any of the other formations (<1–20 acres per thousand acres).

Assuming that natural lands within 200 meters (656 feet) of urban development or major roads are potentially degraded, approximately 34% of the 194,000 acres of natural land in the project region is potentially degraded. Significantly, only 20% of vernal pools and 9% of clay playas in the project region occur on potentially degraded lands. This means that a significant portion of vernal pools and playas that occur in the project region are within large, contiguous areas of natural land cover that have not been subjected to potential degradation from major roads, utility right-of-ways, or development.

Threats

The principal threat facing vernal pool ecosystems and the vernal pool species they support is conversion of lands to cultivated agricultural (i.e., irrigated agriculture) and urban development. Throughout the Central Valley, more than three-quarters of the historical acreage of vernal pools has been converted for agricultural or urban land uses (Holland 1998). Vernal pool habitat also can be lost or degraded by other activities that damage or puncture the hardpan (i.e., the water-restrictive layer underlying the pool) or by activities that destroy or degrade uplands that contribute water to vernal pools. Alteration of adjoining uplands can affect vernal pools through sedimentation or by altering the timing, quantity, or quality of water entering the pools. Activities causing such loss or degradation include conversion of adjoining uplands from natural vegetation to developed or agricultural land uses; deep ripping of soils; water diversion or impoundment; and application of herbicides, fertilizers, or livestock wastes.

Additional threats may include intensive grazing and replacement of native plants by nonnative species. Heavy or year-round grazing by cattle may adversely affect vernal pool plants through herbivory and trampling (Robins and Vollmar 2002). However, grazing also may benefit vernal pool plant species by reducing

Table 3-1. Status of Vernal Pool Ecosystems in the Project Region

	Land Area				Vernal Pools and Swales			Clay Playas		
Geologic Unit[a]	Converted[b]	Potentially Degraded[c]	Presumed Intact[d]	Total	Potentially Degraded[c]	Presumed Intact[d]	Total	Potentially Degraded[c]	Presumed Intact[d]	Total
Ione	111 (1)	554 (6)	8,550 (93)	9,215 (100)	41 (19)	177 (81)	218 (100)	0 (0)	36 (100)	36 (100)
Laguna	1,441 (5)	3,673 (13)	23,397 (82)	28,511 (100)	72 (11)	583 (89)	655 (100)	14 (6)	219 (94)	233 (100)
Mehrten	2,451 (7)	5,967 (17)	26,419 (76)	34,837 (100)	150 (23)	510 (77)	660 (100)	132 (8)	1,538 (92)	1,670 (100)
Modesto	78,908 (81)	13,828 (14)	4,252 (4)	96,988 (100)	55 (46)	65 (54)	120 (100)	4 (11)	31 (89)	35 (100)
North Merced Gravel	791 (4)	2,770 (15)	14,919 (81)	18,480 (100)	157 (17)	759 (83)	916 (100)	42 (12)	308 (88)	350 (100)
Recent Alluvium	27,815 (67)	8,417 (20)	5,190 (13)	41,422 (100)	47 (24)	152 (76)	199 (100)	0 (0)	4 (100)	4 (100)
Riverbank	35,126 (42)	21,137 (25)	27,557 (33)	83,820 (100)	380 (22)	1,346 (78)	1,726 (100)	61 (13)	393 (87)	454 (100)
Turlock Lake	11,249 (34)	9,450 (30)	11,959 (37)	32,658 (100)	30 (38)	48 (62)	78 (100)	<1 (2)	16 (98)	16 (100)
Valley Springs	52 (1)	277 (4)	5945 (95)	6,274 (100)	1 (1)	86 (99)	87 (100)	<1 (2)	16 (98)	16 (100)
Total	**157,944 (45)**	**66,073 (19)**	**128,188 (36)**	**352,205 (100)**	**933 (20)**	**3,726 (80)**	**4,659 (100)**	**253 (9)**	**2,561 (91)**	**2,814 (100)**

Notes:

The total acreages do not correspond with total acreages of conserved lands in other tables because geologic units that do not support vernal pool ecosystems are omitted from this table. This table presents data described in the *Methods of Analysis* section.

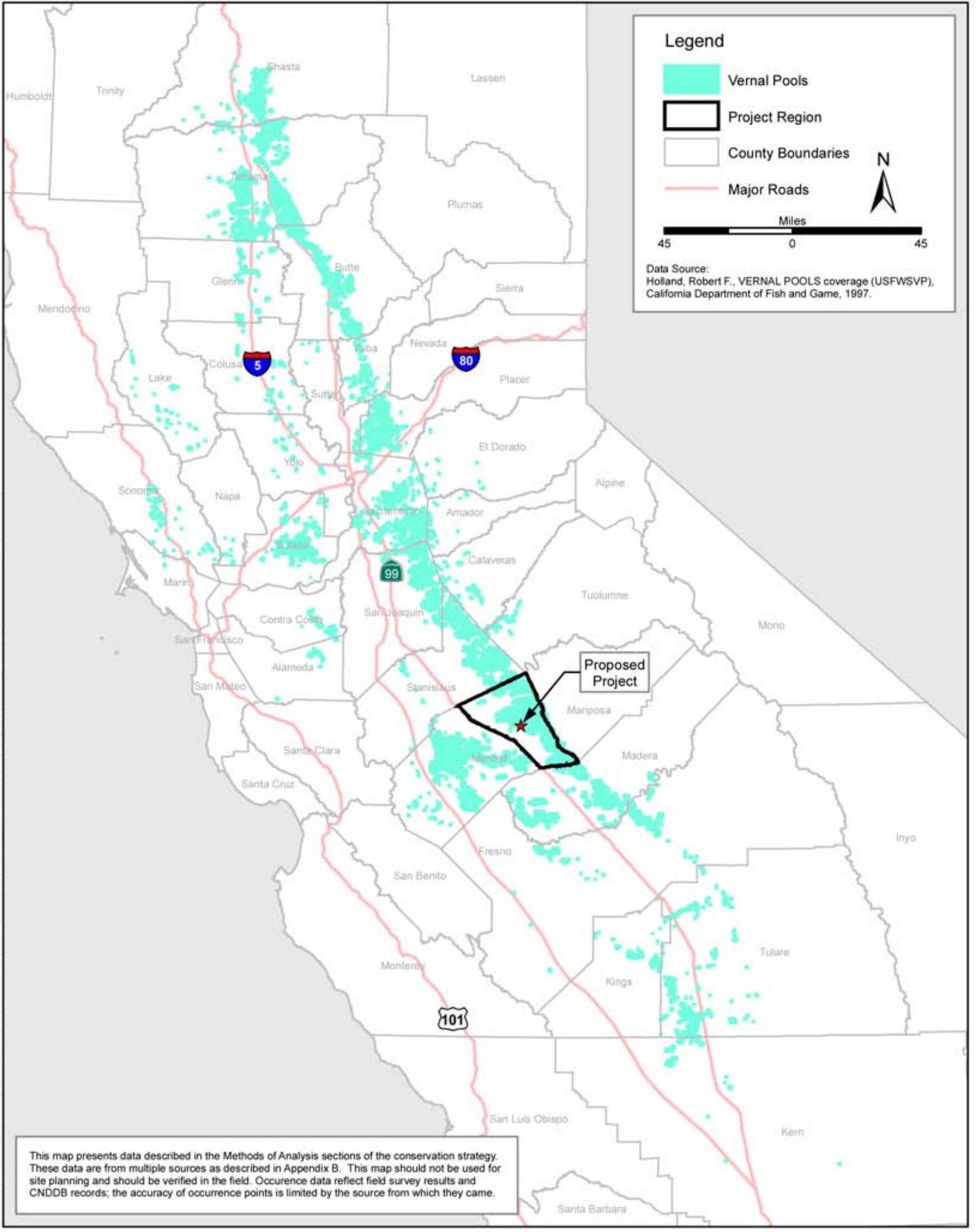
Values in table are in acres. Values in parentheses are the percentages represented by the acreage.

[a] Geologic units correspond to meso-scale categories in the vernal pool classification by Bainbridge (2002).

[b] Land area converted from natural vegetation to other land cover types.

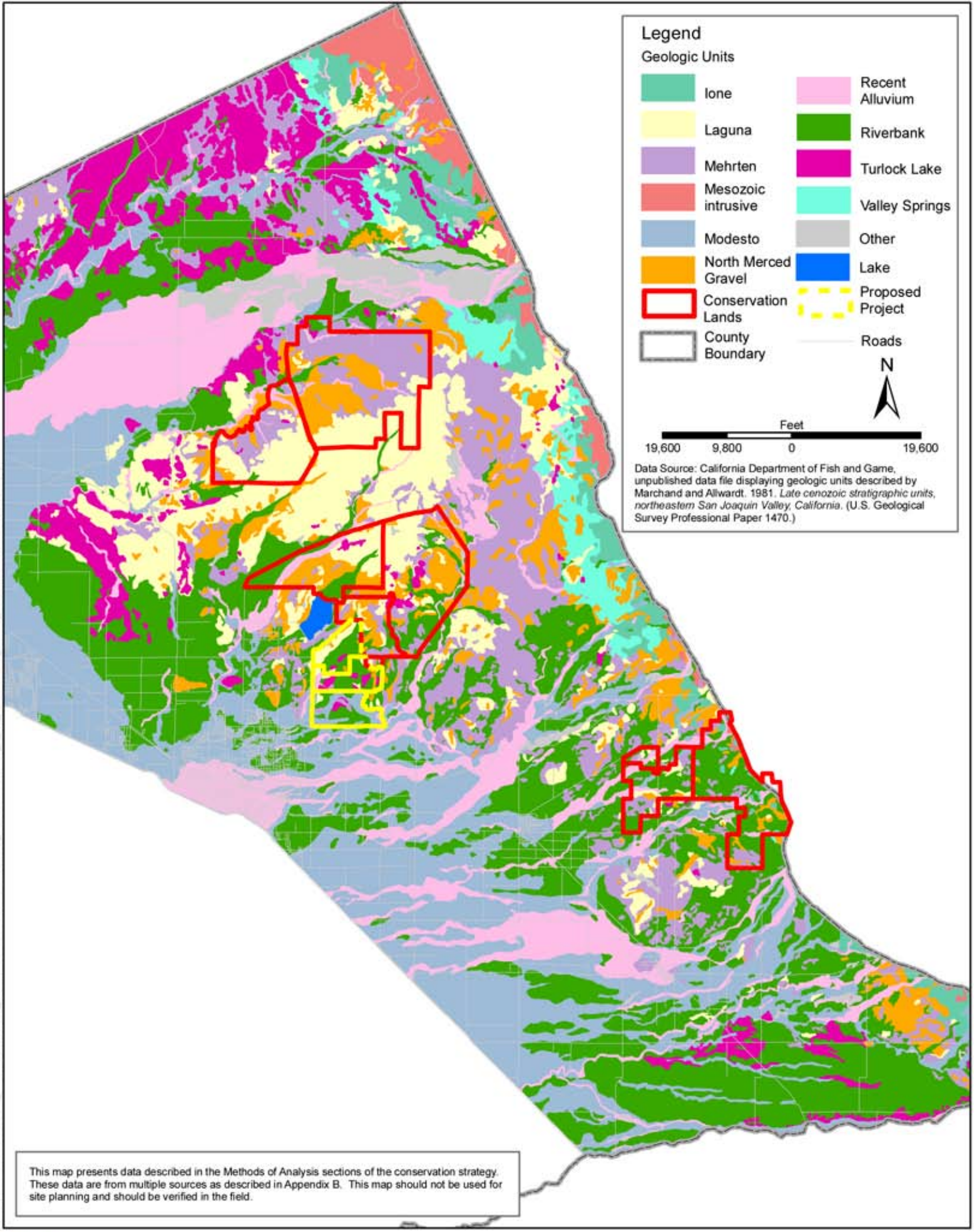
[c] Land within 200 meters (656 feet) of roads or converted land cover types (e.g., urban or developed land).

[d] Land not within 200 meters (656 feet) of roads or converted land cover types.



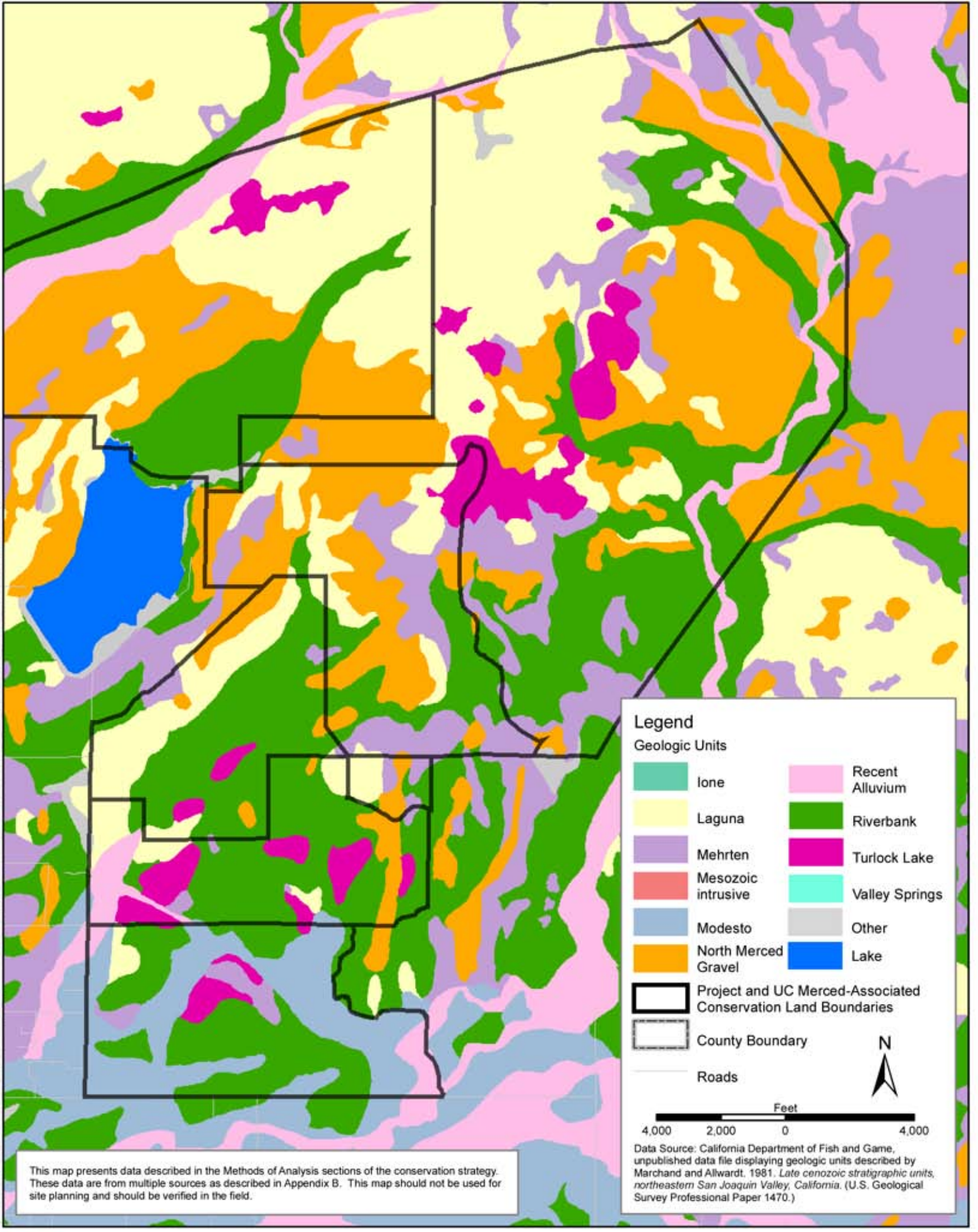
ICF Jones & Stokes

Figure 3-1
Distribution of Vernal Pools in California



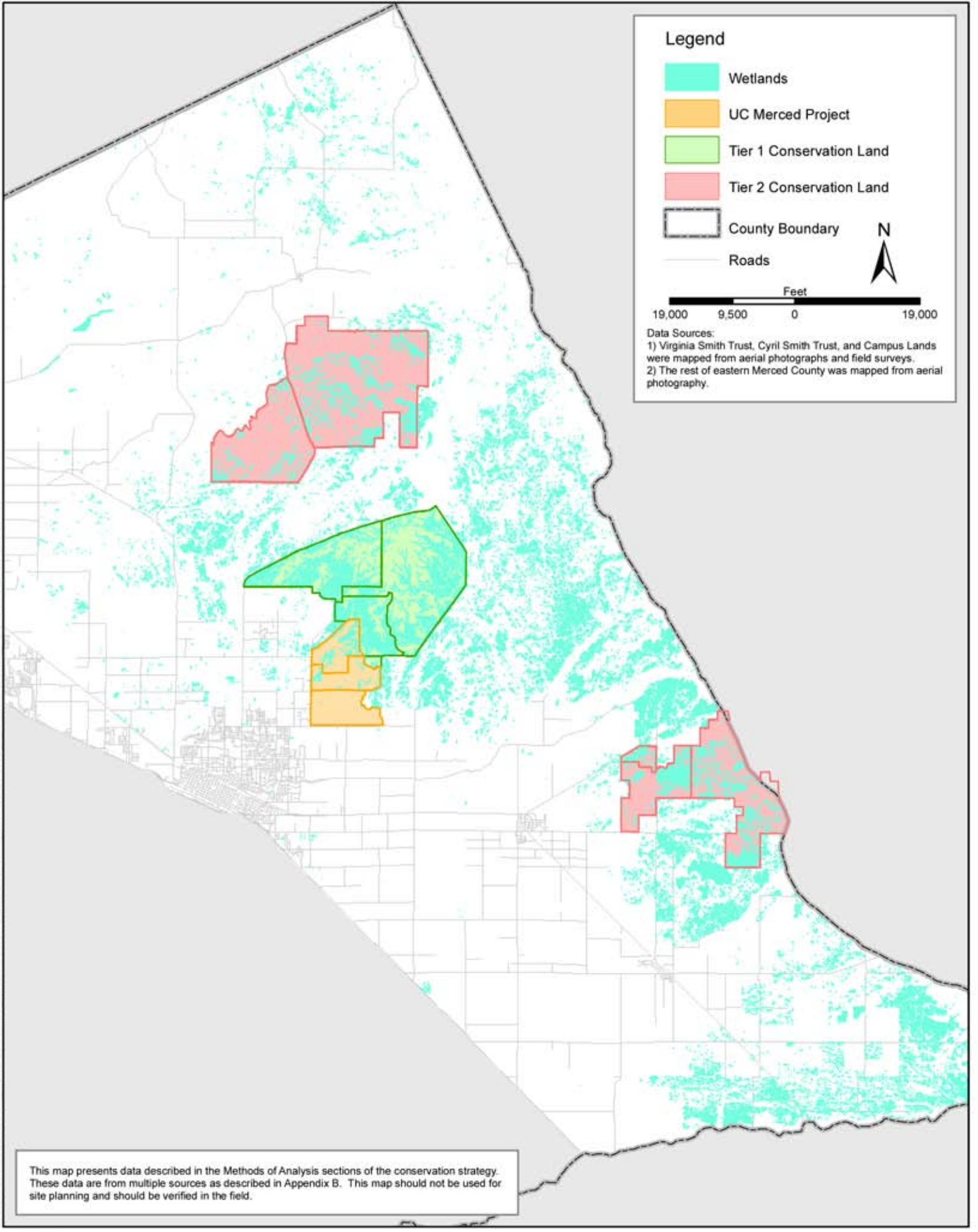
ICF Jones & Stokes

Figure 3-2a
Geologic Units in the Project Region



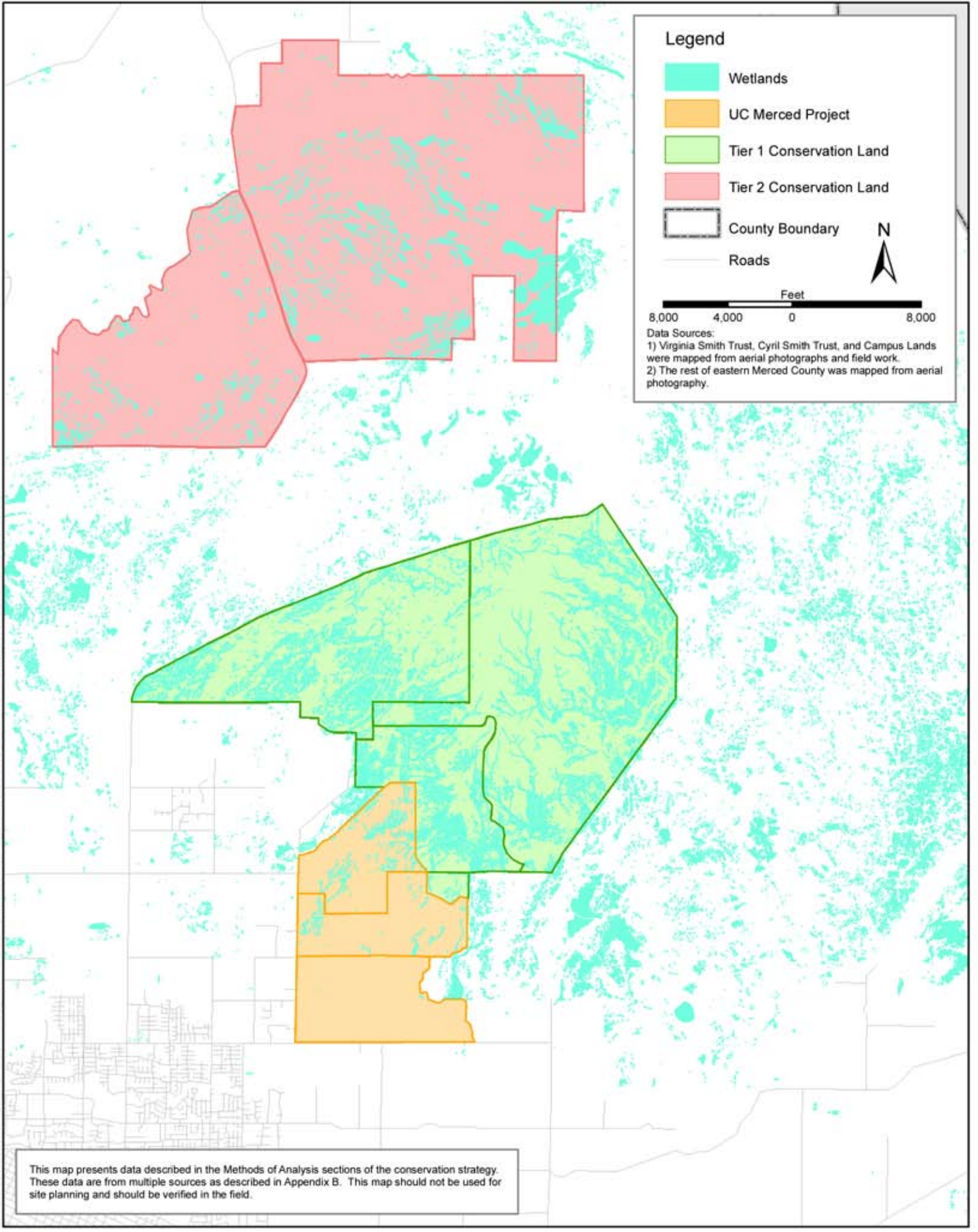
ICF Jones & Stokes

Figure 3-2b
Geologic Units in the UC Merced Project Area



ICF Jones & Stokes

Figure 3-3a
Vernal Pools, Swales, and Clay Playas in the Project Region



ICF Jones & Stokes

Figure 3-3b
Vernal Pools, Swales, and Clay Playas in the UC Merced Project Area

the standing crop of nonnative grasses (Robins and Vollmar 2002; Marty 2005). These grasses can produce a taller and denser cover of vegetation and greater masses of residual dry matter than that produced by native vernal pool plant species. This additional competition and thicker litter layer may reduce growth, reproduction, and successful seedling establishment by native vernal pool plant species (Robins and Vollmar 2002). By altering the open water column, these grasses also may affect vernal pool crustaceans (Robins and Vollmar 2002).

Besides its immediate effects, habitat loss contributes to habitat fragmentation. At the landscape and regional scales, habitat fragmentation can isolate and reduce populations, resulting in processes that progressively drive populations toward extirpation. Small or isolated populations are more prone to inbreeding and are more susceptible to extirpation due to disturbances, other changes in the environment, and fluctuations in population size. Recolonization opportunities are diminished when physical barriers, such as development or lack of vernal pool habitat, isolate populations from one another.

In the project region, annual grasslands supporting vernal pool habitat may be threatened by conversion to cultivated agriculture and recent urban development projects. In addition, unauthorized actions that disturb surface and subsurface soil layers (i.e., deep-ripping) pose significant threats to vernal pool habitats and species in the southwestern portion of the region. It is estimated that, in 2005 and 2006, over 5,600 acres of lands supporting vernal pool habitat in eastern Merced County were converted by unauthorized actions. The majority of these conversion actions, which are currently under investigation, have occurred in the vicinity of Buchanan Hollow Road and the Chowchilla River; in the vicinity of the study area, one conversion action has occurred west of the project (Jones pers. comm.). Vernal pool habitat in the project region also may be threatened by large infrastructure projects, such as an improved Highway 99 corridor or the County's Campus Parkway Project.

Species Accounts

The following accounts describe the ecology, distribution, and threats to vernal pool species that were addressed in the 2002 BO (U.S. Fish and Wildlife Service 2002). The analysis of threats presented in the species accounts do not include some occurrences that have not been incorporated into the latest version of the California Natural Diversity Database (CNDDB), and therefore may overestimate the level of threat.

Plants

Succulent Owl's-Clover

Ecology and Distribution

Succulent owl's-clover is an annual in the snapdragon family (Scrophulariaceae). Like many related species, it is a hemiparasite, meaning that it obtains water and nutrients by forming root grafts with other host plants but manufactures its own food through photosynthesis (Chuang and Heckard 1991). Research on related species of *Castilleja* indicates that many different plants can serve as hosts for a single species or even a single plant individual of *Castilleja*. Seed germination does not require the presence of a host, as root connections only form after plants reach the seedling stage. In fact, some seedlings can survive to maturity without attaching to a host's roots; but in general reproduction is enhanced by root connections (Atsatt and Strong 1970).

The conditions necessary for germination of succulent owl's-clover seeds have not been studied, nor has the timing of seed germination been documented. It is known, however, that flowering in this species occurs in April and May (California Native Plant Society 2001). Although related taxa in the genus *Castilleja* are pollinated by generalist bees (Superfamily Apoidea) (Chuang and Heckard 1991), succulent owl's-clover is thought to be self-pollinating (Heckard 1977). Even so, insects may transfer some pollen among individual plants and species occurring in the same area. Little is known about the demography of succulent owl's-clover, although the number of mature plants in populations can fluctuate by more than two orders of magnitude from year to year (California Natural Diversity Database 2008).

Succulent owl's-clover is endemic to vernal pool complexes along a 66-mile stretch of the eastern San Joaquin Valley and the adjacent foothills up to 2,500 feet. The species' range extends through northern Fresno, western Madera, southeastern San Joaquin, and Stanislaus Counties (Table 3-2). The CNDDB (2008) reports 91 records of occurrence for the species.

Beyond its restriction to vernal pools, the specific habitat requirements of succulent owl's-clover are not known. It occurs in vernal pools with a wide range of area and depth, as well as on a variety of geologic formations and soils (EIP Associates 1999b; Dittes and Guardino 2002; California Natural Diversity Database 2008). A regional analysis based on the results of several surveys indicates that succulent owl's-clover in eastern Merced County occurs primarily on Laguna, Riverbank, and North Merced Gravel geologic units (Appendix C). Commonly reported associates include Fremont's goldfields (*Lasthenia fremontii*), three-colored monkey-flower (*Mimulus tricolor*), vernal pool popcornflower (*Plagiobothrys stipitatus*), downingia (*Downingia* sp.) and coyote-thistle (*Eryngium* sp.) (EIP Associates 1999b; California Natural Diversity Database 2008).

Table 3-2. Summary of CNDDB Records for Vernal Pool Grassland Species Occurring or Potentially Occurring in the Project Region

	Status of Occurrences			Ownership of Occurrences				
Species	Extirpated	Extant	Total	Unknown	Private	Public	Preserved	Documented Counties
Succulent owl's-clover *Castilleja campestris* ssp. *succulenta*	1 (1%)	90 (99%)	91 (100%)	13 (14%)	75 (82%)	5 (5%)	3 (3%)	Fresno, Madera, Merced, San Joaquin, Stanislaus, Tuolumne
Hoover's spurge *Chamaesyce hooveri*	4 (13%)	26 (87%)	30 (100%)	1 (3%)	20 (67%)	10 (33%)	10 (33%)	Butte, Glenn, Merced, Stanislaus, Tehama, Tulare
Colusa grass *Neostapfia colusana*	18 (30%)	42 (70%)	60 (100%)	2 (3%)	54 (90%)	6 (10%)	5 (8%)	Colusa, Glenn, Merced, Solano, Stanislaus, Yolo
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	20 (38%)	32 (62%)	52 (100%)	22 (42%)	28 (54%)	4 (8%)	3 (6%)	Fresno, Madera, Merced, Solano, Stanislaus, Tulare
Hairy orcutt grass *Orcuttia pilosa*	12 (31%)	27 (69%)	39 (100%)	9 (23%)	19 (49%)	11 (28%)	11 (28%)	Butte, Glenn, Madera, Merced, Stanislaus, Tehama
Hartweg's golden sunburst *Pseudobahia bahiifolia*	5 (19%)	21 (81%)	26 (100%)	5 (19%)	21 (81%)	1 (4%)	0 (0%)	Fresno, Madera, Merced, Stanislaus, Sutter, Tuolumne, Yuba
Greene's tuctoria *Tuctoria greenei*	19 (46%)	22 (54%)	41 (100%)	4 (10%)	31 (76%)	6 (15%)	6 (15%)	Butte, Fresno, Madera, Merced, San Joaquin, Shasta, Stanislaus, Tehama, Tulare
Conservancy fairy shrimp *Branchinecta conservatio*	0 (0%)	28 (100%)	28 (100%)	3 (11%)	4 (14%)	2 (7%)	10 (36%)	Butte, Glenn, Merced, Solano, Stanislaus, Tehama, Yolo, Yuba
Vernal pool fairy shrimp *Branchinecta lynchi*	0 (0%)	561 (100%)	561 (100%)	73 (18%)	208 (53%)	124 (31%)	50 (13%)	Alameda, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kings, Madera, Merced, Monterey, Napa, Placer, Riverside, Sacramento, San Benito, San Joaquin, San Luis Obispo, Santa Barbara, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Ventura, Yolo, Yuba
Midvalley fairy shrimp *Branchinecta mesovallensis*	0 (0%)	99 (100%)	99 (100%)	34 (53%)	28 (44%)	2 (3%)	3 (5%)	Contra Costa, Fresno, Madera, Merced, Sacramento, San Joaquin, Solano, Yolo
Vernal pool tadpole shrimp *Lepidurus packardi*	1 (<1%)	227 (99%)	228 (100%)	81 (36%)	74 (32%)	72 (32%)	36 (16%)	Alameda, Butte, Colusa, Contra Costa, Fresno, Glenn, Kings, Merced, Placer, Sacramento, San Joaquin, Shasta, Siskiyou, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba
California tiger salamander *Ambystoma californiense*	55 (6%)	908 (93%)	963 (100%)	307 (37%)	313 (37%)	210 (25%)	98 (12%)	Alameda, Amador, Butte, Calaveras, Contra Costa, Fresno, Glenn, Kern, Kings, Madera, Mariposa, Merced, Monterey, Riverside, Sacramento, San Benito, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Solano, Sonoma, Stanislaus, Sutter, Tulare, Yolo

Source: California Natural Diversity Database 2008.

Threats

The principal threat facing succulent owl's-clover is the loss of habitat due to land conversion and degradation. Additional threats may include intensive grazing and replacement of native plants by nonnative species. Of the 91 records of occurrence for succulent owl's-clover reported in the CNDDB, 90 are presumed to be of extant occurrences (California Natural Diversity Database 2008). Of the sites with presumably extant occurrences, only 3% (three occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Therefore, most populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

Hoover's Spurge

Ecology and Distribution

Hoover's spurge is a prostrate annual in the spurge family (Euphorbiaceae). It has milky sap and photosynthesizes through the C_4 pathway.

Few details of the life history, physiology, or ecology of Hoover's spurge are known. Hoover's spurge does not appear to grow in standing water; its seeds probably germinate after water recedes from pools (Alexander and Schlising 1997). It produces small flowers singly in the leaf axils; these typically bloom during July and August (California Native Plant Society 2001). However, phenology varies among years and among sites, even for those populations in close proximity (Stone et al. 1988). Hoover's spurge is probably pollinated by insects. The glands on the cyathium produce nectar (Wheeler 1941). Beetles, flies, bees, wasps, butterflies, and moths have been observed visiting flowers of Hoover's spurge and may potentially serve as pollinators (Stone et al. 1988; Alexander and Schlising 1997). Seed set apparently begins soon after flowering, and large plants may produce several hundred seeds (Stone et al. 1988). Horned larks (*Eremophila alpestris*) have been observed eating seeds of Hoover's spurge and may assist in seed dispersal (Alexander and Schlising 1997).

Like other annual plants of vernal pools, the number of mature plants in Hoover's spurge populations varies considerably among years. In fact, mature plants can be absent from populations in some years and abundant in subsequent years (California Natural Diversity Database 2008). This indicates that populations rely on the soil seed bank for their persistence.

Hoover's spurge is endemic to vernal pool complexes along a 240-mile stretch of the eastern Central Valley in California at elevations of 80–425 feet. The CNDDB reports 30 records of occurrence (California Natural Diversity Database 2008). Most occurrences are at the Vina Plains in Tehama and Butte Counties or in Tulare County north of Visalia.

Beyond its restriction to vernal pools, little is known of the specific habitat requirements of Hoover's spurge. The species is found primarily in larger and deeper vernal pools on soils that range in texture from clay to sandy loam and in pH from acidic to alkaline, and that include some saline soils (Stone et al. 1988; California Natural Diversity Database 2008). Within these pools, Hoover's spurge grows in varied locations from the margins to the deepest zones. Significantly, it often grows in areas devoid of other species (Stone et al. 1988). Throughout the range of Hoover's spurge, two frequent associates are Greene's tuctoria and hairy Orcutt grass (California Natural Diversity Database 2008). Given the rarity of all three species, this co-occurrence indicates similar habitat requirements for these species at the scales of individual pools or pool complexes.

Threats

The principal threat facing Hoover's spurge is the loss of habitat due to land conversion and degradation. Additional threats may include intensive grazing and replacement of native plants by nonnative species. Of the 30 records of occurrence for Hoover's spurge reported in the CNNDB, 26 are presumed to be of extant occurrences (California Natural Diversity Database 2008). Of the sites with presumably extant occurrences, fewer than 40% (10 occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Accordingly, the majority of populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

Colusa Grass

Ecology and Distribution

Colusa grass is in the Orcuttieae tribe of the grass family (Poaceae). It is an annual grass that photosynthesizes through the C_4 pathway.

The life history of Colusa grass is similar to that of other members of the Orcuttieae. Germination may not take place until after several months of inundation (Keeley 1998). Although germination has not been investigated in the field, Colusa grass seeds are presumed to germinate in late spring when little standing water remains (U.S. Fish and Wildlife Service 2002). Seedlings produce one or two juvenile leaves underwater, followed by multiple decumbent stems with terrestrial leaves (Crampton 1976; Keeley 1998). Plants probably begin to flower within several weeks and are wind pollinated. Seeds are dispersed by water, which breaks up inflorescences (Reeder 1965; Crampton 1976; Griggs 1980, 1981). These seeds can remain dormant for at least 3 or 4 years (Crampton 1976; Griggs 1980; Keeley 1998).

Like most annual plants of vernal pools, the number of mature plants in Colusa grass populations varies considerably from year to year, and the number of seeds

in the soil seed bank may be more than tenfold the number of mature plants. In general, years of above-average rainfall promote higher numbers of mature plants in populations of Orcuttieae, but population responses vary by pool and by species (Griggs 1980; Griggs and Jain 1983). The number of mature plants has been observed to vary by one to four orders of magnitude among successive years and to return to previous levels even after 3–5 consecutive years when no mature plants were present (Griggs 1980; Griggs and Jain 1983; Holland 1987). Thus, many years of observation are necessary to determine whether a population is stable or declining.

Colusa grass is endemic to the Sacramento and San Joaquin Valleys, where it grows in large or deep vernal pools at elevations of 5–360 feet (California Native Plant Society 2001; California Natural Diversity Database 2008). The species' historical distribution included Merced, Stanislaus, Solano, and Colusa Counties (California Natural Diversity Database 2008). The CNDDB reports 60 records of occurrence (Table 3-2) (California Natural Diversity Database 2008).

The species grows primarily in large pools retaining water until late spring (Crampton 1976; U.S. Fish and Wildlife Service 2002). These pools occur on a wide variety of soils. Within them, Colusa grass typically grows in monospecific patches; consequently, associated species may grow in very different microsites within a pool. Interestingly, San Joaquin Valley Orcutt grass, hairy Orcutt grass, Solano grass, and Hoover's spurge occur in the same pools as Colusa grass at several sites (Stone et al. 1988; EIP Associates 1999b; California Natural Diversity Database 2008) Given the rarity of all these species, this co-occurrence indicates similar habitat requirements at the scales of individual pools or pool complexes.

Threats

The principal threat facing Colusa grass is the loss of habitat due to land conversion and degradation. Additional threats may include intensive grazing and replacement of native plants by nonnative species. Of the 60 records of occurrence for Colusa grass listed in the CNNDB, 42 are presumed to be of extant occurrences (California Natural Diversity Database 2008). Of the sites presumably extant, only 12% are preserved and managed for biodiversity (California Natural Diversity Database 2008). Accordingly, most populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

San Joaquin Valley Orcutt Grass

Ecology and Distribution

San Joaquin Valley Orcutt grass is in the Orcuttieae tribe of the grass family (Poaceae). It is an annual grass that photosynthesizes through the C_4 pathway.

The life history of San Joaquin Valley Orcutt grass is similar to that of other species in its genus. Seeds of Orcutt grasses germinate underwater in winter, after being colonized by aquatic fungi (Griggs 1980, 1981; Griggs and Jain 1983; Keeley 1998). Plants then grow underwater for 3 months or more (Keeley 1998). Initially, a basal rosette of juvenile leaves is produced; subsequently, floating leaves are produced. These floating leaves form as water in the pool warms and remain as long as the standing water lasts (Hoover 1941; Griggs 1980, 1981; Reeder 1982; Keeley 1998). As pools dry, typically in June or July, Orcutt grasses begin producing terrestrial leaves. Inflorescences appear within a few days after the water evaporates. The flowers are wind pollinated (Griggs and Jain 1983). Most flowers and seed are produced in June and July; however, flowering may continue into September in wet years (Griggs 1980, 1981). Seed production may vary two- to threefold among years (Griggs 1980; Griggs and Jain 1983). During autumn rains, inflorescences break apart, which scatters seeds that may then be further dispersed by water (Reeder 1965; Crampton 1976; Griggs 1980, 1981).

San Joaquin Valley Orcutt grass is the only Orcutt grass restricted to the San Joaquin Valley. This grass was once relatively common in vernal pool complexes along the eastern margin of the valley in Stanislaus, Merced, Fresno, Madera, and Tulare Counties (Table 3-2). The CNDDB reports 52 records of occurrence (California Natural Diversity Database 2008). It grows at elevations of 100–2,500 feet (California Native Plant Society 2001).

The species grows primarily in large pools retaining water until late spring (Crampton 1976; Stone et al. 1988). Soils underlying these pools are typically acidic, varying in texture from clay to sandy loam (Stone et al. 1988). Interestingly, Colusa grass, hairy Orcutt grass, and Hoover's spurge occur at several of the same sites as San Joaquin Valley Orcutt grass (EIP Associates 1999b; U.S. Fish and Wildlife Service 2002; California Natural Diversity Database 2008). Given the rarity of all of these species, this co-occurrence indicates similar habitat requirements at the scales of individual pools or pool complexes.

Threats

Loss of Orcutt grass habitat to land conversion and degradation has long been recognized as a threat to the species (Hoover 1941). Furthermore, the historical loss of vernal pools has caused a comparable decline in the extent of habitat occupied by San Joaquin Valley Orcutt grass; this decline is partially documented. Of the 52 records of occurrence for San Joaquin Valley Orcutt grass listed in the CNNDB, 32 are presumed to be extant (California Natural Diversity Database 2008). Of the sites with presumably extant occurrences, only 10% (three occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Accordingly, most populations included in the CNDDB are considered to be at intermediate or high risk of extirpation.

Hairy Orcutt Grass

Ecology and Distribution

Hairy Orcutt grass is in the Orcuttieae tribe of the grass family (Poaceae). It is an annual grass that photosynthesizes through the C_4 pathway.

The life history of hairy Orcutt grass is similar to that of other species in its genus. For germination, hairy Orcutt grass seeds require stratification followed by warmer temperatures (Griggs 1974 cited in Stone et al. 1988). Seeds germinate underwater in winter, after being colonized by aquatic fungi (Griggs 1980, 1981; Griggs and Jain 1983; Keeley 1998). Plants then grow underwater for 3 months or more (Keeley 1998). Initially, a basal rosette of juvenile leaves is produced; subsequently, floating leaves are produced. These floating leaves form as water in the pool warms and remain as long as the standing water lasts (Hoover 1941; Griggs 1980, 1981; Reeder 1982; Keeley 1998). As pools dry, typically in June or July, Orcutt grasses begin producing terrestrial leaves. Inflorescences appear a few days after the water evaporates, as early as May and sometimes even in mid-April. Although flowers are predominantly wind pollinated (Griggs and Jain 1983), native bees (Halictidae) have been observed visiting the inflorescences of hairy Orcutt grass to gather pollen (Griggs 1974 cited in Stone et al. 1988). Most flowers and seed are produced in June and July; however, flowering may continue into September in wet years (Griggs 1980, 1981). Individual plants may produce up to 10,000 seeds, and seed production may vary two- to threefold among years (Griggs 1980; Griggs and Jain 1983). During autumn rains, inflorescences break apart, scattering seeds that may then be further dispersed by water (Reeder 1965; Crampton 1976; Griggs 1980, 1981).

Like populations of other vernal pool annuals, populations of hairy Orcutt grass fluctuate dramatically from year to year. In some populations, the number of mature plants has varied by up to four orders of magnitude over time (Griggs 1980; Griggs and Jain 1983; Alexander and Schlising 1997). For example, two populations with no visible plants for three successive years exceeded 10,000 individual plants in the fourth year (Griggs 1980; Griggs and Jain 1983).

Hairy Orcutt grass is endemic to the eastern margins of California's Central Valley. Historically, it occurred from Tehama County south to Merced and Madera Counties at elevations of 80–400 feet (California Native Plant Society 2001; California Natural Diversity Database 2008). The CNDDB lists 39 records of occurrence (California Natural Diversity Database 2008).

The species grows primarily in large pools retaining water until late spring (Crampton 1976; Stone et al. 1988). These pools occur on a variety of soils. Interestingly, hairy Orcutt grass co-occurs at several sites with Colusa grass, Hoover's spurge, and Greene's tuctoria (Stone et al. 1988; California Natural Diversity Database 2008). Given the rarity of all these species, this co-occurrence indicates similar habitat requirements at the scales of individual pools or pool complexes.

Hairy Orcutt grass may have a limited distribution within the project region, where the species is presumed extirpated from two of the three documented occurrences (Dittes and Guardino 2002; California Natural Diversity Database 2008). Consequently, only about 30 acres of presumably occupied habitat is known within the project region. This habitat is on a site under consideration for use as a mitigation bank (Dittes and Guardino 2002).

Threats

Loss of Orcutt grass habitat to land conversion and degradation has long been recognized as a threat to the species (Hoover 1941). Of the 39 records of occurrence for hairy Orcutt grass listed in the CNNDB, 27 are presumed to be of extant occurrences (California Natural Diversity Database 2008). Of the sites with presumably extant occurrences, only 39% (11 occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Accordingly, the majority of populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

Hairy Orcutt grass has a limited distribution within the project region and is currently known to occur at a single site (Dittes and Guardino 2002; California Natural Diversity Database 2008). Changes in land use may cause the degradation or permanent loss of habitat occupied by undocumented populations.

Hartweg's Golden Sunburst

Ecology and Distribution

Hartweg's golden sunburst is an annual in the sunflower family (Asteraceae) (California Native Plant Society 2001). Its life history is largely undocumented, and its physiology and ecology have not been studied. Small plants have been observed in late January and early February, suggesting that it germinates following the first winter rains (U.S. Fish and Wildlife Service 2002). Hartweg's golden sunburst typically flowers in March and April; but in years with late rains, flowering may continue into early May (Johnson 1978; California Native Plant Society 2001; Stebbins 1991 in U.S. Fish and Wildlife Service 2002). The seeds probably begin maturing as the flowers wither, so seed-set and flowering are essentially concurrent. The achenes do not have any apparent structures that would indicate dispersal by either wind or animals; they may be dispersed by gravity.

Population sizes of Hartweg's golden sunburst vary greatly from year to year (Stebbins 1991). For example, periodic monitoring at CNDDB's occurrence 21 revealed that the number of plants varied from 150 in 1987 to 2,000 in 1989 to 800 in 1990 and to 2,500 in 1992 (California Natural Diversity Database 2008). Other annuals with extremely variable occurrence sizes typically have a

persistent seed bank that forms in the soil, and the number of growing plants in a given year is strongly influenced by rainfall and temperature patterns.

Hartweg's golden sunburst is endemic to California's Central Valley. Historically, the species' range may have extended from Yuba County approximately 200 miles south to Fresno County at elevations of 50–460 feet. The CNDDB reports 26 records of occurrence (California Natural Diversity Database 2008). It was apparently locally abundant but never common. The distribution is now concentrated in the Friant region of Fresno County and the La Grange region of Stanislaus County (California Natural Diversity Database 2008).

The specific habitat requirements of Hartweg's golden sunburst are largely unknown. It grows on grassy slopes in valley and foothill grasslands, usually on clay or shallow, fine-textured and gravelly soils (Johnson 1993; California Natural Diversity Database 2008). Where it occurs in vernal pool complexes, it grows on mima mounds, not in the pools. Reported associates include common nonnative annual grasses and forbs, as well as Fremont's goldfields (*Lasthenia fremontii*), shining peppergrass (*Lepidium nitidum*), and miniature lupine (*Lupinus bicolor*)—all three of which are native species (Stebbins 1991 in U.S. Fish and Wildlife Service 2002; California Natural Diversity Database 2008).

Five records of occurrence reported for Hartweg's golden sunburst by the CNDDB are located within the project region (California Natural Diversity Database 2008). All are in the northeastern portion of the region on the Ione or Valley Springs Formations (Dittes and Guardino 2002). Other sites with potentially suitable habitat also have been observed in that portion of the study area. No occupied habitat has been documented in the central or southern portions of the project region.

Threats

Hartweg's golden sunburst has declined primarily due to habitat loss caused by agricultural and urban development. However, overgrazing by cattle, competition from nonnative plants, and off-highway vehicle use also are considered threats (California Natural Diversity Database 2008).

Of the 26 records of occurrence for Hartweg's golden sunburst listed in the CNNDB, 21 are presumed to be of extant occurrences (California Natural Diversity Database 2008). About 60% of presumably extant occurrences have been surveyed on more than one occasion; consequently, subsequent extirpations may be undocumented (Table 3-2). Of the sites with presumably extant occurrences, none are preserved or managed for biodiversity (California Natural Diversity Database 2008). Therefore, all populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

In the project region, Hartweg's golden sunburst is at risk of declines in its distribution and abundance. None of its occupied habitat in the project region is

preserved or managed for biodiversity, nor is any of the habitat under any form of conservation easement.

Greene's Tuctoria

Ecology and Distribution

Greene's tuctoria is in the Orcuttieae tribe of the grass family (Poaceae). It is an annual grass that photosynthesizes through the C_4 pathway.

Germination of Greene's tuctoria occurs several months following inundation (Keeley 1998) as pool water levels are receding. Seedlings of the genus *Tuctoria* do not develop floating juvenile leaves as do related grasses in the genus *Orcuttia*, and the plants may not tolerate inundation (Griggs 1980; Keeley 1998). Plants probably begin to flower within several weeks and are wind pollinated. Greene's tuctoria flowers from May to July (California Native Plant Society 2001), with peak flowering in June and July (Griggs 1981). Seeds are dispersed by water, which breaks up inflorescences. These seeds may remain dormant for more than 1 year.

The number of mature plants in Greene's tuctoria populations can vary by three orders of magnitude from year to year, and populations without mature plants one year can reappear in large numbers in later years (Griggs 1980; Griggs and Jain 1983; Alexander and Schlising 1997). As in populations of other vernal pool annuals, these fluctuations may be due to annual variations in weather, particularly rainfall; to changes in management; or to a combination of the two.

Greene's tuctoria is endemic to vernal pools of California's Central Valley. Its historical range included parts of Shasta, Tehama, and Butte Counties in the northern and eastern Central Valley, and the species range and extended south through Fresno, Madera, Merced, San Joaquin, Stanislaus, and Tulare Counties in the San Joaquin Valley. The CNDDB reports a total of 41 records of occurrence for the species (California Natural Diversity Database 2008).

Greene's tuctoria grows in vernal pools at elevations of 100–3,500 feet (California Native Plant Society 2001). The species grows primarily in large pools; however, these pools tend to be somewhat smaller and shallower and to dry earlier in the year than those typically occupied by other grass species in the Orcuttieae (Stone et al. 1988; Alexander and Schlising 1997). These pools occur on a variety of soils. Greene's tuctoria has been observed to co-occur with Hoover's spurge at several sites (Stone et al. 1988; California Natural Diversity Database 2008).

Threats

The principal threat facing Greene's tuctoria is the loss of vernal pool habitat, particularly due to conversion of vernal pool habitat to agricultural uses (i.e., irrigated agriculture). Additional threats may include intensive grazing and replacement of native plants by nonnatives (California Natural Diversity Database 2008). Heavy or year-round grazing by cattle may adversely affect vernal pool plants through herbivory and trampling (Robins and Vollmar 2002). Grazing also reduces the standing crop of nonnative grasses, which can produce a taller and denser cover of vegetation and greater masses of residual dry matter than produced by native vernal pool plant species (Robins and Vollmar 2002; Marty 2005). This effect is less likely to benefit Greene's tuctoria than some other species, however, because the Greene's tuctoria typically grows in deeper pools where cover of nonnative grasses is usually low.

The CNDDB reports 41 records of occurrence for Greene's tuctoria, of which 22 are presumed to be extant (California Natural Diversity Database 2008). Of the sites with presumably extant occurrences, fewer than 30% (six occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Accordingly, most populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

In the project region, Greene's tuctoria has been extirpated from four of the 11 documented locations of occurrence. None of the remaining sites are preserved, managed primarily for biodiversity, or under conservation easement.

Invertebrates

Because much of the ecology of vernal pool crustacean species is common to the taxa addressed in this document, this initial discussion is provided as background. Species-specific issues are addressed below in the appropriate sections.

Fairy shrimp are omnivorous filter feeders that indiscriminately filter particles of the appropriate size from their surroundings. Their diet consists of bacteria, unicellular algae, metazoans, and suspended plant and animal particles (Eriksen and Belk 1999). Fairy shrimp are prey to a wide variety of animals, including birds, fish, amphibians, dragonfly and damselfly larvae (Order Odonata), backswimmers (Hemiptera: Notonectidae), predaceous diving beetles (Coleoptera: Dytiscidae), and vernal pool tadpole shrimp (Alexander and Schlising 1997; Eriksen and Belk 1999; U.S. Fish and Wildlife Service 2002).

Vernal pool crustaceans reproduce by producing cysts that consist of an embryo within a protective covering. Cysts are expelled from the brood pouch of the female or are retained by the female until her death (Eriksen and Belk 1999). These cysts are capable of withstanding heat, cold, and prolonged desiccation. Additionally, the cysts' protective covering is not affected by digestive enzymes;

consequently, cysts can be transported in the digestive tracts of animals without harm (Horne 1967). Cysts may remain viable for an undetermined number of years.

During summer and fall, vernal pool crustacean populations (including those of vernal pool tadpole shrimp [*Lepidurus packardi*]) are present only as cysts in the dry pool bottom. Individuals go through the rest of their life cycle while pools are inundated. Inundation triggers hatching of some of the dormant cysts, while others remain dormant as a cyst bank, analogous to the seed bank of annual plants (Hathaway and Simovich 1996; U.S. Fish and Wildlife Service 2002). Although the exact cues that trigger hatching are unknown, they must include or depend on the return of moisture to the cyst's location. In addition, temperature is believed to play a large part; and light, oxygen, and osmotic pressure all may serve as triggers (Brendonck 1996).

Animals, wind, and water disperse vernal pool crustaceans. Consumption of gravid fairy shrimp by waterfowl and amphibians can disperse viable cysts great distances because of the shrimp's ability to pass through digestive tracts unharmed. Grazing mammals may disperse cysts during the wet winter and spring months in mud adhering to their feet and bodies. During dry summer months, cysts may be carried considerable distances by high winds and dust storms. Water disperses active shrimp and cysts through swales that interconnect pools and, in some locations, through large-scale flooding that inundates the entire landscape.

Conservancy Fairy Shrimp

Ecology and Distribution

Helm (1998) found that the life span and maturation rate of Conservancy fairy shrimp (*Branchinecta conservatio*) did not differ significantly from other fairy shrimp species under the conditions he observed. He found that Conservancy fairy shrimp reached maturity in an average of 46 days, and populations of adults remained active for as long as 154 days. However, maturation and reproduction rates of vernal pool crustaceans are controlled by water temperature and can vary greatly (Eriksen and Brown 1980; Helm 1998). This species has been observed only to produce one cohort of offspring each wet season (Eriksen and Belk 1999). In general, Conservancy fairy shrimp is observed in very large populations within a given pool and is usually the most abundant fairy shrimp when more than one fairy shrimp species is present (Helm 1998; Eriksen and Belk 1999).

The range of Conservancy fairy shrimp extends from the northern Sacramento Valley to the San Joaquin Valley, and includes Butte, Glenn, Tehama, Solano, and Yuba Counties in the Sacramento Valley and Stanislaus and Merced Counties in the San Joaquin Valley (California Natural Diversity Database 2008). The CNDDB lists a total of 28 records of occurrence.

Conservancy fairy shrimp occur in alkaline pools and vernal lakes and pools (Helm 1998). Observations suggest this species is generally found in pools that are relatively large and turbid (King et al. 1996; Helm 1998; Eriksen and Belk 1999). These pools may exceed several acres in size. The species is known to occur in pools on the Anita, Pescadero, Riz, Solano, Edminster, San Joaquin, and Peters soil series.

Conservancy fairy shrimp occur with several other vernal pool crustaceans, including vernal pool fairy shrimp (*Branchinecta lynchi*), California linderiella (*Linderiella occidentalis*), and vernal pool tadpole shrimp (King et al. 1996; Helm 1998; Eriksen and Belk 1999). The species also occurs with several vernal pool plant species, including Colusa grass and the Orcutt grasses.

Threats

The principal threat facing Conservancy fairy shrimp is the loss of vernal pool habitat due to land conversion and degradation. Additional threats may include intensive grazing; replacement of native plants by nonnatives; and introduction of fish, either by intentional stocking or through natural or agricultural flooding, to vernal pools. Opportunistic fish such as mosquitofish, originally introduced to control mosquito populations, consume fairy shrimp and can eliminate entire populations (U.S. Fish and Wildlife Service 2005).

The CNDDB reports 28 records of occurrence for Conservancy fairy shrimp, all of which are presumed to be extant (California Natural Diversity Database 2008). Ten occupied sites (36%) are on lands preserved and managed for biodiversity (California Natural Diversity Database 2008). The remaining populations currently included in the CNDDB are considered to be at intermediate risk of extirpation.

Vernal Pool Fairy Shrimp

Ecology and Distribution

The early stages of vernal pool fairy shrimp develop rapidly into adults, reaching sexual maturity in as little as 18 days, and completing their life cycle within 9 weeks (Helm 1998). Maturation and reproduction rates of vernal pool crustaceans are controlled by water temperature and can vary greatly (Eriksen and Brown 1980; Helm 1998). Three to six hatches may occur within a season if conditions are suitable (Gallagher 1996; Helm 1998). However, populations often disappear early in the season, long before the vernal pools dry up.

Vernal pool fairy shrimp are the most widely distributed of the special-status vernal pool crustaceans occurring in the project region. The species is found from Shasta County in the north throughout the Central Valley and west to the central Coast Ranges, at elevations of 30–4,000 feet. Additional populations

have been reported from the Agate Desert region of Oregon near Medford; and disjunct populations occur in San Luis Obispo, Santa Barbara, and Riverside Counties. However, most known locations are in the Sacramento and San Joaquin Valleys and along the eastern margin of the central Coast Ranges (Eng et al. 1990). Although vernal pool fairy shrimp occur over a large range, the species is relatively uncommon throughout this range and is typically observed outnumbered by co-occurring fairy shrimp species. The CNDDB lists a total of 561 records of occurrence (California Natural Diversity Database 2008). In the project region, the majority of vernal pool fairy shrimp occurrences have been recorded on the Riverbank and North Merced Gravel units (Appendix C).

Vernal pool fairy shrimp inhabit vernal pools that form in depressions, usually in grassland habitats (Eng et al. 1990). Pools must remain inundated long enough for the species to complete its life cycle. Vernal pool fairy shrimp also occur in other wetlands that provide habitat similar to vernal pools, such as alkaline rain pools, ephemeral drainages, rock outcrop pools, ditches, stream oxbows, stock ponds, vernal swales, and some seasonal wetlands (Helm 1998). Occupied wetlands range in size from as small as several square feet to more than 10 acres.

Vernal pool fairy shrimp and other fairy shrimp have been observed in artificial depressions and drainages where water ponds for a sufficient duration (Helm 1998). Examples of such areas include roadside ditches and ruts left behind by off-road vehicles or heavy equipment. Soil compaction from construction activity can sometimes create an artificial hardpan, or restrictive layer, which allows water to pond and form suitable habitat for vernal pool fairy shrimp.

Vernal pool fairy shrimp are not found in riverine, marine, or other permanent waters (50 FR 48136–48153, September 16, 1994).

Threats

The principal threat facing vernal pool fairy shrimp is the loss of vernal pool habitat due to land conversion and degradation. Additional threats may include intensive grazing; replacement of native plants by nonnatives; and introduction of fish, either by intentional stocking or through natural or agricultural flooding, to vernal pools. Opportunistic fish such as mosquitofish, originally introduced to control mosquito populations, consume fairy shrimp and can eliminate entire populations (U.S. Fish and Wildlife Service 1996).

Of the 395 records of vernal pool fairy shrimp occurrence listed in the CNNDB, all are presumed to be extant (California Natural Diversity Database 2008). Of these sites, only 13% (50 occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Therefore, most populations should be considered to be at intermediate or high risk of extirpation.

Midvalley Fairy Shrimp

Ecology and Distribution

Midvalley fairy shrimp may reproduce in less than 16 days and generally reproduce within several weeks (Helm 1998). Data from laboratory experiments indicate that young of this species may have a higher tolerance for elevated water temperatures than other *Branchinecta* species (Helm 1998). Helm (1998) hypothesizes that this combination of rapid maturation and tolerance of warm water might enable this species to take advantage of spring rain events, which are correlated with reduced inundation periods and higher water temperatures.

Midvalley fairy shrimp is endemic to California's Central Valley, occurring from Sacramento to Fresno Counties (Belk and Fugate 2000). The CNDDB reports 64 records of occurrence for this elusive shrimp (California Natural Diversity Database 2008). In the project region, the vast majority of midvalley fairy shrimp occurrences have been recorded on the Riverbank Formation; a significant number have been recorded on North Merced Gravels (Appendix C).

Midvalley fairy shrimp differ from Conservancy fairy shrimp, vernal pool tadpole shrimp and, to a lesser degree, vernal pool fairy shrimp in that they generally are associated with smaller and more ephemeral pools than the other three species (Helm 1998). Midvalley fairy shrimp also can occur in roadside ditches adjacent to occupied habitat (Belk and Fugate 2000).

Threats

The principal threat facing midvalley fairy shrimp is the loss of vernal pool habitat due to land conversion and degradation. Additional threats may include intensive grazing; replacement of native plants by nonnatives; and introduction of fish, either by intentional stocking or through natural or agricultural flooding, to vernal pools. Opportunistic fish such as mosquitofish, originally introduced to control mosquito populations, consume fairy shrimp and can eliminate entire populations (U.S. Fish and Wildlife Service 1996).

Of the 99 records of occurrence reported for midvalley fairy shrimp in the CNNDB, all are presumed to be extant (California Natural Diversity Database 2008). Only three (6%) of these occurrences are preserved and managed for biodiversity (California Natural Diversity Database 2008). Therefore, almost all populations are considered to be at intermediate or high risk of extirpation.

Vernal Pool Tadpole Shrimp

Ecology and Distribution

Vernal pool tadpole shrimp are omnivorous predators that forage in bottom sediments and on submerged plant material. Their diet includes various plants, crustaceans, insect larvae, and worms. Tadpole shrimp are prey for a variety of animals, including birds, fish, and amphibians (Helm 1998; U.S. Fish and Wildlife Service 2002).

Vernal pool tadpole shrimp reproduce asexually by producing cysts that consist of an embryo within a protective covering (Longhurst 1955; Lynch 1972). They deposit these cysts on vegetation and other objects on the pool bottom as they move about. Cysts are capable of withstanding heat, cold, and prolonged desiccation. Significantly, the cysts' protective covering cannot be affected by digestive enzymes; consequently, they can be transported in the digestive tracts of predators without harm (Horne 1967). Cysts may remain viable for an undetermined number of years.

Once winter rains inundate their habitat, vernal pool tadpole shrimp hatch from cysts within several days (Ahl 1991). Helm (1998) found that vernal pool tadpole shrimp took a minimum of 25 days to mature, and the mean age at first reproduction was 54 days. However, maturation and reproduction rates of vernal pool crustaceans are controlled by water temperature and can vary greatly (Eriksen and Brown 1980; Helm 1998), and other researchers have observed that vernal pool tadpole shrimp generally take between 3 and 4 weeks to mature (Ahl 1991; King et al.1996). Vernal pool tadpole shrimp continue to grow as long as their vernal pool habitats remain inundated—in some cases for 6 months or longer. They periodically shed their shield-like shells, which often can be found along the edges of vernal pools where vernal pool tadpole shrimp occur. The fecundity of vernal pool tadpole shrimp increases with body size; large females can deposit as many as six clutches, averaging 32–61 cysts per clutch, in a single wet season (Ahl 1991).

Vernal pool tadpole shrimp is a California Central Valley endemic species, with the majority of populations in the Sacramento Valley. This species also has been reported from the Sacramento River Delta east of San Francisco Bay and from scattered localities in the San Joaquin Valley from San Joaquin to Madera Counties (Rogers 2001). The CNDDB reports 228 records of occurrence (California Natural Diversity Database 2008). In the project region, vernal pool tadpole shrimp primarily occur in habitats on the Riverbank Formation and, in relatively small densities, on the Mehrten, North Merced Gravel, and Recent Alluvium units (Appendix C).

Vernal pool tadpole shrimp occur in a wide variety of seasonal habitats, including vernal pools, ponded clay flats, alkaline pools, ephemeral stock tanks, and roadside ditches (Helm 1998; Rogers 2001; California Natural Diversity Database 2008). Habitats where vernal pool tadpole shrimp have been observed range in size from small (<25 square feet), clear, vegetated vernal pools; to

highly turbid alkali scald pools to large (>100-acre) winter lakes (Helm 1998; Rogers 2001). These pools and other ephemeral wetlands must dry out and be inundated again for the vernal pool tadpole shrimp cysts to hatch. This species has not been reported in pools with high concentrations of sodium salts but may occur in pools with high concentrations of calcium salts.

Although vernal pool tadpole shrimp are found on a variety of geologic formations and soil types, Helm (1998) found that more than 50% of vernal pool tadpole shrimp occurrences were on High Terrace landforms and Redding and Corning soils. Platenkamp (1998) found that vernal pool tadpole shrimp presence differed significantly between geomorphic surfaces at Beale Air Force Base, and the species was most likely to be found on the Riverbank Formation.

Threats

The principal threat facing vernal pool tadpole shrimp is the loss of vernal pool habitat due to land conversion and degradation. Additional threats may include intensive grazing, replacement of native plants by nonnatives, and introduction of fish to vernal pools.

Of the 228 records of vernal pool tadpole shrimp occurrence listed in the CNNDB, all but one are presumed to be extant (California Natural Diversity Database 2008). Of the 227 sites with presumably extant occurrences, only 16% (36 occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Most other populations currently included in the CNDDB are considered to be at intermediate or high risk of extirpation.

Amphibians

California Tiger Salamander

Ecology and Distribution

California tiger salamander (*Ambystoma californiense*) is a lowland species restricted to grasslands and low foothill regions where suitable breeding habitat (vernal pools, ephemeral pools, and human-made ponds with a minimum inundation period of 3–4 months) occurs. Permanent aquatic sites are unlikely to be used for breeding unless they lack fish predators (Jennings and Hayes 1994). California tiger salamanders also require dry-season refuge sites in the vicinity of breeding sites (within 1 mile) (Jennings and Hayes 1994). Ground squirrel burrows are important dry-season refuge sites for adults and juveniles (Loredo et al. 1996).

California tiger salamanders reproduce during the rainy season. Adults move from subterranean burrow sites to breeding pools during November–February after rains (Jennings and Hayes 1994). These nocturnal breeding migrations can

traverse 3,200 feet or more, with male salamanders often arriving at breeding sites earlier than females (Twitty 1941; Jennings and Hayes 1994; Loredo and Van Vuren 1996). Eggs probably are laid in January and February at the height of the rainy season and are deposited in shallow water attached to grass stalks, dead weeds, or other vegetation under the water surface (Storer 1925; Twitty 1941). Egg deposition to metamorphosis requires 9–12 weeks (Anderson 1968; Feaver 1971). In some cases, metamorphosis may not take place for up to a year (Shaffer et al. 1993 in Jennings and Hayes 1994; Alvarez 2004). Juvenile salamanders migrate at night during the hottest, driest season (Loredo et al. 1996). Rare summer rains have been reported to stimulate relatively large numbers of juveniles to emigrate from ponds (Loredo and Van Vuren 1996). In Santa Barbara County, dispersing juvenile California tiger salamanders have been trapped more than 1,200 feet from their birth pond, and adults have been found more than 1.2 miles from breeding ponds. Most marked salamanders have been recaptured at the pond where they initially were captured. However, in one study, 20% of California tiger salamanders hatched in one pond traveled a minimum distance of 1,900 feet to breed. Non-dispersing salamanders tend to stay close to breeding ponds. Dispersal distance appears to be closely tied to precipitation, with salamanders traveling farther in years with more precipitation (65 FR 57242).

During dry weather, these salamanders take refuge in crevices in the soil, in ground squirrel burrows, or in other burrows (Loredo et al. 1996). Once established in underground burrows, these salamanders may move short distances within burrows or overland to other burrows, generally during wet weather (65 FR 57242, September 21, 2000).

Although individual California tiger salamanders may survive more than 10 years, few individuals survive to reproduce. California tiger salamanders do not breed until 4 or 5 years of age; and in some populations, fewer than 5% of marked juveniles survived to become breeding adults (65 FR 57242).

California tiger salamander larvae eat algae and various invertebrates, including water fleas, copepods, and fairy shrimp. Pacific treefrog and western spadefoot larvae are known to compete with California tiger salamander larvae for some algal and invertebrate food items. Large salamander larvae also consume amphibian larvae, including smaller California tiger salamander larvae (Anderson 1968).

The diet of adult California tiger salamanders probably consists of earthworms, snails, fish, insects, and small mammals (Stebbins 1959, 1985). California tiger salamander is known to prey on western spadefoot and Pacific treefrog (*Pseudacris [Hyla] regilla*) larvae (Anderson 1968).

Native predators of larval and adult California tiger salamanders include great blue herons (*Ardea herodias*), egrets (*Casmerodius* sp.), common garter snakes (*Thamnophis sirtalis*), and large spadefoot larvae (Barry and Shaffer 1994; 65 FR 57242, September 21, 2000). Baldwin and Stanford (1986) observed a western pond turtle pursuing a larval California tiger salamander and an adult red-legged

frog (*Rana aurora*) ingesting a larval California tiger salamander. Other predators of this species include bullfrogs (*Rana catesbeiana*), Louisiana red swamp crayfish (*Procambarus clarki*), mosquitofish (*Gambusia affinis*), and other introduced fishes (Anderson 1968; Jennings and Hayes 1994; 65 FR 57242, September 21, 2000).

California tiger salamanders have a commensal relationship with California ground squirrel, in which the salamander benefits from the refuge habitat created by the burrowing activity of the squirrels. In one study, California tiger salamanders showed no avoidance of occupied ground squirrel burrows, suggesting that the squirrels pose no threat to the salamander (Loredo et al. 1996).

California tiger salamanders are endemic to the San Joaquin–Sacramento River Valleys, bordering foothills, and coastal valleys of central California (Barry and Shaffer 1994). The species occurs from Sonoma County and the Colusa-Yolo County line south to Santa Barbara County in the Coast Ranges, and from southern Sacramento County south to Tulare County in the Central Valley (Jennings and Hayes 1994).

Threats

The principal threat facing California tiger salamander is the loss of vernal pool habitat due to land conversion and degradation. The introduction of nonnative predators into vernal pools and stock ponds, either by intentional stocking or through natural or agricultural flooding, also threatens the survival of California tiger salamander. For example, opportunistic fish such as mosquitofish—originally introduced to control mosquito populations—consume tiger salamander larvae and can eliminate entire breeding populations. Strong negative correlations between the presence of mosquitofish or bullfrogs and the presence of California tiger salamander are presented in recent literature (68 FR 28648–28670, May 23, 2003).

The CNDDB lists 963 records of occurrence for California tiger salamander, of which 908 (94%) are presumed to be extant (California Natural Diversity Database 2008). Of the sites with presumably extant occurrences, only 12% (98 occurrences) are preserved and managed for biodiversity (California Natural Diversity Database 2008). Accordingly, populations of this species are considered to be at intermediate or high risk of extirpation.

Methods of Analysis

Three analyses conducted to evaluate the effects of the Proposed Action on vernal pool ecosystems and the species that depend on them are presented here. The first analysis quantifies the number of acres of vernal pool wetlands that would be converted or degraded, as well as the number of acres conserved in the

project region by implementation of the Proposed Action. The second analysis determines for each vernal pool-dependent species the percentage of known occupied habitat (in acres) in the project region that would be converted, degraded, or conserved through implementation of the Proposed Action. The third analysis examines the status of all lands in the project region (i.e., converted, degraded, or presumed intact), the level of threat to those lands based on zoning designations, and changes to the level of threat based on implementation of the Proposed Action.

These analyses were based largely on data collected during several studies conducted on behalf of UC and the County, and they were funded largely through interagency agreements with DFG. The studies of the project area and other lands in the project region are listed below; the locations of these studies are shown in Figures 3-4, 3-5, and 3-6.

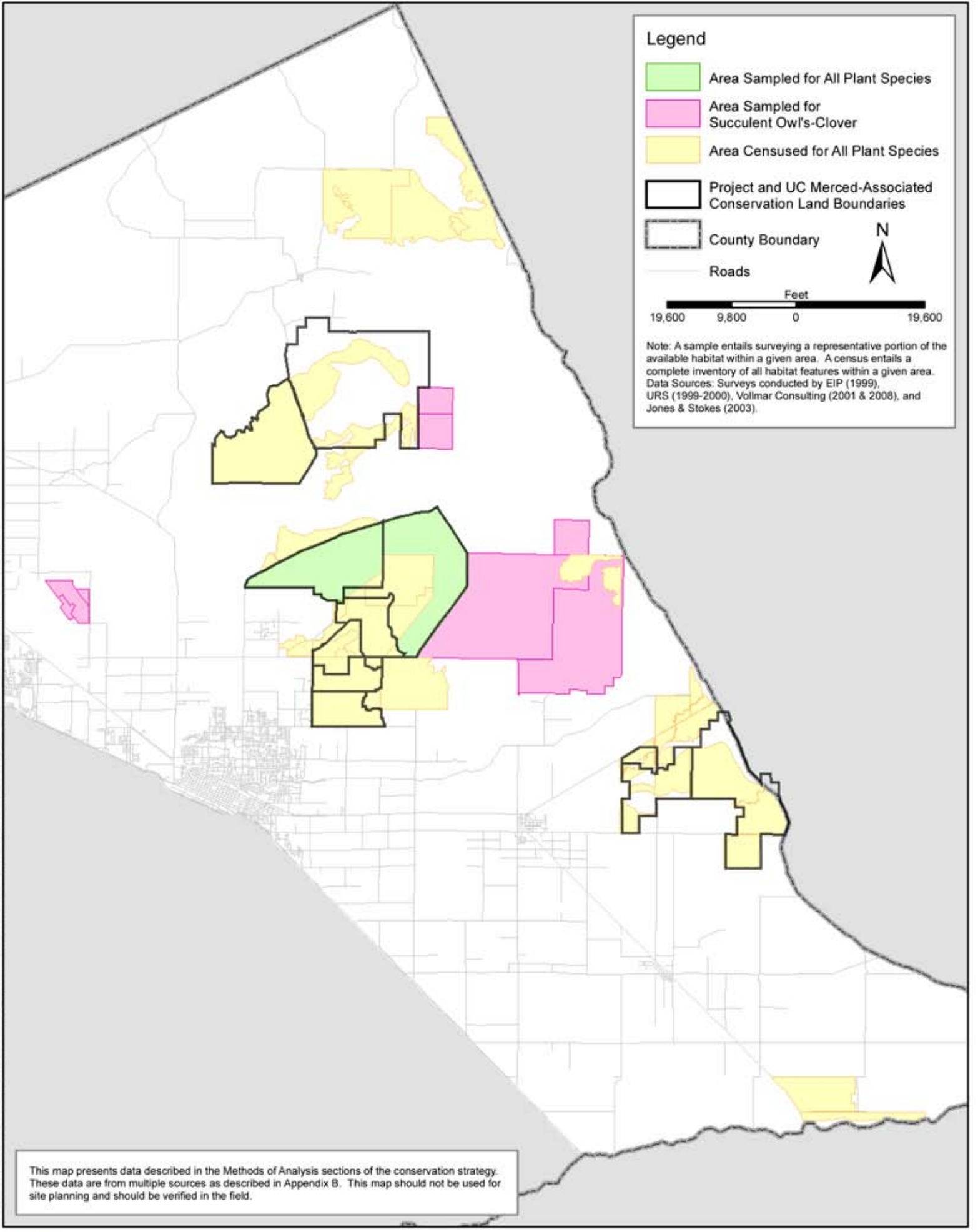
- Wetland inventories and delineations (EIP Associates 2000, 2002b; Gibson & Skordal 2008).
- Surveys for special-status plant species (EIP Associates 1999b, 2001f; Dittes and Guardino 2002; Appendix D of this document).
- Surveys for special-status animals (EIP Associates 1999a, 2001c, 2001d, 2001e; URS Corporation 1999, 2000; Helm and Vollmar 2002; Laabs et al. 2002; Laabs and Allaback 2002; Orloff 2002a, 2002b; Pierson and Rainey 2002).
- Studies estimating effects or making management recommendations (URS Corporation 2001a, 2001b; EIP Associates 2002a; Jones & Stokes 2002a; Noss et al. 2002; Robins and Vollmar 2002; U.S. Fish and Wildlife Service 2002).

The data from the above studies were compiled by DFG into GIS datasets using ArcInfo software. The metadata for and descriptions of these data sources are included in Appendix B. Additional information came from the following:

- Results of 2003 surveys for succulent owl's-clover conducted by Jones & Stokes (Appendix D).
- The CNDDB (2008).
- Results of 2008 surveys for vernal pool plant and animal species (Vollmar Consulting 2008).

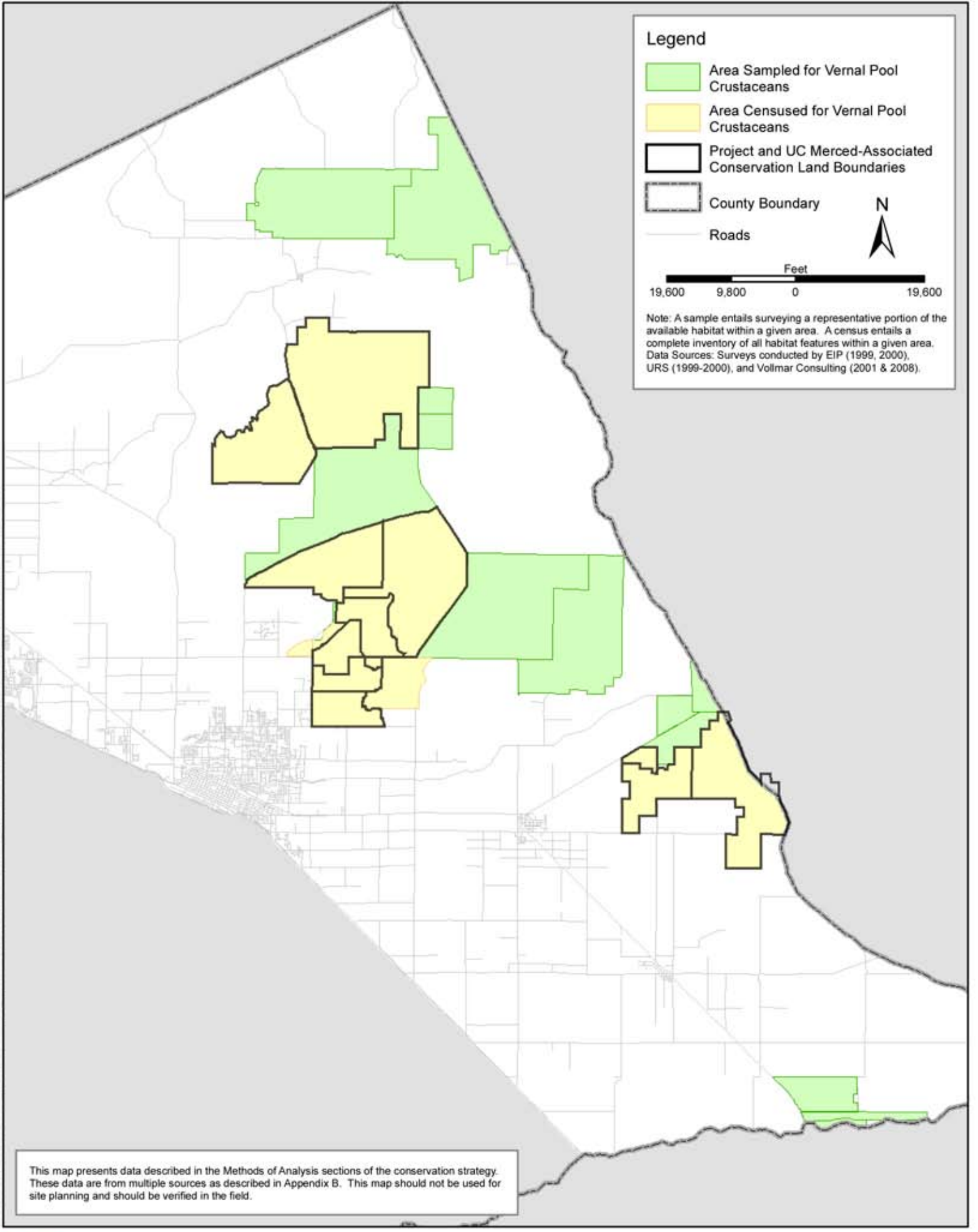
These data sources were used to create GIS data layers depicting the distribution and abundance of vernal wetlands and areas of known occupied habitat. GIS layers depicting the distribution of land cover, land use/zoning, and roads were derived from the sources listed below. In addition to the GIS data files described above, three additional layers were used to analyze the effects of implementation of the Proposed Action.

- Land cover data were assembled from a composite of datasets for the project region representing the most current land use data available. For this composite, data sources included DWR Land Use/Land Cover, California



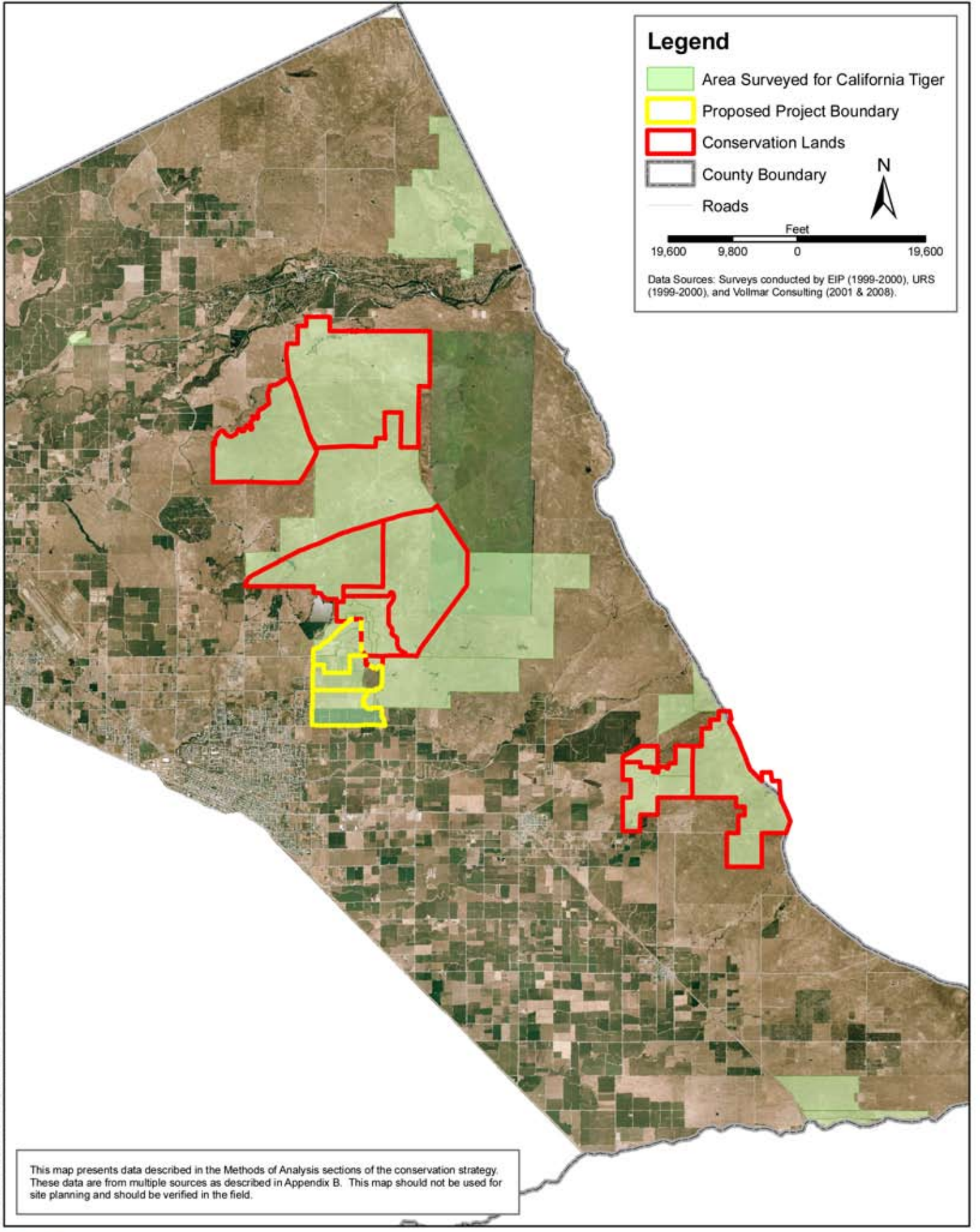
ICF Jones & Stokes

Figure 3-4
Locations of Plant Surveys



ICF Jones & Stokes

Figure 3-5
Locations of Crustacean Surveys



ICF Jones & Stokes
an ICF International Company

Figure 3-6
Locations of Amphibian Surveys

Department of Conservation Important Farmlands Mapping Program, DFG/Ducks Unlimited California Central Valley Wetland and Riparian, CDF Hardwoods, GAP vegetation, and CDF CALVEG2000 datasets.

- Land use/zoning designations were extracted from the Merced County Association of Governments dataset (last updated July 18, 2001).
- Road data were extracted from the Merced County Association of Governments dataset (last updated November 17, 1999).

These GIS layers were combined with layers delineating the Proposed Action (including both development and Conservation Lands) to examine the potential effects of implementing the Proposed Action.

The classification of wetlands used in the data layers depicting the distribution of vernal pool and other wetland types in the project region used a slightly different classification of wetlands than the classification used in the 2002 BA, 2002 BA Supplement, and 2002 BO. The data layers used for this analysis classify swales as *swales* even if they are not part of a larger vernal pool complex, whereas the classification used in the 2002 BA, 2002 BA Supplement, and 2002 BO regard those swales as *linear wetlands*, a category that also includes streams, ditches, and canals.

The analysis presented here includes some data sources that were not included in or were not available during development of the 2002 BA, 2002 BA Supplement, and 2002 BO. Consequently, acreages presented in this document differ somewhat from those presented there. These acreages, however, were incorporated into recent documents.

Analysis of Project Effects on Vernal Pool Ecosystems

The extent of land supporting vernal pool ecosystems that may be affected by constructing the UC Merced Campus and University Community components of the Proposed Action was determined by calculating the direct loss of habitat due to land use conversion, as well as the indirect loss of habitat on adjacent lands due to hydrologic effects associated with the project. A distance of 250 feet is frequently used in a regulatory context as the distance that detrimental indirect effects extend from the edge of development into adjacent vernal pool habitat (e.g., U.S. Fish and Wildlife Service 1996). The regulatory standard distance of 250 feet therefore was used to quantify project effects on vernal pools and other suitable wetland features (Goude pers. comm.). Exceptions to this 250-foot distance were made where obvious hydrologic barriers, such as a canal levee, would protect the suitable habitat from potential hydrologic effects associated with the project. Accordingly, the project area boundary plus a 250-foot buffer area (except where hydrologic barriers occur) was combined with the wetland habitat layer to estimate the areas of wetlands that may be affected. Any wetland feature that occurs, in part, within the 250-foot buffer was considered to be

affected in its entirety. In addition, wetland features on conserved lands within the 250-foot buffer of proposed development were not included in the acreage calculation for conserved vernal pool habitats.

In addition, lands supporting vernal pool ecosystems were classified as "potentially degraded" or "presumed intact" based on their distance from roads, developed lands, and other incompatible land uses. Lands within 200 meters of incompatible land uses were classified as potentially degraded; lands greater than 200 meters from incompatible land uses were classified as presumed intact.

Analysis of Project Effects on Habitats Occupied by Target Species

The analysis examined the distribution of suitable habitats within the project region known to be occupied by the eight species listed below that are associated with vernal pools and other seasonal wetlands:

- Succulent owl's-clover,
- Colusa grass,
- San Joaquin Valley Orcutt grass,
- Conservancy fairy shrimp,
- Vernal pool fairy shrimp,
- Midvalley fairy shrimp,
- Vernal pool tadpole shrimp, and
- California tiger salamander.

Except for midvalley fairy shrimp, the above species are federally listed as threatened or endangered.

An analysis of occupied habitat distribution was not conducted for the following listed species because there are no documented occurrences of these species in the project region:

- Hoover's spurge,
- Hairy Orcutt grass,
- Hartweg's golden sunburst, and
- Greene's tuctoria.

Using the data sources describe above and the following assumptions, a GIS layer was constructed to depict *known occupied habitat* in the project region. The locations of vernal pool plant and invertebrate observations were reported in the majority of sources as point locations. This differs from location information reported in the CNDDB, which is typically an aggregate of individual

observations that result in representative polygons, as discussed below. Not all point observations reported fell within a wetland feature depicted in the wetlands GIS layer. This is most likely due to a combination of several factors: the precision and accuracy of the GPS units used to collect the data varied among surveys, point locations were not always collected from the center of a feature (the collector may have been standing on the margin), or the personnel who conducted species surveys and the personnel who mapped wetlands interpreted the boundaries of wetland features differently. To address this issue, suitable habitat features occurring within 200 meters (656 feet) of point observations were considered to be occupied. The 200-meter buffer distance was selected to represent the greatest possible extent of distribution associated with each point observation. This distance was determined by examining wetland hydrology in the project region.

The location of vernal pool plants and invertebrates in the CNDDB are recorded as polygons. Therefore, the CNDDB polygons were used in place of creating a 200-meter buffer around a point observation, and all suitable wetland features occurring (either wholly or partially) within these polygons were considered to be occupied habitat.

California tiger salamanders utilize both wetland and upland habitats; therefore, point observations may represent either documented breeding sites (wetlands) or individual sightings in upland areas. All point observations obtained from the sources listed above were in suitable wetlands. However, because California tiger salamanders use upland habitats up to 1.3 miles from breeding sites (U.S. Fish and Wildlife Service 2003), a 1.3-mile buffer was placed around each point observation, and all land (wetland and upland) within this area was considered to be occupied habitat (Goude pers. comm.).

Wetland features occurring within 200 meters (656 feet) of roads or converted land (i.e., potentially degraded habitat) were not included in conservation acreages calculated for vernal pool species.

The descriptions of some species' distributions differ from those in the 2002 BA, 2002 BA Supplement, and 2002 BO in two ways: a more recent version of the CNDDB was used for this analysis and this analysis incorporates the results of 2003 UC surveys conducted for succulent owl's clover (Appendix D) and the 2007–2008 surveys conducted for vernal pool species (Vollmar 2008), which were not available when the 2002 BAs and 2002 BO were prepared.

Limitations of the Data Depicting Known Occupied Habitat

Although a moderate proportion of vernal wetland habitat in the project region has been surveyed for the presence of special-status species, differences among surveys complicate the analysis of species' distribution data. About one-eighth of the grasslands-vernal pool area in the project region has been either sampled

censused for special-status species that occur in vernal wetlands.[1] These surveyed lands represent almost one-half the vernal pools and more than one-third of the clay playas in the project region. However, the observations of species presence in wetlands come from several biological surveys that differed in design, year conducted, and information recorded (Appendix B). Therefore, combining this information into a simple composite dataset could introduce substantial bias based on differences in methods and timing. For example, more vernal pool species would be expected to be documented in an area subjected to a complete census rather than a sampling of available habitat. Similarly, sampling an area at a higher intensity (i.e., higher percentage of pools surveyed) would be expected to produce more species detections than sampling at a lower intensity. Finally, differences in observers, annual rainfall patterns, and seasonal timing of surveys all affect the likelihood of detecting species presence.

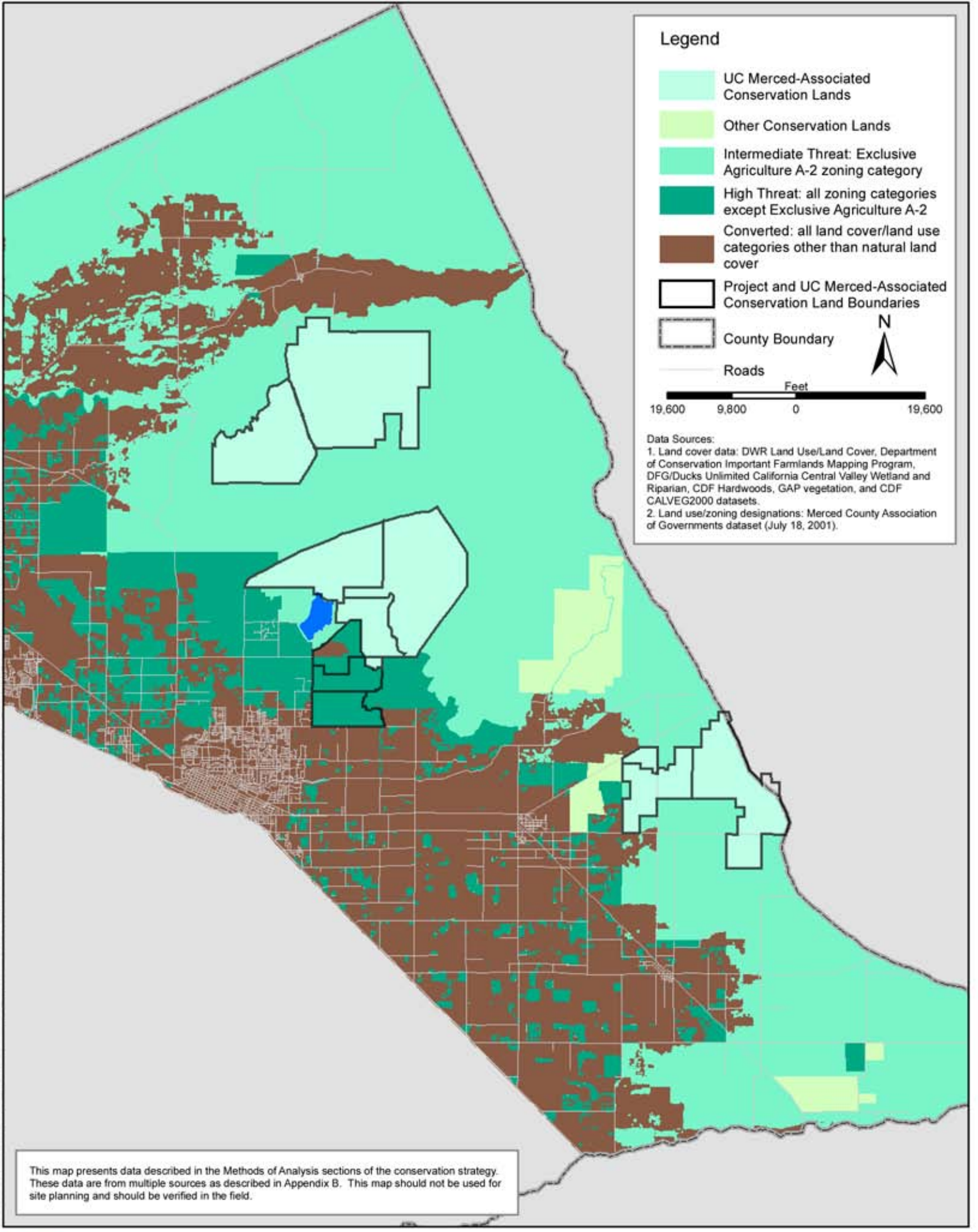
In the absence of survey results from multiple years or for most areas from a single year, accounting for inter-year variability is problematic. Although the analysis presented here reduces the potential effects of differences in survey methods on the quantification of occupied habitat, the results do not fully separate effects of survey methods from actual differences in habitat quality, population size, or viability that inherently exist in various areas of occupied habitat. Therefore, characterizations of lands on the basis of habitat quality, population size, or viability must be viewed cautiously.

Analysis of Project Effects on Land Status and Threats

For natural vegetation, wetlands, and occupied habitat, status (i.e., current condition) and threats (i.e., the likelihood of degradation or loss) were evaluated on the basis of a GIS analysis for the project region.

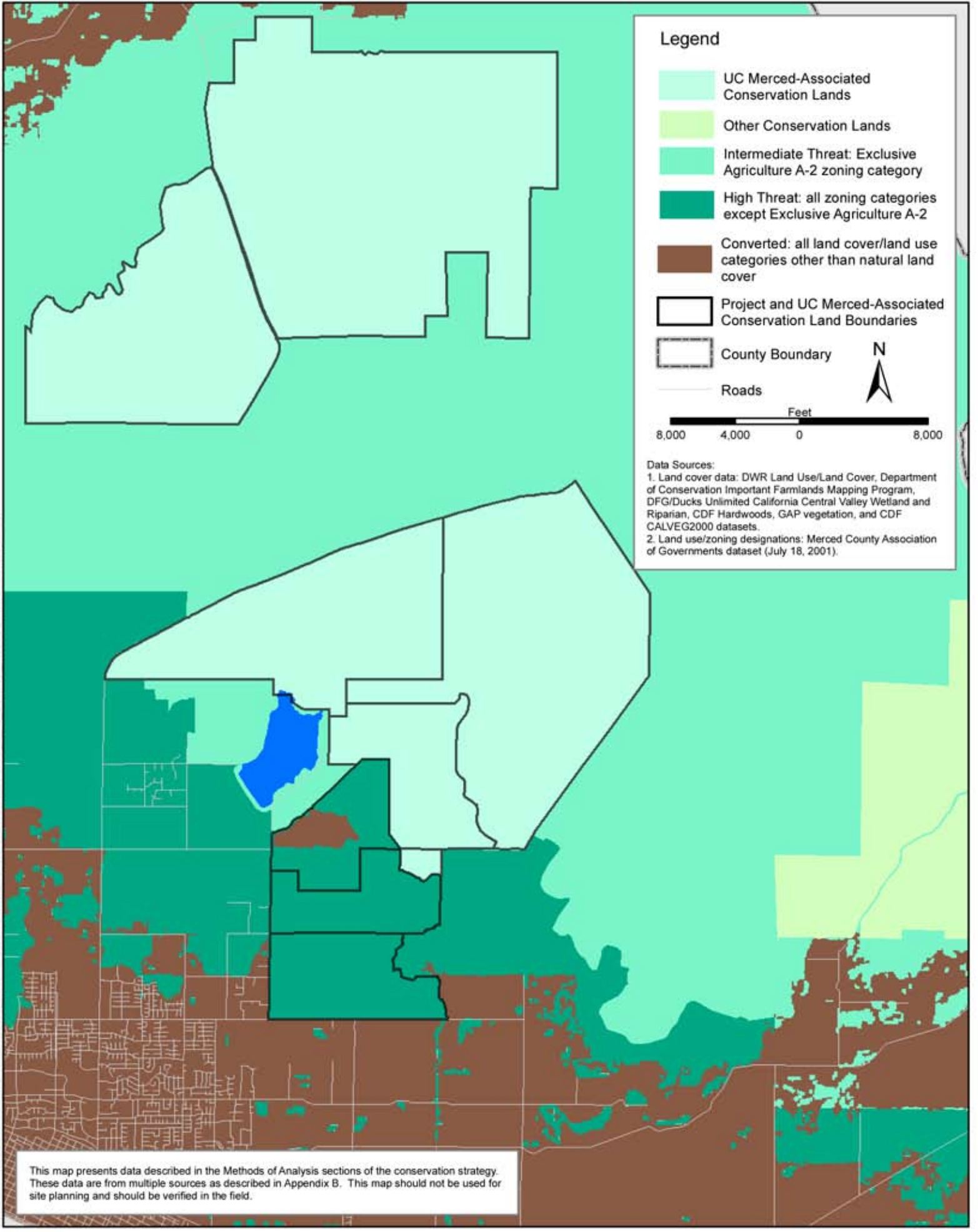
The level of threat to vernal pool ecosystems (and associated species) was determined for all lands in the project region on the basis of zoning classification and the existence of conservation easements. Land in all zoning categories except the Exclusive Agriculture A-2 category was considered to have a high level of threat of permanent loss or potential degradation associated with permanent conversion to incompatible land uses. Land in the Exclusive Agriculture A-2 category was considered to have an intermediate level of threat because of its greater restrictions on developed land uses but lack of requirements for management for conservation values. Lands under conservation easement (VST, Myers Easterly, and Tier 2 mitigation lands) and in conservation ownership (CST), and those committed for future conservation easement (CNR) and other non-UC-related Conservation Lands, were assigned a low level of threat (Figures 3-7a and b).

[1] A *sample* entails surveying a representative portion of the available habitat within a given area. A *census* entails a complete inventory of all habitat features within a given area.



ICF Jones & Stokes

Figure 3-7a
Land Zoning and Conservation Easements in the Project Region



ICF Jones & Stokes

Figure 3-7b
Threats to Natural Cover in the UC Merced Project Area

Effects of the Proposed Action

Implementation of the Proposed Action would result in the permanent conversion of approximately 1,107 acres of land supporting vernal pool ecosystems on seven different geologic formations. Of this land, 790 acres (71%) currently are potentially degraded by existing roads or land conversion and 317 acres (29%) are presumed to be intact (Table 3-3).

The Conservation Lands encompass approximately 25,909 acres of land supporting vernal pool ecosystems on nine different geologic formations. Of this conservation land, 90% is presumed intact and 10% is potentially degraded by existing roads or incompatible land uses (Table 3-3). The protection, enhancement, and management of these Conservation Lands will compensate for the potential effects of the project on vernal pool ecosystems and associated species in the project region, as described in detail below.

As noted previously in the introduction to Species Accounts, the following effects analysis for species of conservation concern is based on the effects on areas of occupied habitat, derived from results of both the CNDDB and all other UC-related survey results.

Table 3-3. Status of Vernal Pool Ecosystems in the Project Area and Conservation Lands

	Proposed Action			Conservation Lands		
Ecosystem Type[a]	Potentially Degraded[b]	Presumed Intact[c]	Total	Potentially Degraded[b]	Presumed Intact[c]	Total
Ione	0 (0)	0 (0)	0 (0)	5 (4)	122 (96)	127 (100)
Laguna	142 (64)	80 (38)	222 (100)	382 (6)	5,869 (94)	6,251 (100)
Mehrten	16 (66)	8 (34)	24 (100)	346 (6)	5,730 (94)	6,076 (100)
Modesto	30 (100)	0 (0)	30 (100)	119 (80)	29 (20)	148 (100)
North Merced Gravel	38 (39)	58 (61)	97 (100)	447 (8)	5,206 (92)	5,653 (100)
Recent Alluvium	55 (100)	0 (0)	55 (100)	326 (24)	1,024 (76)	1,350 (100)
Riverbank	419 (71)	171 (29)	590 (100)	938 (16)	4,878 (84)	5,816 (100)
Turlock Lake	90 (100)	0 (0)	90 (100)	0 (0)	460 (100)	460 (100)
Valley Springs	0 (0)	0 (0)	0	11 (39)	17 (61)	28 (100)
Total	**790 (71)**	**317 (29)**	**1,107 (100)**	**2,574 (10)**	**23,335 (90)**	**25,909 (100)**

Notes:

The total acreages do not correspond with total acreages of conserved lands in other tables because geologic units that do not support vernal pool ecosystems are omitted from this table.

This table presents data described in the *Methods of Analysis* section. The data presented in this table are from multiple sources, as described in Appendix B.

Values in the table are in acres and include both wetland and upland land area. Values in parentheses are percentages represented by the acreage in each category.

[a] Ecosystem types represent geologic formations and correspond to meso-scale categories in the vernal pool classification by Bainbridge (2002).

[b] Land within 200 meters (656 feet) of roads or converted land cover types (e.g., urban or developed land).

[c] Land not within 200 meters (656 feet) of roads or converted land cover types.

Vernal Pool Ecosystems

More than 45% of lands supporting vernal pool ecosystems in the project region have been converted to agricultural and urban land uses. Existing roads and land conversions may have degraded an additional 19% of these lands, leaving only 36% (128,188 acres) presumed intact. However, approximately 80% of vernal pools and swales and 91% of clay playas occurring within these lands were categorized as presumed intact (Table 3-1). The analysis of vernal pool ecosystem types based on the distribution of geologic formations shows that much of the land occurring on the Modesto Formation, Recent Alluvium, and the Riverbank Formation has been lost to land conversion (Figures 3-2a and b). In contrast, a high percentage of the Ione, Laguna, Mehrten, and Valley Springs Formations and North Merced Gravels remains in the presumed intact category. Furthermore, in each of these five largely intact formations, less than 8% of the land is at a high level of threat (Table 3-4).

Table 3-4. Threats to Vernal Pool Ecosystems in the Project Region

Ecosystem Type[a]	Land Area[b]				Vernal Pools and Swales				Clay Playas			
	Level of Threat[c]				Level of Threat[c]				Level of Threat[c]			
	High	Intermediate	Low	Total Area[d]	High	Intermediate	Low	Total Area[d]	High	Intermediate	Low	Total Area[d]
Ione	0 (0)	8,998 (98)	187 (2)	9,185 (100)	0 (0)	207 (95)	11 (5)	218 (100)	0 (0)	36 (100)	0 (0)	36 (100)
Laguna	2,338 (8)	25,071 (91)	149 (1)	27,558 (100)	29 (4)	617 (94)	12 (2)	658 (100)	3 (1)	288 (98)	3 (1)	294 (100)
Mehrten	2,470 (8)	29,514 (90)	726 (2)	32,710 (100)	29 (4)	628 (93)	16 (2)	673 (100)	106 (6)	1,509 (90)	56 (3)	1,671 (100)
Modesto	8,878 (48)	9,329 (51)	219 (1)	18,426 (100)	9 (8)	104 (87)	7 (6)	120 (100)	0 (0)	25 (71)	10 (29)	35 (100)
North Merced Gravel	928 (5)	16,724 (93)	411 (2)	18,063 (100)	17 (2)	882 (96)	18 (2)	917 (100)	5 (1)	339 (97)	7 (2)	351 (100)
Recent Alluvium	3,825 (27)	10,388 (72)	190 (1)	14,403 (100)	17 (8)	183 (91)	1 (0)	201 (100)	0 (0)	4 (100)	0 (0)	4 (100)
Riverbank	13,084 (26)	36,252 (71)	1,892 (4)	51,228 (100)	188 (11)	1414 (81)	135 (8)	1,737 (100)	12 (3)	422 (93)	21 (5)	455 (100)
Turlock Lake	3,111 (14)	19,729 (86)	41 (0)	22,881 (100)	18 (23)	61 (77)	<1 (<1)	79 (100)	2 (12)	15 (88)	0 (0)	17 (100)
Valley Springs	0 (0)	5,195 (83)	1,076 (17)	6,271 (100)	0 (0)	53 (61)	34 (39)	87 (100)	0 (0)	11 (65)	6 (35)	17 (100)
Total	**34,634 (17)**	**161,200 (80)**	**4,891 (2)**	**200,725 (100)**	**307 (7)**	**4,149 (88)**	**234 (5)**	**4,690 (100)**	**128 (4)**	**2,649 (92)**	**103 (4)**	**2,880 (100)**

Notes:

This table presents data described in the *Methods of Analysis*. The data presented in this table are from multiple sources.

Values in the table are in acres. Values in parentheses are percentages represented by the acreage in each category.

[a] Ecosystem types represent geologic formations and correspond to meso-scale categories in the vernal pool classification by Bainbridge (2002).

[b] Land area includes potentially degraded and presumably intact areas but does not include land converted from natural vegetation.

[c] Land with a low level of threat is managed primarily for biodiversity; land with an intermediate level of threat is zoned as Exclusive Agricultural (A-2) and not managed primarily for biodiversity; land with a high level of threat is not zoned Exclusive Agricultural (A-2) and is not managed primarily for biodiversity.

[d] Total area of land presumed intact or potentially degraded.

Lands occurring on the Modesto Formation have suffered the greatest historic loss (81%) from land conversion (Table 3-1); furthermore, the Modesto Formation includes the greatest percentage of lands (48%) at a high level of threat (Table 3-4). The Riverbank Formation is the most abundant formation in the project area, while the Laguna and Mehrten Formations are the most abundant on Conservation Lands (Tables 3-3 and 3-4).

Construction of the Proposed Action would affect vernal pool ecosystems occurring on the Laguna, Mehrten, Modesto, Riverbank, and Turlock Lake Formations and on North Merced Gravel and Recent Alluvium (Table 3-3). Most lands (71%) within the project area are potentially degraded. The project affects only a small area (30 acres) of the Modesto Formation and also conserves only a relatively small area (148 acres) of this formation type (Table 3-3).

Vernal pool ecosystems on all geologic formations affected by the Proposed Action, and two additional unaffected formations (Ione and Valley Springs), are protected on Conservation Lands (Table 3-3). The ratio of land area protected on Conservation Lands to that lost under the Proposed Action for the various formations range from 5:1 to 253:1 (based on acreages in Table 3-3).

Plants

Succulent Owl's-Clover

Approximately 1,390 acres of documented occupied habitat for succulent owl's-clover occurs in the project region (Figures 3-8a and b). Of this habitat, 239 acres (17%) are potentially degraded and 1,151 acres (83%) remain presumed intact. Under non-project conditions (i.e., without incorporating project effects, including Conservation Lands protection), documented occupied habitat for succulent owl's-clover is under the following levels of threat from land conversion or degradation: 5% at high risk, 92% at intermediate risk, and 3% at low risk (Table 3-5).

Implementation of the Proposed Action would result in permanent conversion of approximately 25 acres (2%) and potential indirect impacts to an additional 6 acres of the documented occupied habitat for succulent owl's-clover. However, the acquisition of Conservation Lands has resulted in permanent protection of approximately 689 acres (51%) of the documented occupied habitat in the project region (Table 3-6). Notably, a significant amount (32%) of the documented occupied habitat proposed for conservation occurs within the VST (Table 3-7). Implementation of the Proposed Action would significantly reduce the proportion of known occupied lands in the project region at an intermediate level of threat from 92% to 38%, by shifting those within Conservation Lands to a low risk of conversion (Table 3-5).

Hoover's Spurge

Hoover's spurge has not been documented to occur within the project region (EIP Associates 1999b; Dittes and Guardino 2002; California Natural Diversity Database 2008); therefore, implementation of the Proposed Action would not affect any known occupied habitat. However, the project region is within the geographic range of Hoover's spurge and contains apparently suitable habitat for the species that has not been fully surveyed to determine whether it occurs there. Implementation of the Proposed Action would result in permanent conversion of approximately 1,107 acres of land with some potential to support populations of Hoover's spurge. This area comprises less than 1% of the land supporting these ecosystems in the project region (Tables 3-1 and 3-3).

Conversely, the Conservation Lands encompass approximately 25,909 acres of land with some potential to support populations of Hoover's spurge, comprising about 13% of the land supporting vernal pool ecosystems in the project region. Implementation of the Proposed Action therefore would result in permanent protection of large areas of vernal pools and seasonal wetlands that may provide suitable habitat for Hoover's spurge.

Colusa Grass

Approximately 282 acres of documented occupied habitat for Colusa grass occurs in the project region (Figures 3-9a and b). Of this habitat, 14 acres (5%) are potentially degraded and 268 acres (95%) presumably remain intact. Under non-project conditions, documented occupied habitat for Colusa grass is classified at the following levels of threat from land conversion or degradation: 0% at high risk, 97% at intermediate risk, and 3% at low risk (Table 3-5).

Colusa grass has not been documented to occur in or adjacent to the project footprint; therefore, implementation of the Proposed Action would not result in the loss of any known occupied habitat for this species. However, Conservation Lands encompass 156 acres (55%) of the documented occupied habitat in the project region (Tables 3-6 and 3-7). These areas occur within the VST (75%) and the CNR (25%) (Table 3-7). Therefore, implementation of the Proposed Action would result in a decrease in the percentage of known occupied habitat at moderate risk from land conversion from 97% to 45%, while increasing the percentage of occupied habitat at low risk of conversion from 3% to 55% (Table 3-5).

San Joaquin Valley Orcutt Grass

Approximately 110 acres of documented occupied habitat for San Joaquin Valley Orcutt grass occurs in the project region (Figures 3-10a and b). Of this habitat, 34 acres (31%) are potentially degraded and 76 acres (69%) remain presumed intact. Under non-project conditions, documented occupied habitat for San

Table 3-5. Status of and Threats to Known Occupied Habitat for Eight Vernal Pool Grassland Species in the Project Region

	Status		Level of Threat without Project Conservation Lands[c]			Level of Threat with Project Conservation Lands[c]			
Species	Potentially Degraded[a]	Presumed Intact[b]	High	Intermediate	Low	High	Intermediate	Low	Total
Succulent owl's-clover *Castilleja campestris* ssp. *succulenta*	239 (17)	1,151 (83)	77 (5)	1,278 (92)	36 (3)	55 (4)	543 (38)	815 (58)	1,391 (100)
Colusa grass *Neostapfia colusana*	14 (5)	268 (95)	0 (0)	274 (97)	8 (3)	0 (0)	127 (45)	155 (55)	282 (100)
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	34 (31)	76 (69)	44 (40)	66 (60)	0 (0)	44 (40)	50 (45)	16 (15)	110 (100)
Conservancy fairy shrimp *Branchinecta conservatio*	0 (0)	107 (100)	0 (0)	107 (100)	0 (0)	0 (0)	66 (62)	41 (38)	107 (100)
Vernal pool fairy shrimp *Branchinecta lynchi*	387 (17)	1,907 (83)	182 (8)	2,003 (88)	96 (4)	149 (7)	781 (34)	1,351 (59)	2,294 (100)
Midvalley fairy shrimp *Branchinecta mesovallensis*	95 (16)	505 (84)	123 (21)	440 (73)	37 (6)	104 (17)	117 (20)	380 (63)	600 (100)
Vernal pool tadpole shrimp *Lepidurus packardi*	52 (18)	244 (82)	83 (28)	174 (59)	39 (13)	82 (28)	163 (55)	51 (17)	296 (100)
California tiger salamander *Ambystoma californiense*	19,279 (27)	51,709 (73)	9,257 (13)	59,692 (84)	2,039 (3)	9,141 (13)	39,163 (55)	22,684 (32)	70,988 (100)

Notes:

This table presents data described in the *Methods of Analysis* section. The data presented in this table are from multiple sources, as described in Appendix B. Occurrence data reflect field survey results and California Natural Diversity Database records.

Values in the table are in acres. Values in parentheses are percentages represented by the acreage in each category.

[a] Land within 200 meters (656 feet) of roads or converted land cover types (e.g., urban or developed land)

[b] Land not within 200 meters (656 feet) of roads or converted land cover types.

[c] Land with a low level of threat is managed primarily for biodiversity; land with an intermediate level of threat is zoned as Exclusive Agricultural (A-2) and is not managed primarily for biodiversity; land with a high level of threat is not zoned Exclusive Agricultural (A-2) and is not managed primarily for biodiversity.

Table 3-6. Potential Effects of the Proposed UC Merced Project on Known Occupied Habitat for Eight Vernal Pool Grassland Species

Species	Documented Occupied Habitat in the Project Region	Occupied Habitat Affected[a] by Proposed Action					Occupied Habitat on Conservation Lands	
		UC Merced Campus	Community North	Community South	Proposed Action	University's Proposed Project	Tier 1 Properties	Tier 2 Properties
Succulent owl's-clover *Castilleja campestris* ssp. *succulenta*	1,337	27 (2)	4(<1)	0	31 (2)	31 (2)	381 (28)	308 (23)
Colusa grass *Neostapfia colusana*	282	0	0	0	0	0	156 (55)	0
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	156	0	0	0	0	0	16 (10)	0
Conservancy fairy shrimp *Branchinecta conservatio*	107	0	0	0	0	0	14 (13)	0
Vernal pool fairy shrimp *Branchinecta lynchi*	2,384	42 (2)	19 (<1)	<1 (<1)	61 (3)	62 (4)	627 (26)	516 (22)
Midvalley fairy shrimp *Branchinecta mesovallensis*	653	18 (3)	9 (1)	0	27 (4)	27 (4)	259 (40)	66 (10)
Vernal pool tadpole shrimp *Lepidurus packardi*	318	0	4 (1)	0	4 (1)	4 (1)	14 (4)	<1 (<1)
California tiger salamander *Ambystoma californiense*	69,406	971 (1)	913 (1)	0	1,884 (3)	1,884 (3)	8,787 (13)	11,349 (16)

Notes:

This table presents data described in the *Methods of Analysis* section. The data presented in this table are from multiple sources, as described in Appendix B. Occurrence data reflect field survey results and California Natural Diversity Database records.

Values in the table are acres of occupied habitat; values in parentheses are the percentages that the acreage represents of the total occupied habitat in the project region.

[a] Occupied habitat occurring, at least in part, within 250 feet of the proposed project. Known occupied habitat is defined in the *Methods of Analysis* section.

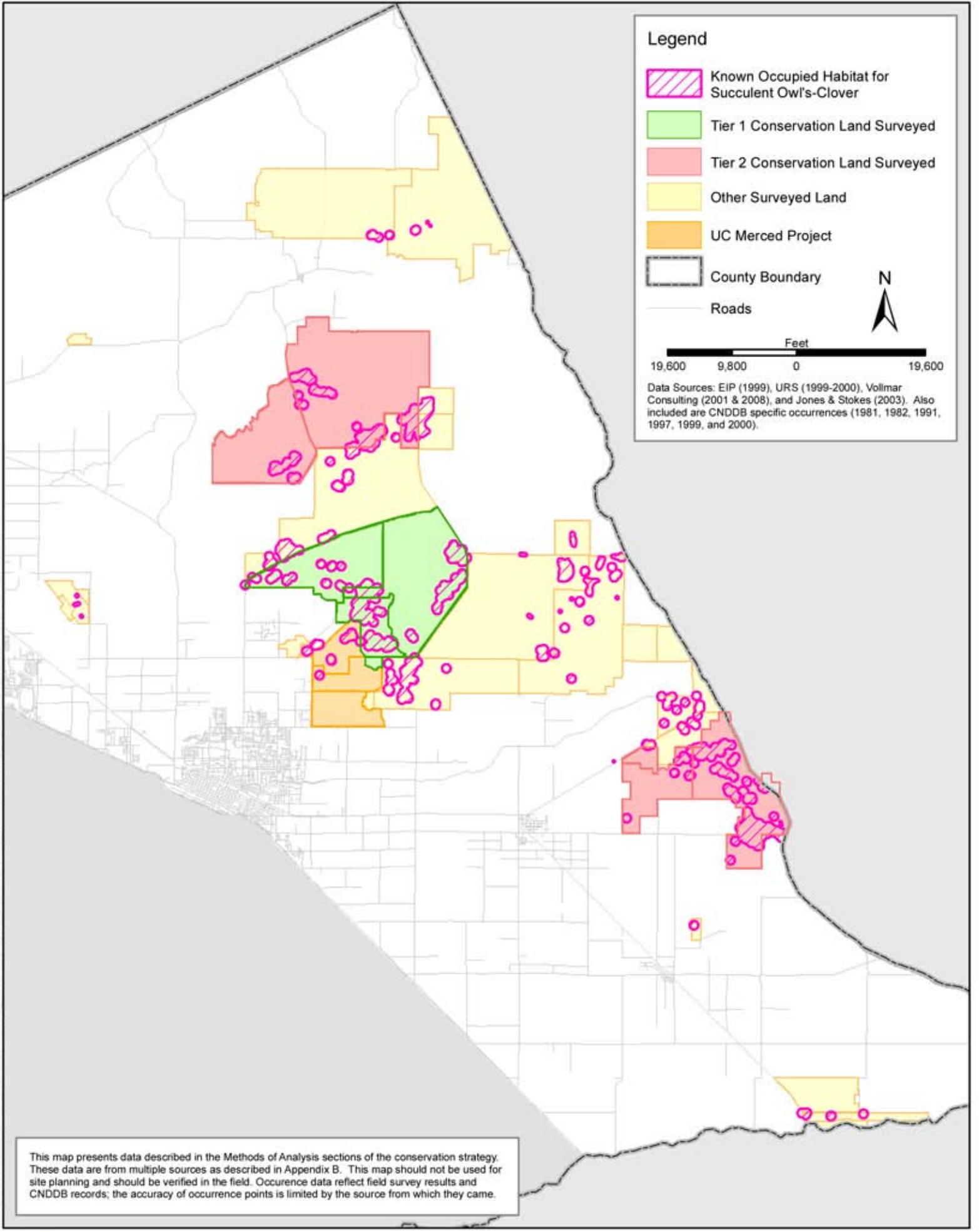
Table 3-7. Distribution of Known Occupied Habitat for Eight Vernal Pool Grassland Species on UC Merced Conservation Properties

	Tier 1 Properties					Tier 2 Properties						
Species	VST[a]	CST[a]	CNR[a]	Myers Easterly	Subtotal	Robinson	Chance	Cunningham	Carlson	Nelson	Subtotal	Total
Succulent owl's-clover *Castilleja campestris* ssp. *succulenta*	219 (32)	68 (10)	94 (14)	0	381 (55)	3 (<1)	164 (24)	56 (8)	1 (<1)	84 (12)	308 (45)	689
Colusa grass *Neostapfia colusana*	117 (75)	0	39 (25)	0	156 (100)	0	0	0	0	0	0	156
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	0	0	16 (100)	0	16 (100)	0	0	0	0	0	0	16
Conservancy fairy shrimp *Branchinecta conservatio*	0	0	14 (100)	0	14 (100)	0	0	0	0	0	0	14
Vernal pool fairy shrimp *Branchinecta lynchi*	349 (31)	137 (12)	139 (12)	2 (<1)	627 (55)	11 (1)	71 (6)	60 (5)	34 (3)	340 (30)	516 (45)	1,143
Midvalley fairy shrimp *Branchinecta mesovallensis*	90 (28)	64 (20)	105 (32)	0	259 (80)	<1 (<1)	0	0	32 (10)	34 (10)	66 (20)	325
Vernal pool tadpole shrimp *Lepidurus packardi*	14 (97)	0	0	0	14 (97)	0	0	0	0	<1 (3)	<1 (3)	15
California tiger salamander *Ambystoma californiense*	4,904 (24)	2,545 (13)	1,256 (6)	90 (<1)	8,795 (44)	2,307 (11)	4,675 (23)	1,179 (6)	194 (1)	2,994 (15)	11,349 (56)	20,144

Notes: This table presents data described in the *Methods of Analysis* section. The data presented in this table are from multiple sources, as described in Appendix B. Occurrence data reflect survey results and California Natural Diversity Database records.

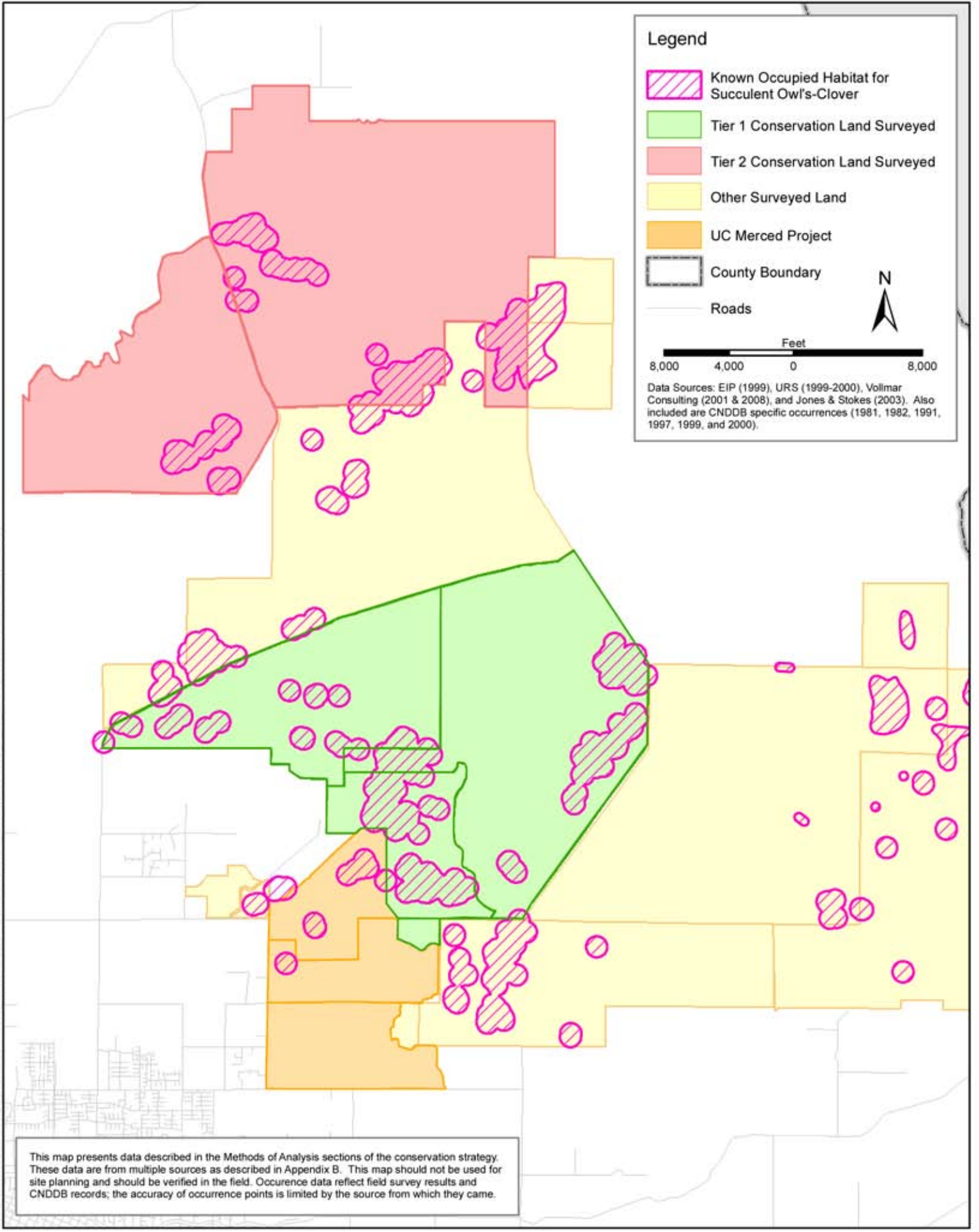
Values in the table are acres of occupied habitat. Values in parentheses are the percentages the acreage represents of the total occupied habitat on conserved lands.

[a] VST = Virgil Smith Trust; CST = Cyril Smith Trust; CNR = Campus Natural Reserve.



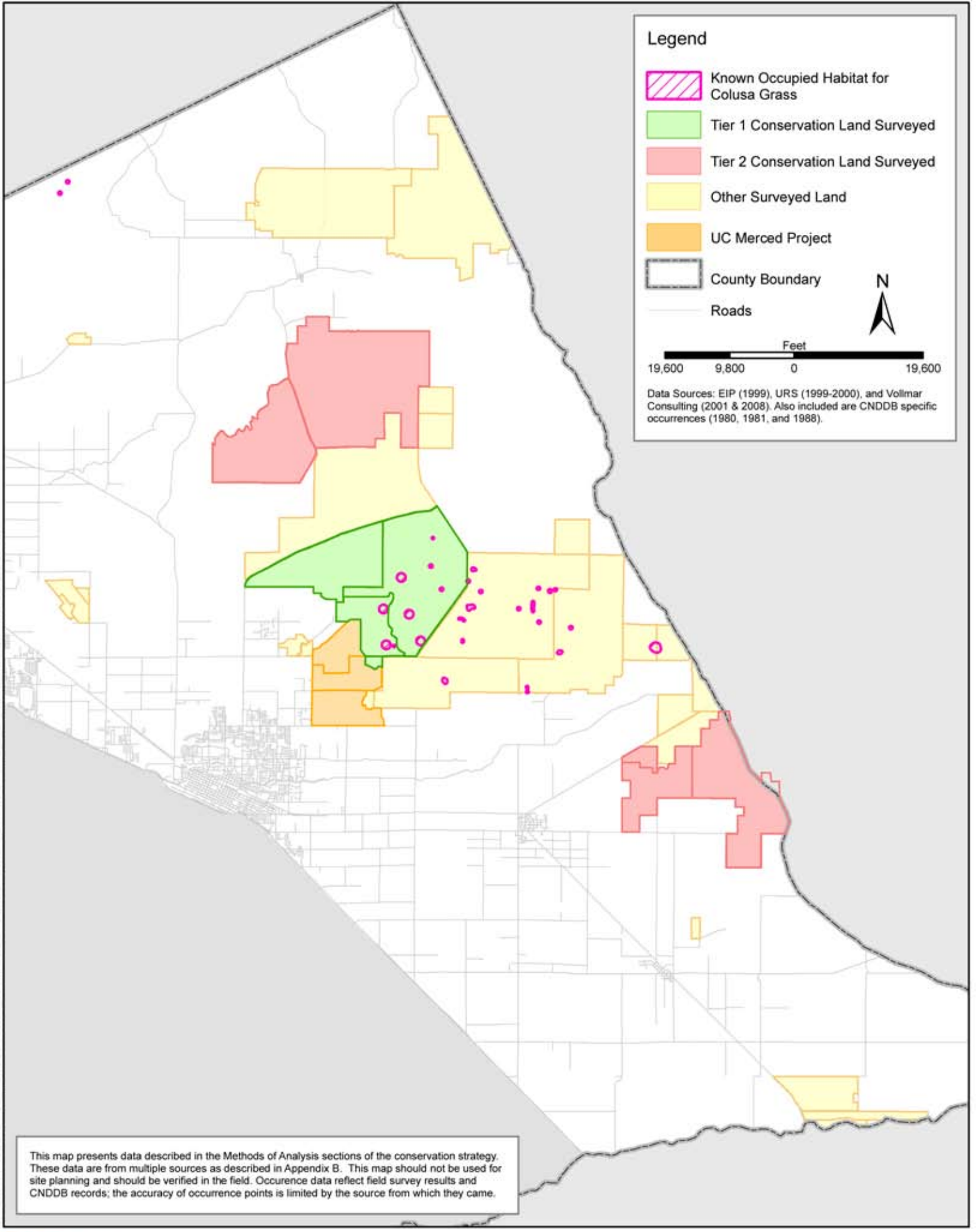
ICF Jones & Stokes

Figure 3-8a
Succulent Owl's-Clover in the Project Region



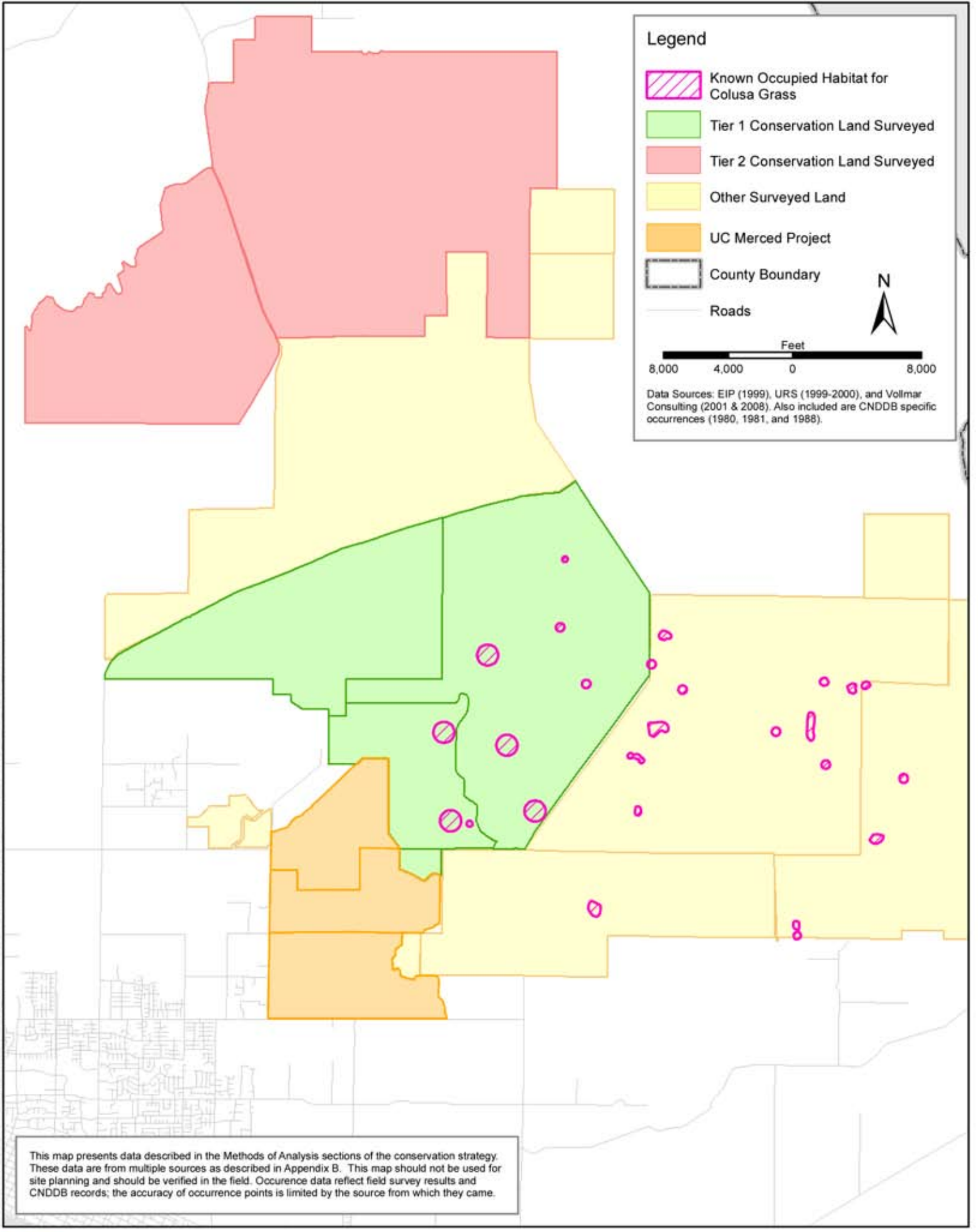
ICF Jones & Stokes

Figure 3-8b
Succulent Owl's-Clover in the UC Merced Project Area



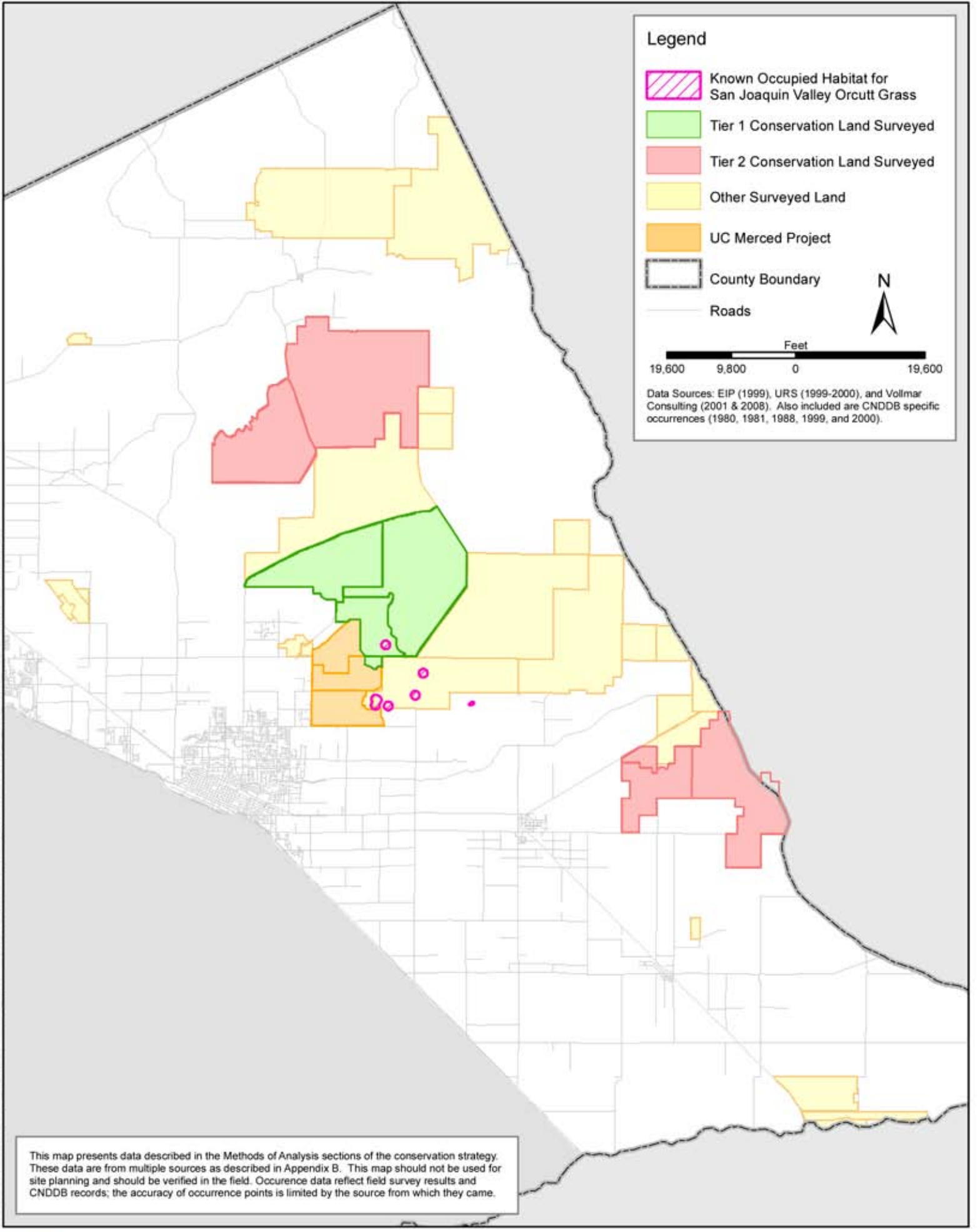
ICF Jones & Stokes

Figure 3-9a
Colusa Grass in the Project Region



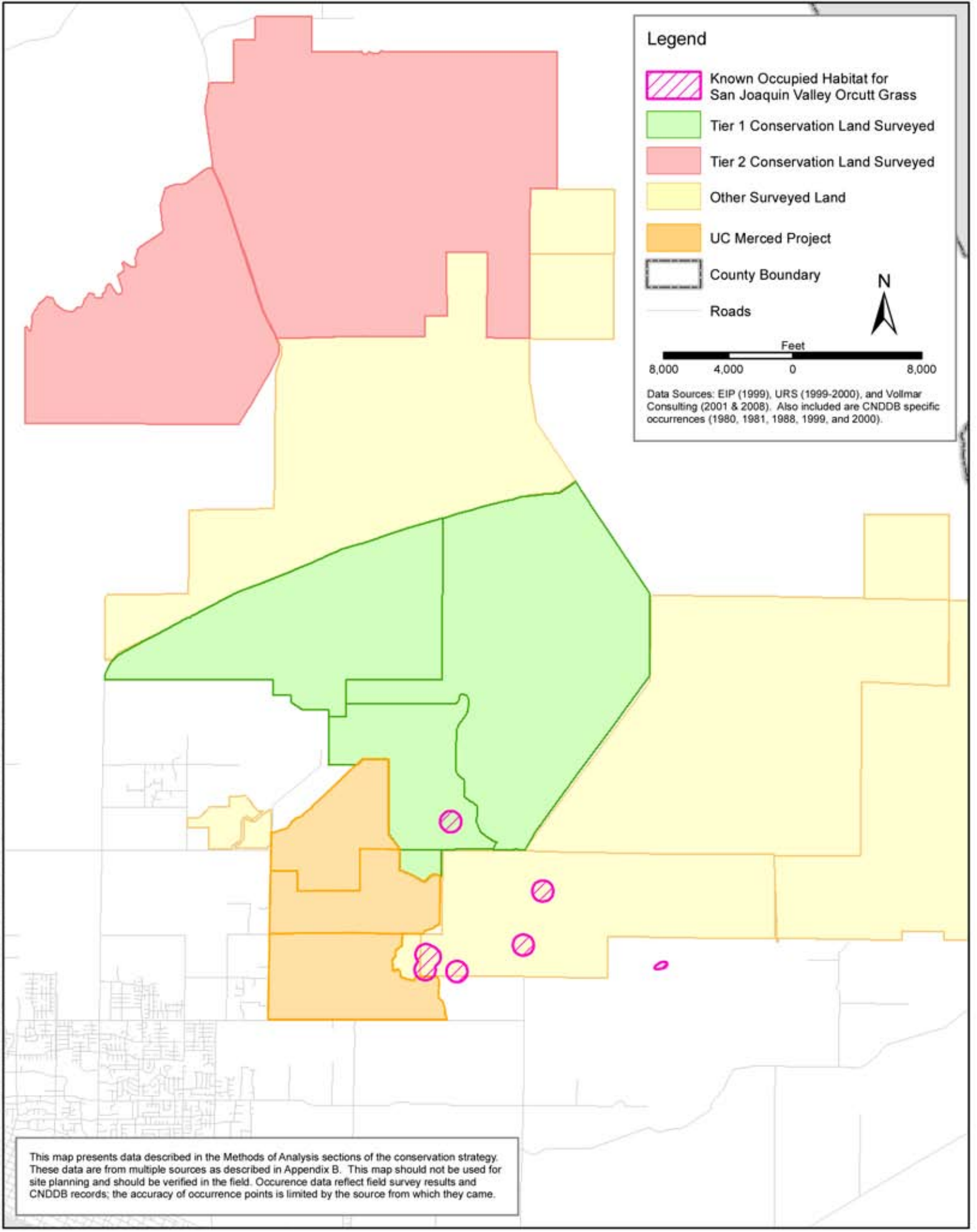
ICF Jones & Stokes

Figure 3-9b
Colusa Grass in the UC Merced Project Area



ICF Jones & Stokes

Figure 3-10a
San Joaquin Valley Orcutt Grass in the Project Region



ICF Jones & Stokes

Figure 3-10b
San Joaquin Valley Orcutt Grass in the UC Merced Project Area

Joaquin Valley Orcutt grass is classified at the following levels of threat from land conversion or degradation: 40% at high risk, 60% at intermediate risk, and 0% at low risk (Table 3-5).

San Joaquin Valley Orcutt grass has not been documented to occur within the project footprint or within 250 feet of the project footprint; therefore, implementation of the Proposed Action would not result in the conversion of or indirect impact to any known occupied habitat. One record of San Joaquin Valley Orcutt grass has been documented to occur within 16 acres of suitable vernal pool habitat within the CNR (Table 3-7). This area represents 10% of the documented occupied habitat in the project region (Tables 3-6 and 3-7). With implementation of the Proposed Action, documented occupied habitat for San Joaquin Valley Orcutt grass would reduce the threat from land conversion or degradation for 16 acres that are at intermediate risk, resulting in the following post-project threat levels: 44% at high risk, 50% at intermediate risk, and 16% at low risk (Table 3-5).

Hairy Orcutt Grass

Hairy Orcutt grass has not been documented to occur within the project region (EIP Associates 1999b; Dittes and Guardino 2002; California Natural Diversity Database 2008); therefore, implementation of the Proposed Action would not affect any known occupied habitat. However, the project region is within the geographic range of hairy Orcutt grass and supports apparently suitable habitat for the species that has not been surveyed to determine whether it occurs there. Implementation of the Proposed Action would result in permanent conversion of approximately 1,107 acres of land with some potential to support populations of hairy Orcutt grass. This area comprises less than 1% of the land supporting vernal pool ecosystems in the project region (Tables 3-1 and 3-3).

Conversely, the Conservation Lands encompass approximately 25,909 acres of land with some potential to support populations of hairy Orcutt grass, comprising about 13% of the land supporting vernal pool ecosystems in the project region. Implementation of the Proposed Action would result in permanent protection of large areas of vernal pools and seasonal wetlands that may provide suitable habitat for hairy Orcutt grass.

Hartweg's Golden Sunburst

Hartweg's golden sunburst has not been documented to occur within the project region. Habitats capable of supporting this species do not occur in or adjacent to the project footprint. Although it has not been documented to occur within the project region, habitats capable of supporting this species were identified on some Conservation Lands (i.e., the Chance and Nelson Ranches [Dittes and Guardino 2002]). Implementation of the Proposed Action would result in permanent protection of these habitats.

Greene's Tuctoria

Greene's tuctoria has been documented to occur at 11 locations within the project region (California Natural Diversity Database 2008), none of which occur on or adjacent to the project footprint. Surveys for the species conducted in the project region have resulted in no new observed occurrences other than those reported in the CNDDB. Implementation of the Proposed Action would not result in conversion of any known occupied habitat. However, the project region is within the geographic range of Greene's tuctoria and contains apparently suitable habitat for the species. Consequently, implementation of the Proposed Action would result in conversion of approximately 1,107 acres of land with some potential to support populations of Greene's tuctoria. This area comprises less than 1% of the land supporting vernal pool ecosystems in the project region (Tables 3-1 and 3-3).

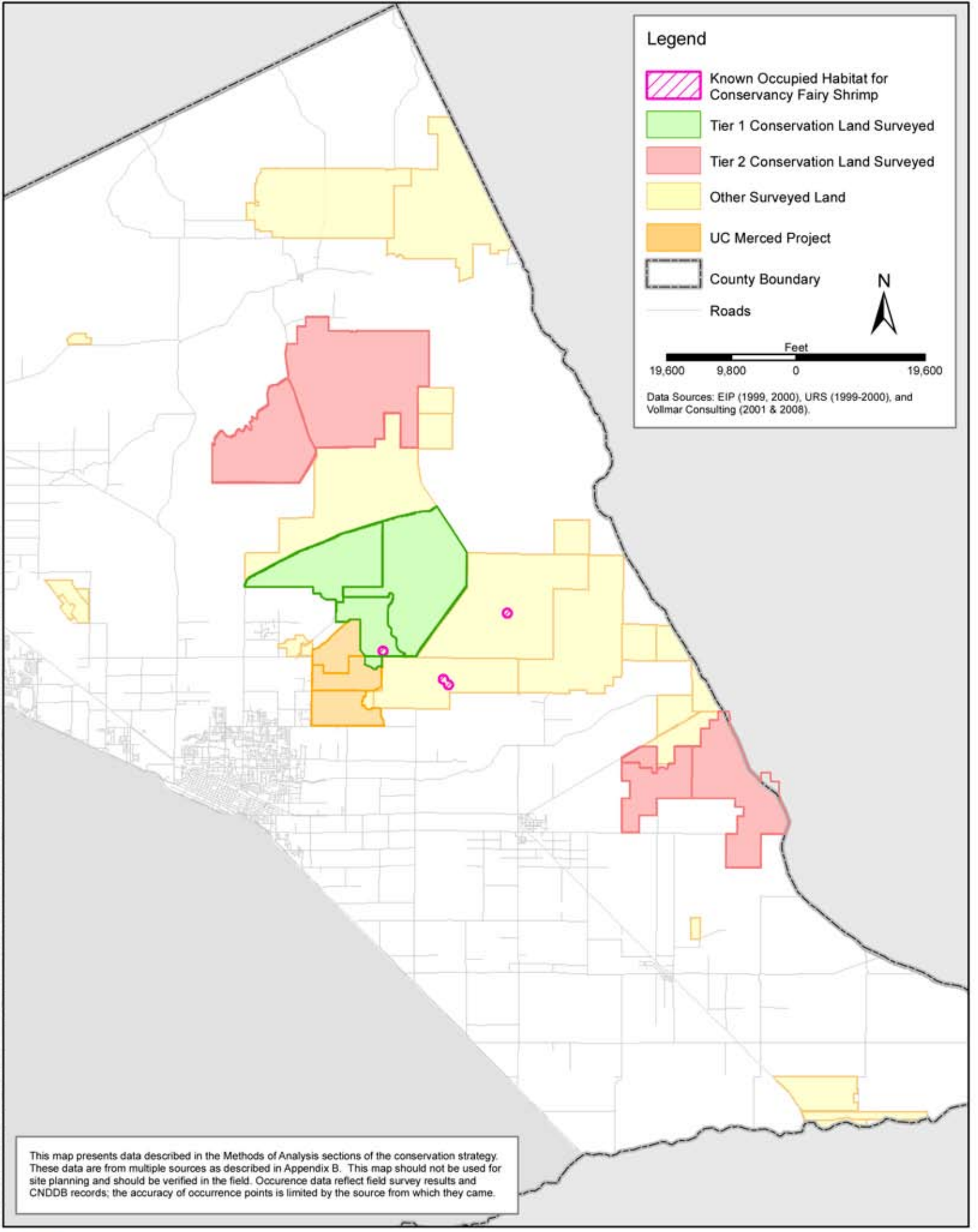
Conversely, the Conservation Lands encompass approximately 25,909 acres of land with some potential to support populations of Greene's tuctoria, comprising about 13% of the vernal pool ecosystems in the project region. Implementation of the Proposed Action therefore would result in permanent protection of large areas of vernal pools and seasonal wetlands in the project region that may provide suitable habitat for Greene's tuctoria.

Invertebrates

Conservancy Fairy Shrimp

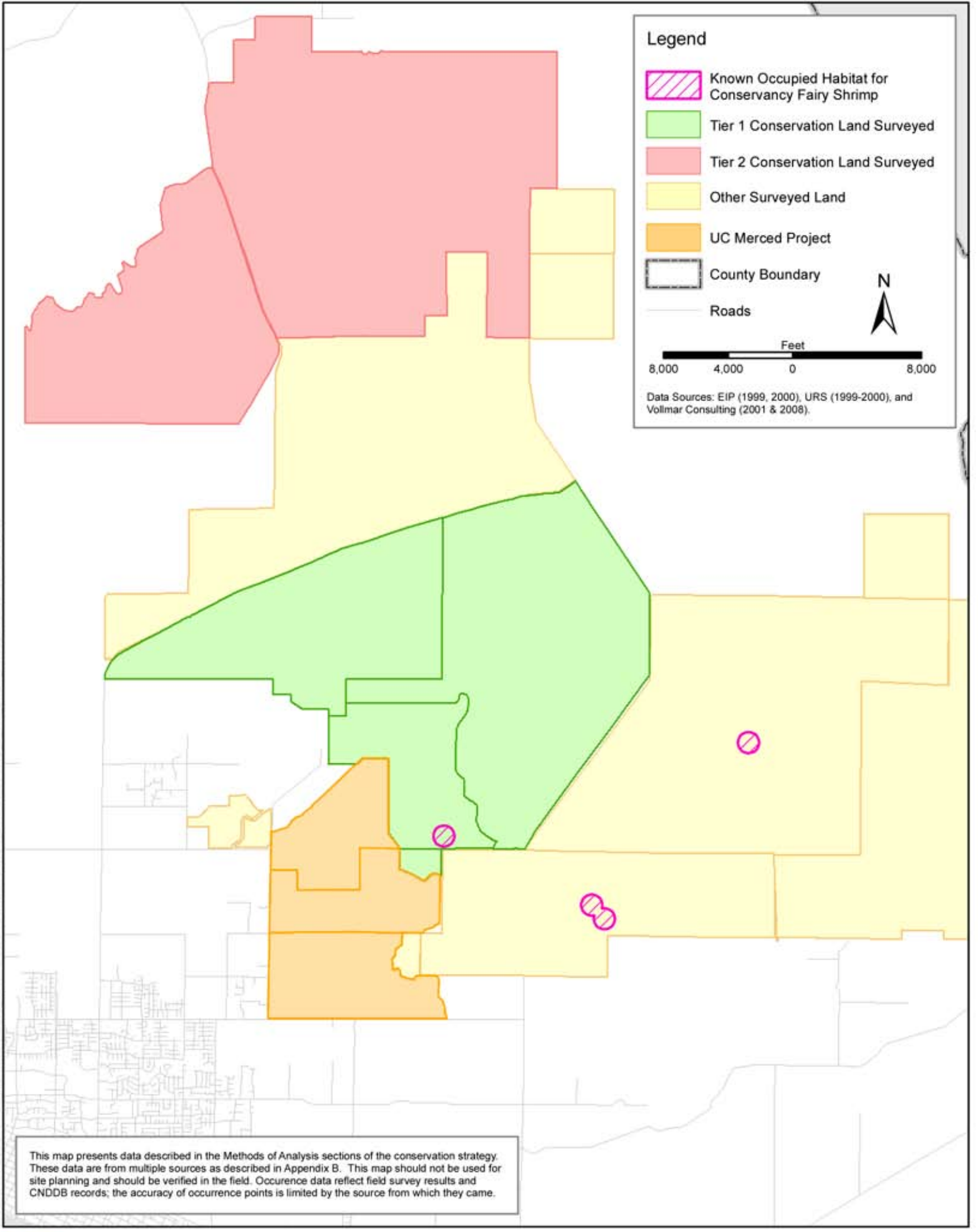
Approximately 107 acres of documented occupied habitat for Conservancy fairy shrimp occurs within the project region, all of which is presumed intact according to the land cover analysis (Figures 3-11a and b). Under non-project conditions, all Conservancy fairy shrimp occurrences in the project region are at intermediate risk of conversion or degradation because they occur on lands that are zoned as Exclusive Agriculture (A-2) that are not managed primarily for biodiversity (Table 3-5).

Conservancy fairy shrimp has not been documented to occur in the project footprint or within 250 feet of the footprint. Therefore, implementation of the Proposed Action would not result in the loss of any known occupied habitat. One record of Conservancy fairy shrimp is associated with approximately 14 acres of vernal pool habitat on Conservation Lands within the CNR. This area represents 13% of the documented occupied habitat in the project region. All of the documented occupied habitat proposed for conservation occurs within the CNR (Tables 3-6 and 3-7). Implementation of the Proposed Action would result in approximately 41 acres (38%) of documented occupied habitat in the project region changing from the intermediate risk category to the low risk category (Table 3-5).



ICF Jones & Stokes

Figure 3-11a
Conservancy Fairy Shrimp in the Project Region



ICF Jones & Stokes

Figure 3-11b
Conservancy Fairy Shrimp in the UC Merced Project Area

Vernal Pool Fairy Shrimp

Approximately 2,294 acres of documented occupied habitat occurs in the project region. Of this, 387 acres (17%) are potentially degraded, and 1,907 acres (83%) presumably are intact (Figures 3-12a and b). Under non-project conditions, documented occupied habitat for vernal pool fairy shrimp is under the following levels of threat from land conversion or degradation: 8% at high risk, 88% at intermediate risk, and 4% at low risk (Table 3-5).

Implementation of the Proposed Action would result in conversion of approximately 61 acres (3%) of the documented occupied habitat in the project region. Conversely, approximately 1,143 acres (48%) of the documented occupied habitat in the project region occurs on Conservation Lands (Tables 3-6 and 3-7). Therefore, implementation of the Proposed Action would substantially reduce the percentage of known occupied habitat at intermediate risk from land conversion from 88% to 34%, while increasing the percentage of occupied habitat at low risk of conversion from 4% to 59% (Table 3-5).

Midvalley Fairy Shrimp

Approximately 600 acres of documented occupied habitat for midvalley fairy shrimp occurs in the project region (Figures 3-13a and b). Of the known occupied habitat, 95 acres (16%) are potentially degraded and 505 acres (84%) presumably are intact. Under pre-project conditions, documented occupied habitat for midvalley fairy shrimp is under the following levels of threat from land conversion or degradation: 21% at high risk, 73% at intermediate risk, and 6% at low risk (Table 3-5). It should be noted, however, that this species is often not observed during traditional vernal pool surveys due to its apparent adaptations to relatively warm water temperatures and short ponding duration. The distribution and abundance of this species therefore are under-represented by metrics such as the amount of known occupied habitat to a greater degree than for some of the other vernal pool invertebrates.

Implementation of the Proposed Action would result in conversion of approximately 24 acres (4%) and potential indirect impacts to less than 4 acres of the known occupied habitat in the project region. Conversely, approximately 325 acres (50%) of known occupied habitat in the project region occurs on Conservation Lands (Tables 3-6 and 3-7). Therefore, implementation of the Proposed Action would decrease the percentage of known occupied habitat at intermediate risk from land conversion from 73% to 20%, while increasing in the percentage of occupied habitat at low risk of conversion from 6% to 63% (Table 3-5).

Vernal Pool Tadpole Shrimp

Approximately 296 acres of documented occupied habitat for vernal pool tadpole shrimp occurs in the project region (Figures 3-14a and b). Of this, 52 acres (18%) are potentially degraded and 244 acres (82%) presumably are intact. Under non-project conditions, documented occupied habitat for vernal pool tadpole shrimp is under the following levels of threat from land conversion or degradation: 28% at high risk, 59% at intermediate risk, and 13% at low risk (Table 3-5).

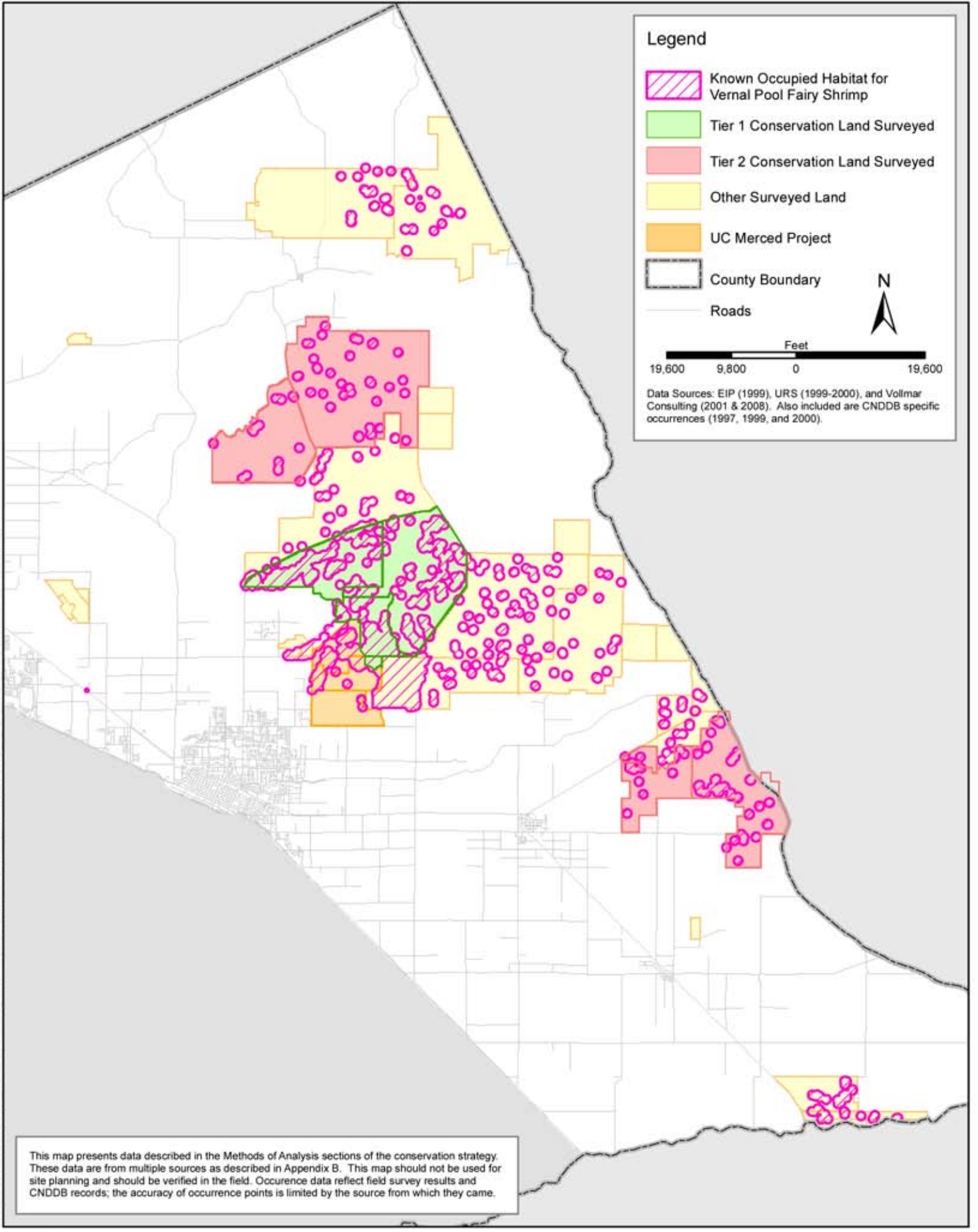
Implementation of the Proposed Action would result in permanent conversion of approximately 2 acres (1%) and potential indirect impacts to an additional 2 acres of known occupied habitat for vernal pool tadpole shrimp in the project region. Conversely, approximately 15 acres (5%) of the known occupied habitat in the project region would be protected and managed s on Conservation Lands (Tables 3-6 and 3-7). Therefore, implementation of the Proposed Action would result in a decrease in the percentage of known occupied habitat at intermediate risk from land conversion from 59% to 55%, while increasing in the percentage of occupied habitat at low risk of conversion from 13% to 17% (Table 3-5).

Amphibians

California Tiger Salamander

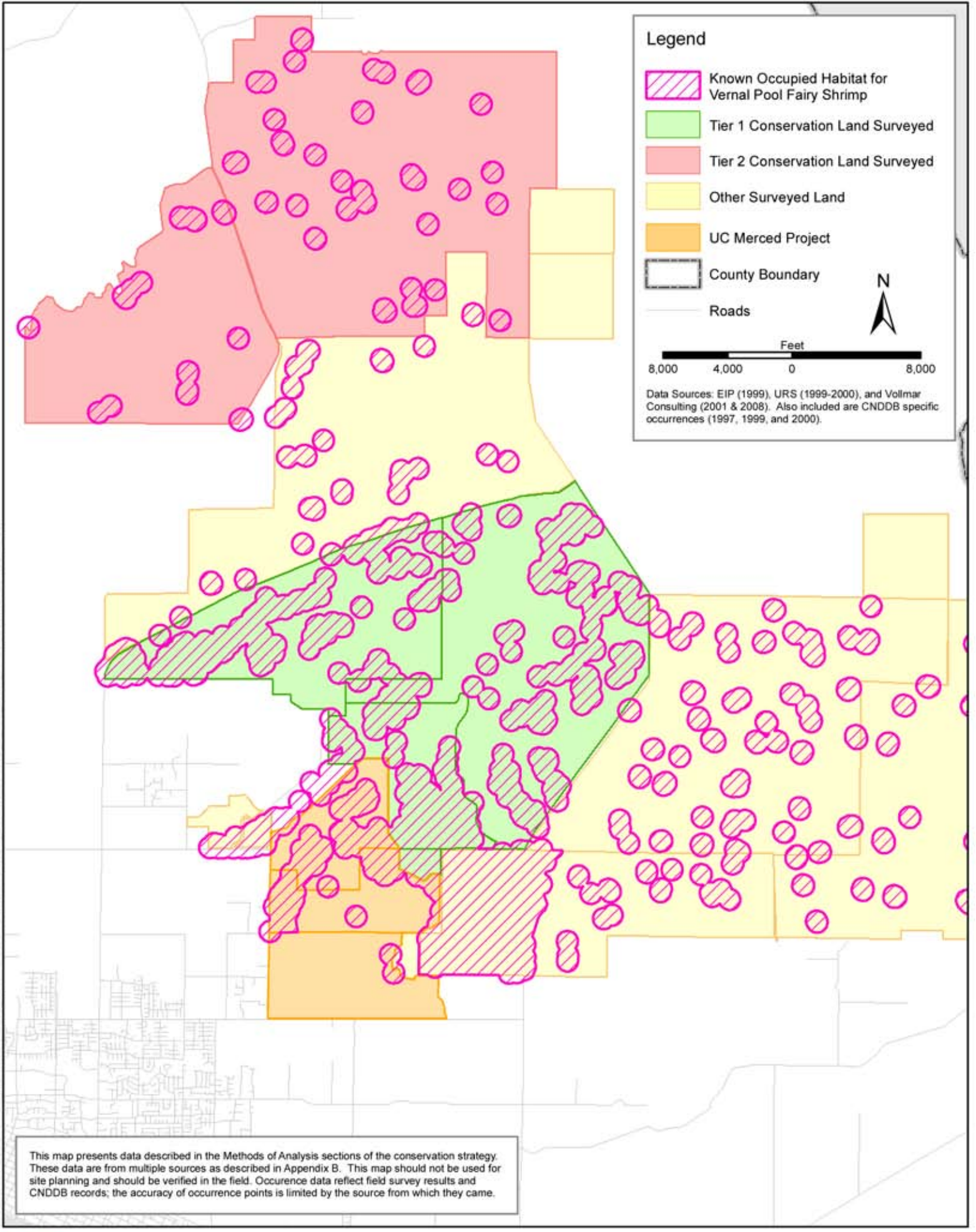
California tiger salamander larvae have been observed at a number of vernal pools and stock ponds throughout much of the project region (Laabs et al. 2002; California Natural Diversity Database 2008) (Figures 3-15a and b). Approximately 70,988 acres of documented occupied habitat occurs in the project region. Of this, 19,279 acres (27%) are potentially degraded and 51,709 acres (73%) presumably are intact. Under non-project conditions, documented occupied habitat for California tiger salamander is under the following levels of threat from land conversion or degradation: 13% at high risk, 84% at intermediate risk, and 3% at low risk (Table 3-5).

Implementation of the Proposed Action would result in permanent conversion of approximately 1,648 acres (3%) and potential indirect impacts to an additional 236 acres of the documented occupied habitat in the project region. Conversely, approximately 20,144 acres (28%) of documented occupied habitat in the project region occurs on Conservation Lands (Table 3-6). Therefore, implementation of the Proposed Action would result in a decrease in the percentage of known occupied habitat at intermediate risk from land conversion from 84% to 55%, with a concomitant increase in the percentage of occupied habitat at low risk of conversion from 3% to approximately 32% (Table 3-5).



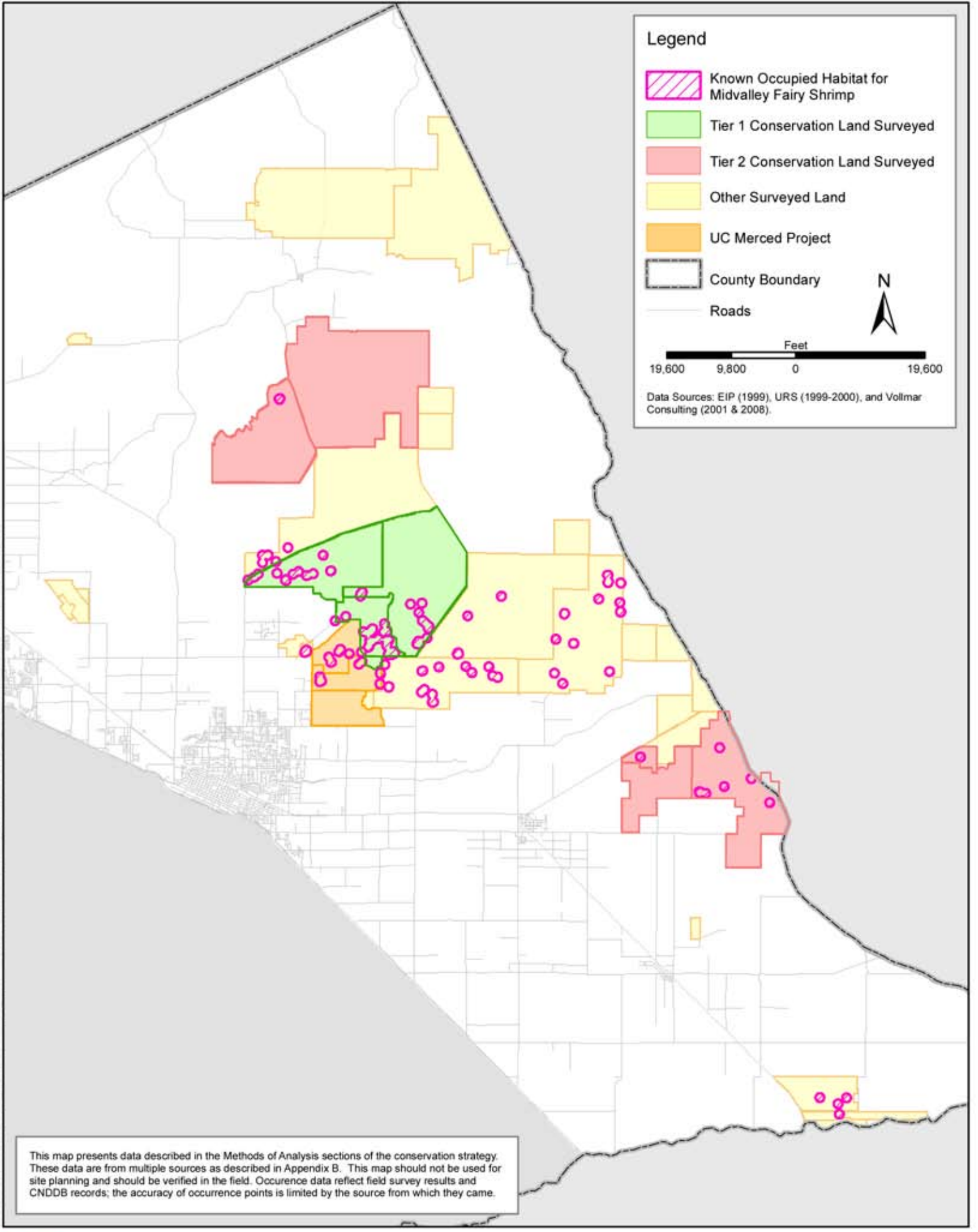
ICF Jones & Stokes

Figure 3-12a
Vernal Pool Fairy Shrimp in the Project Region



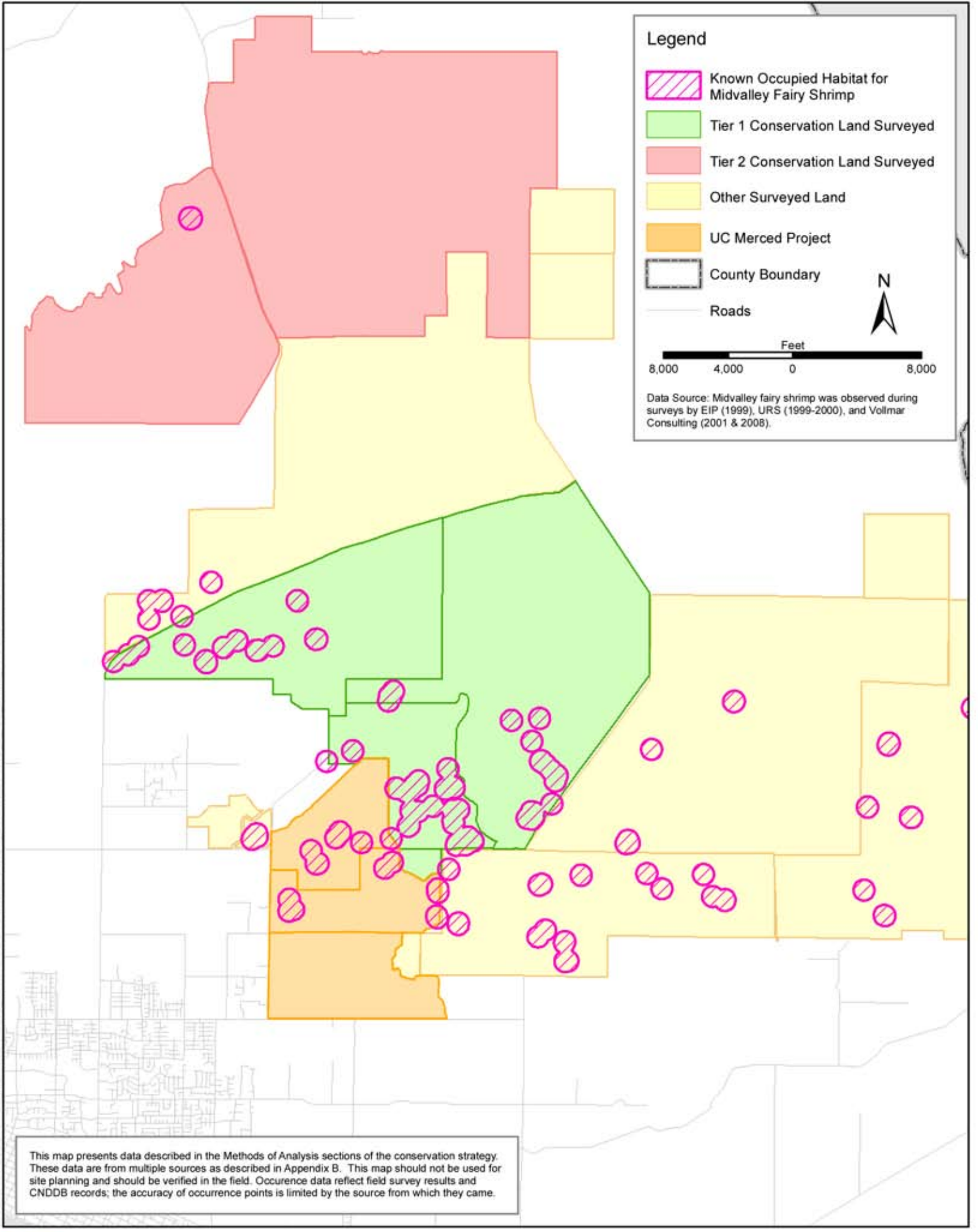
ICF Jones & Stokes

Figure 3-12b
Vernal Pool Fairy Shrimp in the UC Merced Project Area



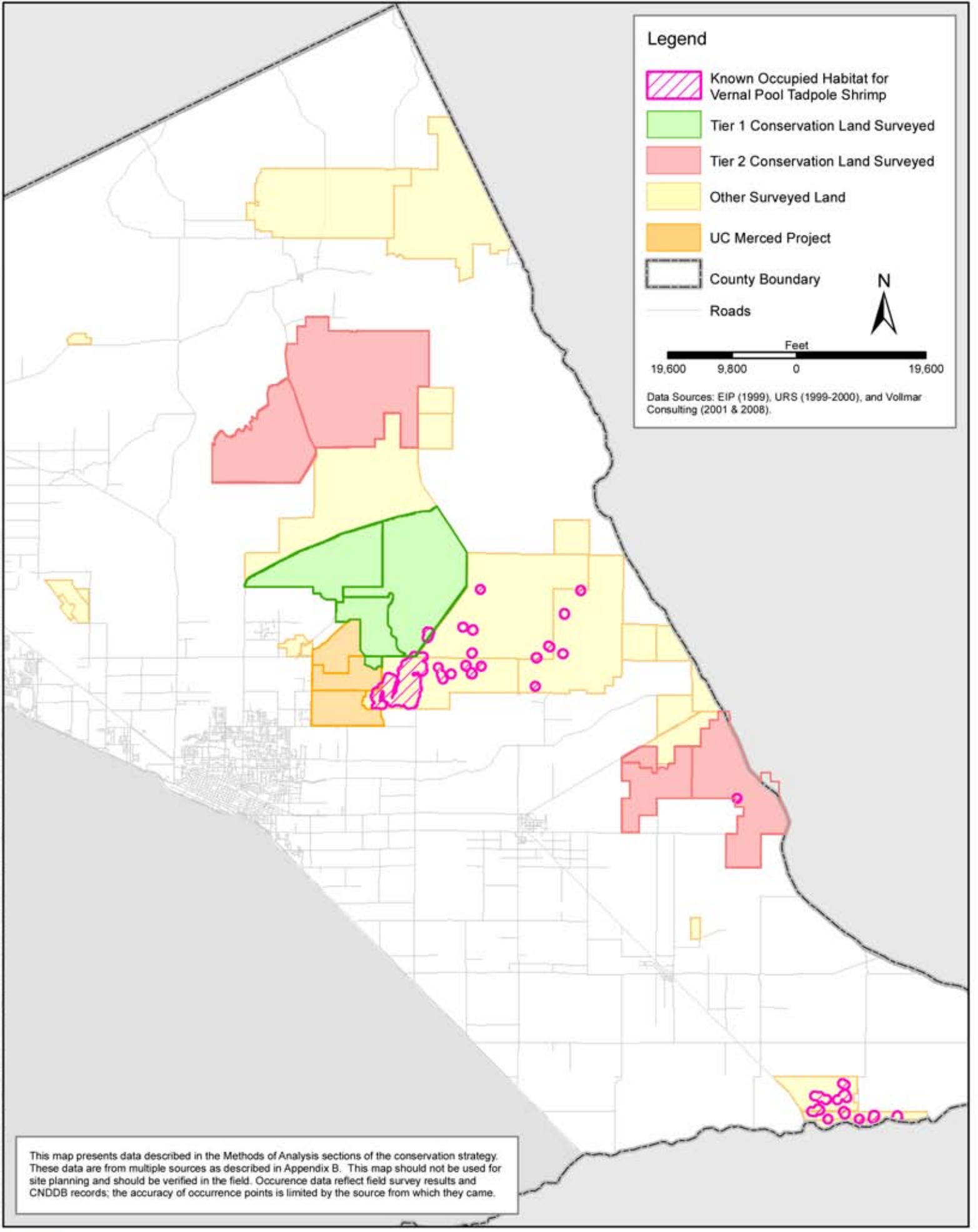
ICF Jones & Stokes

Figure 3-13a
Midvalley Fairy Shrimp in the Project Region



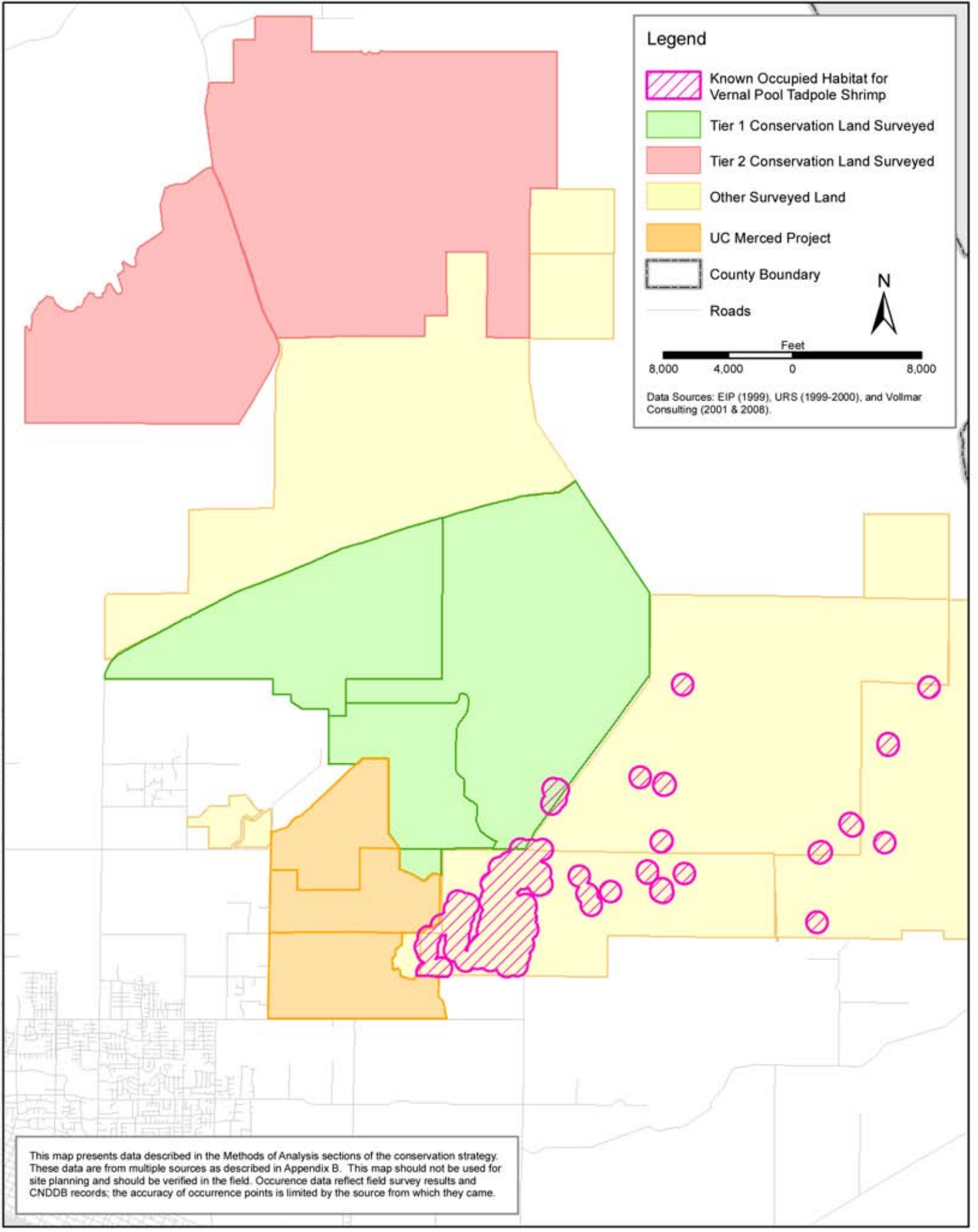
ICF Jones & Stokes

Figure 3-13b
Midvalley Fairy Shrimp in the UC Merced Project Area



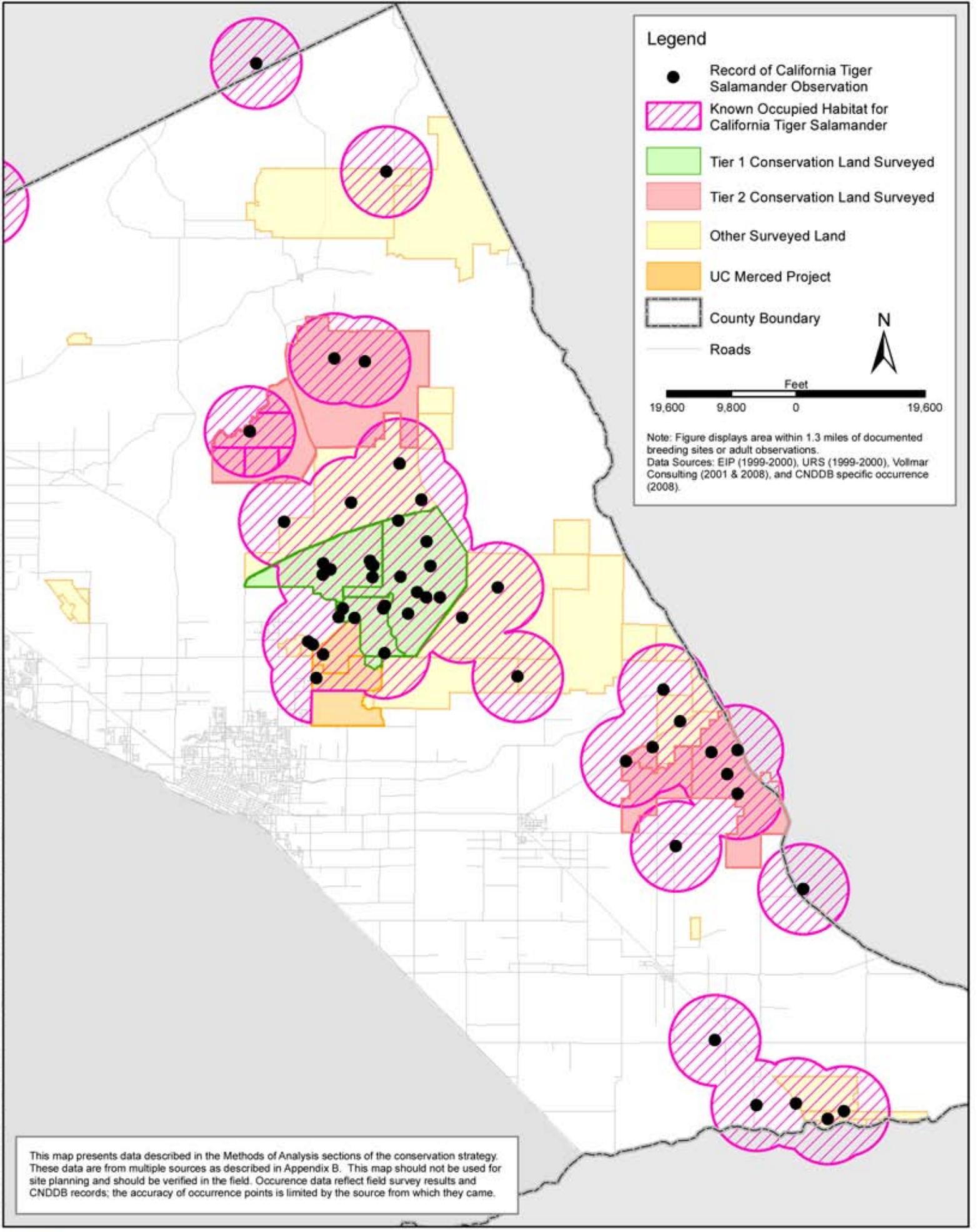
ICF Jones & Stokes

Figure 3-14a
Vernal Pool Tadpole Shrimp in the Project Region



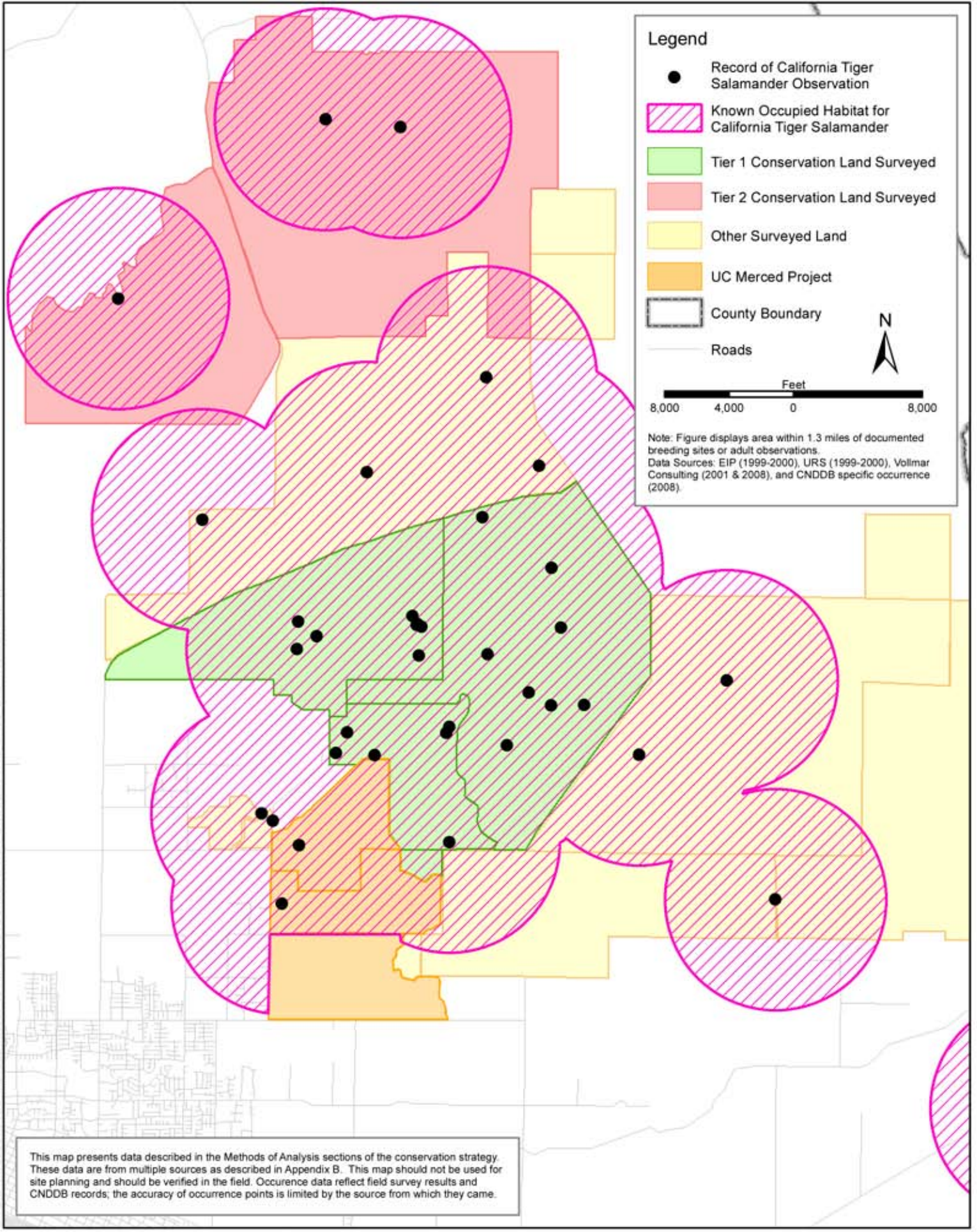
ICF Jones & Stokes

Figure 3-14b
Vernal Pool Tadpole Shrimp in the UC Merced Project Area



ICF Jones & Stokes

Figure 3-15a
Distribution of California Tiger Salamander Observations in the Project Region



ICF Jones & Stokes

Figure 3-15b
Distribution of California Tiger Salamander Observations in the UC Merced Project Area

Chapter 4
Other Special-Status Species

This chapter addresses the capability of habitats in the project region to support various special-status species and the potential effects of implementation of the Proposed Action on these species and their habitats.

For the purposes of this document, *other special-status species* are those plants and animals not identified in the BO (U.S. Fish and Wildlife Service 2002) as target species that are legally protected under the California Endangered Species Act (CESA), ESA, or other regulations but are considered sufficiently rare by the scientific community to warrant special consideration under California Environmental Quality Act (CEQA). *Special-status plants and animals* are species in the categories listed below:

- Species listed or proposed for listing as threatened or endangered under the ESA (50 CFR 17.12 [listed plants], 50 CFR 17.11 [listed animals], and various notices in the FR [proposed species]).
- Species that are candidates for possible future listing as threatened or endangered under the ESA (61 FR 40: 7596-7613, February 28, 1996).
- Species listed or proposed for listing by the State of California as threatened or endangered under CESA (14 CCR] 670.5).
- Species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380).
- Plants listed as rare or endangered under the California Native Plant Protection Act (California Fish and Game Code, Sections 1900 et seq.).
- Plants considered by the California Native Plant Society (CNPS) to be "rare, threatened, or endangered in California" (Lists 1B and 2 in California Native Plant Society 2001).
- Plants listed by CNPS as plants about which more information is needed to determine their status and plants of limited distribution (Lists 3 and 4 in California Native Plant Society 2001), which may be included as special-status species on the basis of local significance or recent biological information.
- Animal species of special concern to DFG, and animal species designated as a lower risk/near threatened taxon by the World Conservation Union (California Department of Fish and Game 2008; Shuford and Galdari 2008).
- Animals fully protected in California (California Fish and Game Code, Sections 3511 [birds], 4700 [mammals], and 5050 [reptiles and amphibians]).

The resources listed below were used to identify special-status invertebrates, amphibians, reptiles, birds, mammals, and plants with the potential to occur in the project region.

- Environmental and regulatory documents and supporting surveys for the UC Merced Project (EIP Associates 1999a, 1999b, 1999c, 2001b, 2001c, 2001d, 2001f, 2002a, 2004c; Jones & Stokes 2002a; URS Corporation 2001a, 2002a; U.S. Fish and Wildlife Service 2002).
- USFWS list of federal endangered and threatened species that occur in or may be affected by projects in Merced County (U.S. Fish and Wildlife Service 2006a).
- CNDDB search for Merced County (2008).

Species Accounts

The following sections describe the ecology and distribution of other special-status species and general threats to the species in the region and state.

Invertebrates

Valley Elderberry Longhorn Beetle

Ecology and Distribution

Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB) is federally listed as threatened (45 FR 52803). The species occurs from as far south as Kern County to as far north as Shasta County (U.S. Fish and Wildlife Service 1999). The majority of specimens and recorded observations appear to be from the Sacramento/Davis area. VELB is closely associated with blue elderberry (*Sambucus mexicana*), the obligate host plant for beetle larvae. Blue elderberry is considered a typical riparian shrub in California. This hardy shrub successfully grows in a variety of riparian habitat types (U.S. Fish and Wildlife Service 1984).

The presence of exit holes in elderberry stems indicates previous use by VELB. The cylindrical exit holes are approximately 0.25 inch in diameter and can be found on stems at least 1 inch in diameter—from a few inches up to 10 feet above ground (U.S. Fish and Wildlife Service 1984).

The entire project region is within the species' range and contains habitats capable of supporting the beetle. The species has been documented in a few locations in the project region (California Natural Diversity Database 2008).

Threats

The major threats to VELB survival are the conversion of riparian habitats to agricultural uses; levee construction; stream and river channelization; removal of riparian vegetation and rip-rapping of shoreline; and recreational, industrial, and urban development, which have caused alteration and fragmentation of riparian habitats and, to a lesser extent, to upland habitats that support the beetle. An increase in nonnative species such as Argentine ant, which may eat the early life stages of the beetle, also is considered a threat to this species. An additional threat may be the use of insecticides and herbicides in agricultural areas and along road rights-of-way; such applications may have limited the species' distribution (U.S. Fish and Wildlife Service 1984).

Amphibians and Reptiles

Western Spadefoot

Ecology and Distribution

Western spadefoot is a state species of special concern. The species occurs in the Central Valley and adjacent foothills and in the Coast Ranges from Point Conception to Santa Barbara County and south to the Mexican border (Zeiner et al. 1988).

Suitable habitats include grassland habitats and valley-foothill hardwood forests with shallow temporary pools formed by heavy winter rains. The shallow temporary pools provide the aquatic component essential for breeding and egg laying. Underground burrows are also important to provide cover for most of the year when adequate pools are not available. Some populations have persisted in orchards and vineyards (Zeiner et al. 1988).

The project region is within the species range and contains habitat capable of supporting the species. Western spadefoot has been documented in numerous locations throughout the project region (California Natural Diversity Database 2008).

Threats

The principal threats to western spadefoot are loss of seasonal aquatic breeding habitat due to urban development; conversion to agricultural land; introduction of nonnative predators (and competitors); and stochastic events that particularly affect small, isolated populations. Additionally, spadefoots are known to be extremely sensitive to low-frequency noise and vibration, such as may be produced by construction equipment. Such disturbance near aestivation or breeding habitat could disrupt local populations' normal activity, leading to

reduced reproduction or mortality (California Department of Fish and Game 1994a).

Western Pond Turtle

Ecology and Distribution

Western pond turtle is a state species of special concern. Western pond turtles historically occurred as far north as western Washington (although it is now thought to be near extinction in that region) and south to northwestern Baja, California, mostly west of the Cascade-Sierran crest. Outlying areas include the Mojave River in southern California; the Truckee, Carson, and East Walker Rivers in Nevada; near Susanville in Lassen County, California; and in Drews Creek, the Canyon Creek area, and the Deschutes River in Oregon—where it was introduced (Stebbins 2003).

Western pond turtle is a thoroughly aquatic turtle of water bodies such as ponds, marshes, rivers, streams, and irrigation ditches with rock or mud substrates that support aquatic vegetation (e.g., watercress, cattails, and water lilies). Western pond turtles are often seen basking on logs, emergent vegetation, and mudbanks (Stebbins 2003). They move to upland areas up to 0.25 mile from watercourses to deposit eggs and overwinter (Jennings and Hayes 1994). Their diet consists of aquatic plants, insects, worms, fish, amphibian eggs and larvae, crayfish, aquatic invertebrates, and carrion (Stebbins 2003).

The project region is within the species range and contains habitats capable of supporting the species. Western pond turtle has been documented in numerous locations throughout the project region (California Natural Diversity Database 2008).

Threats

The major threats to western pond turtle are destruction or alteration of nesting habitat during egg incubation due to agriculture or livestock activity; predation on eggs and hatchlings by introduced nonnative species such as bullfrogs and bass, as well as terrestrial predators such as raccoons and foxes; competition with nonnative fish for food sources used by hatchlings; and disease (California Department of Fish and Game 1994b).

Blunt-Nosed Leopard Lizard

Ecology and Distribution

Blunt-nosed leopard lizard (*Gambelia silus*) is state- and federally listed as endangered. It occurs in the San Joaquin Valley and adjacent foothills (Zeiner et al. 1988).

Blunt-nosed leopard lizard is found in sparsely vegetated plains, alkali flats, grasslands, low foothills, canyon floors, and large washes (Montanucci 1970). There is no water requirement for this species. Blunt-nosed leopard lizards hibernate in winter and are active from mid-spring to mid-fall. Females sometimes alter mammal burrows to form closed-chamber nests. Their diet consists of grasshoppers, cicadas, and small lizards (Zeiner et al. 1988).

The project region is within the species` range, but habitats capable of supporting this species are limited. Blunt-nosed leopard lizard has been documented in Merced County, but the CNDDB lists no occurrences in the project region (California Natural Diversity Database 2008).

Threats

Habitat loss and fragmentation from conversion of natural land cover types to agriculture and urban development are the primary threats to blunt-nosed leopard lizard populations. Excessive livestock grazing removes essential vegetative cover, destroys burrows used for shelter, and can lead to soil erosion. The use of pesticides and rodenticides may directly and indirectly affect blunt-nosed leopard lizards (U.S. Fish and Wildlife Service 1998).

California Horned Lizard

Ecology and Distribution

California horned lizard (*Phrynosoma coronatum frontale*) is a state species of special concern. In the Central Valley, the species occurs from southern Tehama County south; in the Sierra Nevada foothills from Butte County to Tulare County at elevations below 4,000 feet; in the mountains of southern California, excluding desert regions, at elevations below 6,000 feet; and throughout the Coast Ranges south of Sonoma County (Zeiner et al. 1988).

California horned lizards occur in several habitat types, ranging from areas with an exposed gravelly-sandy substrate containing scattered shrubs, to clearings in riparian woodlands, to dry uniform chamise (*Adenostoma fasciculatum*) chaparral, to annual grassland with scattered perennial seepweed (*Suaeda* sp.) or saltbush (*Atriplex polycarpa*) (California Department of Fish and Game 1994c). Horned lizards rely on camouflage to avoid predators. They typically use loose

soil to escape predators and heat, as well as for winter hibernation and other periods of inactivity. The breeding period varies from year to year and with location. Horned lizards lay eggs in nests constructed in loose soil. Their diet of this species consists of ants, small beetles, wasps, grasshoppers, flies, and caterpillars (Zeiner et al. 1988).

The project region is within the species range, but habitats capable of supporting the species are limited. California horned lizard has been documented in Merced County near the project region (California Natural Diversity Database 2008).

Threats

The major threats to California horned lizard are habitat loss and fragmentation from conversion of natural land cover types to agriculture and urban development. In the Central Valley, conversion of relict lake sand dunes and alluvial fans to agriculture and other development, such as pipelines, canals, and roads, has resulted in the disappearance of the species from many areas. Other threats include reduction of food resources due to pesticide use and replacement of native ant populations by Argentine ants (California Department of Fish and Game 1994c).

Giant Garter Snake

Ecology and Distribution

Giant garter snake (*Thamnophis* gigas) is state- and federally listed as threatened. The current range extends from near Orland in Glenn County and Delevan National Wildlife Refuge in Colusa County to Los Banos Creek and Mud Slough in the San Joaquin Valley. The species is now apparently absent or extremely rare in the San Joaquin Valley south of north Fresno (Stebbins 2003). Giant garter snakes utilize rice fields in the Sacramento Valley, as well as managed marsh areas in National Wildlife Refuges and State Wildlife Areas. There have been few recent sightings in the San Joaquin Valley (U.S. Fish and Wildlife Service 2006b).

Giant garter snakes are associated with aquatic habitats characterized by the following features:

- Adequate water during the snake's active season (early spring through mid-fall) to provide food and cover;
- Emergent herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season;
- Grassy banks and openings in waterside vegetation for basking; and
- Higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in winter U.S. Fish and Wildlife Service (2006b).

Their diet includes small fishes, tadpoles, and frogs. Small mammal burrows and similar cavities are used for cover during the winter dormancy period (U.S. Fish and Wildlife Service 2006b).

The project region is within the historic range of this species. There is one record from 1908 for this species in the project region, but no recent sightings have been documented (California Natural Diversity Database 2008). Suitable habitat within the project area is associated with seasonal marsh, irrigation canals, and ditches.

Threats

The major threats to the survival of giant garter snake are habitat loss and fragmentation due to urban development. Specific human activities that threaten this species include destruction of wetlands and channelization of streams, destruction of food sources, introduction of nonnative predators and parasites, water pollution, and removal by collectors. Additionally, flood control activities and changes in agricultural and land management practices have removed or degraded suitable habitat (U.S. Fish and Wildlife Service 2006b).

Birds

The project region contains nesting and foraging habitats capable of supporting numerous special-status birds. Special-status bird species known to occur in the project region include white-tailed kite (*Elanus leucurus*), northern harrier (*Circus cyaneus*), bald eagle (*Haliaeetus leucocephalus*), golden eagle (*Aquila chrysaetos*), Swainson's hawk (*Buteo swainsoni*), merlin (*Falco columbarius*), prairie falcon (*F. mexicanus*), mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanus*), short-eared owl (*Asio flammeus*), western burrowing owl (*Ahtene cunicularia hypugaea*), loggerhead shrike (*Lanius ludovicianus*), California horned lark (*Eremophila alpestrisis actia*), and tricolored blackbird (*Agelaius tricolor*). Of these species, white-tailed kite, northern harrier, Swainson's hawk, western burrowing owl, loggerhead shrike, California horned lark, and tricolored blackbird have been documented nesting in the project region. Special-status bird species for which there is suitable habitat but no known occurrences in the project region are Cooper's hawk, greater sandhill crane (*Grus canadensis tabida*), and peregrine falcon (*F. peregrinus*). All special-status bird species known to occur in the project region are discussed below.

White-Tailed Kite

Ecology and Distribution

White-tailed kite is a fully protected species under California Fish and Game Code Section 3511. The species has a restricted distribution in the United States, occurring only in California and western Oregon and along the Texas coast (American Ornithologists' Union 1983). The species is fairly common in California's Central Valley lowlands (Zeiner et al. 1990a).

White-tailed kites nest in open canopy forests, riparian areas, oak-woodland, and savannah habitats. Nests typically occur near agricultural lands, where foraging most often occurs. Foraging also occurs in open grasslands, meadows, and emergent wetlands. White-tailed kites use dense trees for cover. Breeding occurs from February to October, with peak activity from May through August. Their diet commonly consists of voles, mice, and other diurnal species. White-tailed kites are known to glide or hover about 100 feet above ground while hunting for prey and then to make a vertical descent to prey (Zeiner et al. 1990a).

The project region is within the species breeding and wintering range, and contains nesting and foraging habitats capable of supporting the species. White-tailed kites have been documented foraging in the project area (URS Corporation 2002a).

Threats

The major threats to white-tailed kite are habitat destruction due to urbanization, illegal shooting, and pesticide use.

Northern Harrier

Ecology and Distribution

Northern harrier is a state species of special concern. The breeding range includes most of the Central Valley, the Sacramento–San Joaquin Delta, the Suisun Marsh, and portions of San Francisco Bay (Zeiner et al. 1990a).

Tall grasses and forbs in wetlands and field borders provide nesting habitat for northern harriers. Typical roosting sites are on the ground in shrubby vegetation, often near marshes. The breeding season for this species is between April and September, with peak activity in June and July. Northern harriers feed on voles and other small mammals, birds, small reptiles, crustaceans, and insects (Zeiner et al. 1990a).

The project region is within the species breeding and wintering range and contains habitats capable of supporting nesting and foraging. Northern harriers have been documented nesting in the project area (URS Corporation 2002a).

Threats

The principle threats facing northern harriers are destruction of marshes, grasslands, and other wet areas suitable for nesting; and plowing, burning, and grazing of nesting habitats during the breeding season (Zeiner et al. 1990a).

Bald Eagle

Ecology and Distribution

Bald eagle is a state-listed endangered species and is fully protected under California Fish and Game Code Section 3511; the species was removed from the federal list of endangered species on July 9, 2007 (72 FR 37346) but is still federally protected under the Bald and Golden Eagle Protection Act (*FR 72 31132–31140*). Bald eagle breeds or winters throughout California except in the desert areas (Zeiner et al. 1990a). Most breeding activity in California occurs in Butte, Lake, Lassen, Modoc, Plumas, Shasta, Siskiyou, and Trinity Counties (Zeiner et al. 1990). Breeding populations are increasing throughout northern and central California, and sporadic breeding as been documented at several locations in southern California (Zeiner et al. 1990a).

Bald eagles generally occur near large bodies of water with large trees and snags. Tall, open-canopy trees (particularly ponderosa pine) and cliffs are favored for nesting. High tree snags, trees, or rocks are used for perching and roosting. Bald eagles use dense, isolated conifer and riparian stands in winter for communal roosting. Their diet consists mainly of fish and frequently carrion. Bald eagles are also known to eat injured waterbirds and small mammals displaced by flooding (Zeiner et al. 1990a).

The project region is within the species wintering range and contains suitable foraging habitat. Bald eagles have been documented foraging in the project region (URS Corporation 2002a).

Threats

The bald eagle population was delisted as a threatened species by USFWS after population goals identified in the recovery plan were met or exceeded. Certain threats to this species remain, including destruction of suitable nesting habitat, human disturbance, pesticides, and illegal shooting.

Golden Eagle

Ecology and Distribution

Golden eagle is fully protected under California Fish and Game Code and is federally protected under the Bald and Golden Eagle Protection Act. The species was removed from the list of California species of special concern because overall populations were stable (Shuford and Galdari 2008). The golden eagle is an uncommon permanent resident and migrant throughout California (Zeiner et al. 1990a).

Golden eagles can be found in a variety of habitats, including foothills, mountains, sage-juniper flats, and deserts. Suitable nest sites include cliffs or large trees in open areas. Nesting eagles construct large platform-type nests. Breeding occurs from late January through August, with peak activity occurring March through July. A variety of open habitats are used for foraging; these include grasslands, deserts, savannahs, young forests, and shrubby areas. Their diet consists mostly of small mammals but may include reptiles, birds, and carrion (Zeiner et al. 1990a).

The project region is within the species wintering range and contains suitable foraging habitat. This species has been documented foraging in the project vicinity (URS Corporation 2002a).

Threats

The major threats to golden eagle are habitat destruction (reclamation of grasslands for agriculture), shooting, and human disturbance at nest sites. Disturbance by humans during the breeding season was found to be the major source of nest failure in other western states (California Department of Fish and Game 1978a).

Swainson's Hawk

Ecology and Distribution

Swainson's hawk is a state-listed threatened species. Swainson's hawks migrate annually from wintering areas as far south as Argentina to breeding locations in northwestern Canada, the western United States, and Mexico. In California, the distribution includes the Central Valley, the Klamath Basin, the northeastern plateau in Modoc and Lassen Counties, and the Mojave Desert (Zeiner et al. 1990a).

Swainson's hawks nest in the Central Valley in large trees in riparian corridors, oak savannah, and juniper-sage flats in open tree stands. This species also is typically found nesting adjacent to agricultural fields. Swainson's hawks breed

from late March to late August, with peak activity from late May through July. In the Central Valley, Swainson's hawks forage in large, open agricultural habitats, including alfalfa and hay fields (California Department of Fish and Game 2000a). Their diet consists of small mammals, invertebrates, amphibians, reptiles, birds and, less frequently, fish (Zeiner et al. 1990a).

The project region is within the species breeding range and contains habitats capable of supporting nesting and foraging. This species has been documented nesting in numerous locations throughout the project region and has been observed foraging just south of the project footprint (California Natural Diversity Database 2008; URS Corporation 2002a).

Threats

The loss of agricultural lands to residential and commercial development is a continued threat to Swainson's hawks throughout California. Additional threats include habitat loss due to riverbank protection projects, conversion from agricultural crops that provide abundant foraging opportunities to permanent or semi-permanent crops such as vineyards and orchards, shooting, pesticide poisoning of prey animals, secondary poisoning of hawks on the wintering grounds, and human disturbance at nest sites (California Department of Fish and Game 2000a).

Mountain Plover

Ecology and Distribution

Mountain plover is a state species of special concern. Mountain plovers do not nest in California but are winter residents, primarily in the Central Valley from Sutter and Yuba Counties south to Kern County (Zeiner et al. 1990a).

Suitable wintering habitat for mountain plover includes open areas with very short grasses, plowed fields, and scattered shrub or sagebrush. This species avoids areas with tall, dense vegetation. Their diet consists of large insects, particularly grasshoppers (Zeiner et al. 1990a).

The project region is within the species wintering range and contains suitable foraging habitat. This species has been documented foraging in the project area (URS Corporation 2002a).

Threats

The major threat to this species in California, especially in the Central Valley, is pesticide use. The species has been reported to be highly susceptible to pesticides and other contaminants through exposure to aerial spraying and ground applications on agricultural lands, on both breeding and wintering grounds.

Predation by species such as prairie falcon and coyote also has been suggested as a threat (California Department of Fish and Game 2000b).

Short-Eared Owl

Ecology and Distribution

Short-eared owl is a state species of special concern. This species was formerly a resident and breeder throughout much of the state, excluding the higher mountains. They are also winter migrants to California, found mostly in the Central Valley and western Sierra Nevada foothills but also along the coast (Zeiner et al. 1990a).

Habitats typically used by short-eared owls are those that are open with few to no trees, such as grasslands, prairies, dunes, meadows, irrigated areas, and saline or fresh emergent wetlands. Dense vegetation is an important habitat component. These owls use tall grasses, brush, ditches, and wetlands for cover. Short-eared owls are ground-nesting birds that use depressional areas surrounded by tall vegetative cover. The species also is known to use burrows. Breeding occurs from early March through July. Their diet consists of a variety of prey, including small mammals, reptiles, amphibians, arthropods, and birds in winter coastal areas (Zeiner et al. 1990a).

The project region is within the species wintering range and contains suitable foraging habitat. This species has been documented in the project region (URS Corporation 2002a).

Threats

The major threats to short-eared owl are destruction of marsh and tall grassland habitat in lowlands and shooting (California Department of Fish and Game 1978b).

Western Burrowing Owl

Ecology and Distribution

Burrowing owl is a state species of special concern. Burrowing owls are found throughout much of California in annual and perennial grassland, desert, and arid scrubland (California Department of Fish and Game 1995).

Throughout their range, burrowing owls rely on burrows excavated by fossorial mammals or reptiles, including prairie dogs, ground squirrels, badgers, skunks, armadillos, woodchucks, foxes, coyotes, and gopher tortoises. Where the number and availability of natural burrows are limited (for example, where

burrows have been destroyed or ground squirrels eradicated), burrowing owls will occupy drainage culverts, cavities under piles of rubble, discarded pipe, and other tunnel-like structures. The breeding season is February through August, peaking in April and May (Zeiner et al. 1990a).

The project region is within the species breeding and wintering range, and contains suitable breeding and foraging habitats. Western burrowing owls have been documented throughout the project region and are known to nest within the project footprint (California Natural Diversity Database 2008; URS Corporation 2002a).

Threats

The major threats to burrowing owl are conversion of grasslands and pasturelands to agriculture and destruction of ground squirrel colonies (i.e., pest control activities). Rodenticides used in such activities also have been suggested as a potential threat. Burrowing owls have been known to suffer mortality due to roadside shooting, vehicle collisions, road maintenance operations, and general harassment resulting from nest proximity to roads (California Department of Fish and Game 1978c).

Loggerhead Shrike

Ecology and Distribution

Loggerhead shrike is a state species of special concern. Loggerhead shrikes occur year-round throughout the lowlands and foothills of California (Zeiner et al. 1990a).

Suitable habitat includes open areas with shrubs, fences, utility line poles, or other perches. Loggerhead shrikes tend to avoid urbanized areas but often frequent open croplands. Nests of this species are usually hidden in densely foliaged shrubs or trees. The breeding season is March through August. Their diet consists mainly of large insects but may include small birds, mammals, amphibians, reptiles, fish, carrion, and invertebrates (Zeiner et al. 1990a).

The project region is within the species breeding and wintering range, and contains suitable breeding and foraging habitat. Loggerhead shrikes have been documented in the project footprint (URS Corporation 2002a).

Threats

The primary threats to loggerhead shrikes are urban development and pesticide use.

Oregon Vesper Sparrow

Ecology and Distribution

Oregon vesper sparrow is a subspecies of the vesper sparrow that was recently recognized as a state species of special concern (Shuford and Galdari 2008). The subspecies winters almost entirely within California in the Central Valley and coastal southern California (Erickson 2008).

The vesper sparrow is an obligate grassland species that feeds on invertebrates and seeds on the ground and in vegetation. It occurs primarily on open ground with little vegetation or short grass, including stubble fields, meadows, and roadsides (Erickson 2008). The species has not been documented in the project footprint or on Conservation Lands, although it may occur there.

Threats

The primary threats to the Oregon vesper sparrow are development of flat, low elevation grasslands. Other threats include agricultural practices and pesticide use (Erickson 2008).

Grasshopper Sparrow

Ecology and Distribution

The grasshopper sparrow was recently recognized as a state species of special concern (Shuford and Galdari 2008). The species breeds in a patchy distribution in grassland areas through much of the Central Valley and Coastal California (Unitt 2008).

The habitat requirements of the grasshopper sparrow have not been well documented, but the species generally occurs in large patches of grassland of medium height and moderately open conditions with scattered shrubs. It feeds on invertebrates and seeds on the ground and in vegetation. Bare ground may be an important habitat component (Unitt 2008). The species has not been documented in the project footprint or on Conservation Lands, although it may occur there.

Threats

The primary threats to the grasshopper sparrow are urbanization and conversion of grasslands to vineyards or other crops. The effects of grazing have been variable in different portions of grasshopper sparrow's range, but heavy grazing has eliminated populations in some locations (Unitt 2008).

Tricolored Blackbird

Ecology and Distribution

Tricolored blackbird is a state species of special concern. Tricolored blackbird nesting colonies have been documented in all Central Valley counties. The vast majority of the population occurs in central California, with additional populations in coastal and inland southern California locations, as well as scattered sites in Oregon, western Nevada, and western coastal Baja California (Beedy and Hamilton 1997).

There are three primary characteristics of nesting colony sites: open accessible water; a protected nesting substrate, characterized either by flooded areas or by thorny or spiny vegetation; and a suitable foraging space providing adequate insect prey within a few miles of the nesting colony. Nesting substrates used by tricolored blackbirds include freshwater marsh dominated by tules and cattails, willows, blackberries, thistles, and nettles (Beedy and Hamilton 1997).

The project region is within the species winter and summer range, and nesting has been documented within the project region (California Natural Diversity Database 2008). A large flock (approximately 3,000) of tricolored blackbirds was documented foraging in the UC Merced Phase 1 project area by a Jones & Stokes biologist during environmental compliance monitoring (Jones & Stokes 2003). To date, no nesting colonies have been documented within the project footprint.

Threats

The major threats to this species are destruction of nest colonies and loss of suitable nesting habitat. Historical accounts have documented nest destruction by predators including wolves (*Canis lupus*), gray foxes (*Urocyon cinereoargenteus*), potentially opossums (*Didelphis virginiana*), raccoons (*Procyon lotor*), mink (*Mustela vison*), more recently feral cats, Swainson's hawks, black-crowned night-herons (*Nycticorax nycticorax*) Cooper's hawks, burrowing owls, and American crows (*Corvus brachyrhynchos*).

In some areas, development has eliminated historical nesting areas as well as critical foraging areas associated with these sites. Other threats to tricolored blackbirds include poisoning, contamination and pollution, and human disturbance during nesting (Beedy and Hamilton 1997).

Mammals

American Badger

Ecology and Distribution

American badger (*Taxidea taxus*) is a state species of special concern. In California, badgers occur throughout the state except in the humid coastal forests of northwestern California in Del Norte and Humboldt Counties (California Department of Fish and Game 1986).

Badgers occur in a wide variety of open, arid habitats but are most commonly associated with grasslands, savannas, mountain meadows, and open areas of desert scrub. The principal habitat requirements for the species appear to be sufficient food (burrowing rodents); friable soils; and relatively open, uncultivated ground. Burrows are used for denning, escape, and predation on burrowing rodents. Badgers mate in summer and early autumn; young are born in March and early April (California Department of Fish and Game 1986).

The project region is within the American badger's expected range and supports suitable habitat for the species. This species has been documented in Merced County just outside the project region (California Natural Diversity Database 2008).

Threats

The major threat to American badger is habitat conversion to agricultural and urban development. Rodenticides also pose a threat to this species because they can poison badgers directly through exposure and secondarily by reducing the prey base. Additionally, badgers are often viewed as pests and are commonly shot and trapped (California Department of Fish and Game 1986).

Merced Kangaroo Rat

Ecology and Distribution

Merced kangaroo rat (*Dipodomys heermanni dixoni*) is designated by the World Conservation Union as a lower risk/near threatened taxon. It is a subspecies of Heermann kangaroo rat that occurs only in the Merced County area.

This species is found in dry grassy plains with partly open gravelly ground, on slopes with sparse chaparral. Breeding occurs from February through October, with peak activity in April. Their diet consists mostly of green vegetation (Burt and Grossenheider 1980).

The project region is within the known range of the Merced kangaroo rat and supports suitable habitat for the taxon. This subspecies has been documented in numerous locations throughout the project region (California Natural Diversity Database 2008) and was documented on the VST property during focused surveys (URS Corporation 2002a).

Threats

The major threats to this species are development and land conversion.

Pallid Bat

Ecology and Distribution

Pallid bat (*Antrozous pallidus*) is a state species of special concern. This species is a year-round resident throughout California. It is locally common at low elevations (Zeiner et al. 1990b).

Pallid bat occupies a wide variety of habitats, including grasslands, shrublands, woodlands, and forests from sea level to elevations supporting mixed conifer forests. This species prefers open, dry habitats with rocky outcrops, cliffs, or crevices for roosting. Pallid bats roost during the day in caves, crevices, mines, and sometimes in hollow trees and buildings. Night roosts are in similar areas that may be more open. Mating occurs from late October through February, and young are born from April through July. Their diet consists of a variety of insects (Zeiner et al. 1990b).

The project region is within the known range of the pallid bat and supports suitable foraging and limited roosting habitat for the species. This species has been documented just north of the project region but not in it (California Natural Diversity Database 2008).

Threats

The major threats to the pallid bat are human disturbance and destruction of roost sites.

Plants

The major threat to the special-status plant species discussed in this section is the conversion of lands to agricultural (i.e., irrigated agricultural lands) and urban uses. Four of these species are hydrophytic species that occur in vernal pool habitats. A detailed discussion of threats to vernal pool ecosystems is presented in Chapter 3.

None of the plant species discussed below are federally listed species. However, some are designated by the State of California as rare; and all appear on one of the CNPS lists, as defined below:

- List 1A species: presumed extinct in California.
- List 1B species: rare, threatened, or endangered in California and elsewhere.
- List 2 species: rare, threatened, or endangered in California but more common elsewhere.
- List 3 species: plants about which more information is needed to determine their status.
- List 4 species: plants of limited distribution.

Henderson's Bentgrass

Henderson's bentgrass (*Agrostis hendersonii*) is a very uncommon species that faces threats to some of the populations; it has been assigned to CNPS List 3 because taxonomic questions are associated with it. It can be confused with small-flowered bentgrass (*Agrostis microphylla*), which has similar morphology and habitat associations.

Henderson's bentgrass occurs at elevations below 3,380 feet in Shasta, Tehama, Butte, and Merced Counties (California Natural Diversity Database 2008). Little information on the species' habitat associations and specific habitat requirements is available. Henderson's bentgrass is usually found in seasonal wetlands (typically vernal pools and swales) in annual grassland, oak woodland, and coniferous forest habitats (California Natural Diversity Database 2008).

The project region is within the geographic range of Henderson's bentgrass and contains habitat that is suitable for the species. The species has been documented at four locations within the project region. One occurrence, about 0.5 mile east of the intersection of Hornitos Road and SR 59, has not been observed since 1935 and possibly has been extirpated (California Natural Diversity Database 2008).

Hoover's Calycadenia

Hoover's calycadenia (*Calycadenia hooveri*) is a CNPS List 1B species. It is found in valley and foothill grasslands and in woodlands on exposed, rocky, barren soils derived from calcareous sandstone formations. It occurs in the northern and central Sierra Nevada foothills at elevations below 900 feet. Hoover's calycadenia is known from 38 occurrences in Calaveras, Madera, Merced, Mariposa, and Stanislaus Counties (California Natural Diversity Database 2008).

The project region is within the geographic range of Hoover's calycadenia and contains habitat that is suitable for the species. The species has been documented

at 21 locations within the project region (California Natural Diversity Database 2008).

Beaked Clarkia

Beaked clarkia (*Clarkia rostrata*) is a CNPS List 1B species. It is often found in annual grassland and blue oak woodland communities on north-facing slopes, rock outcrops, and bluffs in rocky or sandy soil. It occurs in the central Sierra Nevada foothills and adjacent San Joaquin Valley at elevations below 1,500 feet. It is known from 34 occurrences in Mariposa, Merced, and Stanislaus Counties (California Natural Diversity Database 2008).

The project region is within the geographic range of beaked clarkia and contains habitat that is suitable for the species. Beaked clarkia has been documented at five locations within the project region (California Natural Diversity Database 2008).

Ewan's Larkspur

Ewan's larkspur (*Delphinium hansenii* subsp. *ewanianum*) is a CNPS List 4 species. It occurs in annual grassland and blue oak woodlands at elevations below 1,970 feet (California Native Plant Society 2001). It occurs in the Sierra Nevada foothills and adjacent San Joaquin Valley from Calaveras to Kern Counties. Fewer than 25 occurrences have been documented, although others have been reported (Dittes and Guardino 2002).

The project region is within the geographic range of Ewan's larkspur and contains habitat that is suitable for the species. The species has been documented at several locations within the project region (Dittes and Guardino 2002).

Dwarf Downingia

Dwarf downingia (*Downingia pusilla*) is a CNPS List 1B species. It occurs in vernal pools in the interior North Coast Ranges, southern Sacramento Valley, and northern and central San Joaquin Valley. It has been reported from 114 occurrences, 10 of which have been extirpated (California Natural Diversity Database 2008).

The project region is within the geographic range of dwarf downingia and contains habitat that is suitable for the species. Dwarf downingia has been documented at 10 locations within the project region (California Natural Diversity Database 2008).

Spiny-Sepaled Button-Celery

Spiny-sepaled button-celery (*Eryngium spinosepalum*) is a CNPS List 1B species that occurs in vernal pools. The species has previously been regarded to occur in the Sierra Nevada foothills from Tuolumne to Tulare Counties (California Natural Diversity Database 2008). Dittes and Guardino (2002) discussed the occurrence of spiny-sepaled button-celery in Merced County and noted taxonomic problems with identifying the species in this area. More recent research has determined that populations north of Fresno County are not *E. spinosepalum* but another species (*E. castrense*) with similar morphological characteristics. According to Dr. Robert Preston, lead author for the treatment of *Eryngium* in the forthcoming second edition of *The Jepson Manual*, all populations of *Eryngium* in eastern Merced County with spiny sepals will be treated as *E. castrense* (Preston and Park no date).

Because the project region is no longer considered to be within the range of spiny-sepaled button-celery, this species would not be affected by the Proposed Action and is not addressed further in the Conservation Strategy.

Stinkbells

Stinkbells (*Fritillaria agrestis*) is a CNPS List 4 species. It occurs on clay soils in annual grasslands and in grassy openings in other habitats, including chaparral, oak woodland, and pinyon-juniper woodland (California Native Plant Society 2001). It is widely distributed in northern California, ranging from the outer North Coast Ranges into the South Coast Ranges, with scattered populations in the southern Sacramento Valley and Sierra Nevada foothills (Ness 1993).

The project region is within the geographic range of stinkbells and contains suitable habitat for the species. The species has been documented at one location within the project region (Dittes and Guardino 2002).

Boggs Lake Hedge-Hyssop

Boggs Lake hedge-hyssop (*Gratiola heterosepala*) is state listed as rare and is a CNPS List 1B species. It is found in the shallow waters or moist clay soils of vernal pools and in the margins of shallow lakes and reservoirs, where it inhabits barren, muddy areas on extremely shallow soils (California Natural Diversity Database 2008). It is widely distributed in northern California, ranging from the Modoc Plateau south into the southern Sacramento Valley and Sierra Nevada foothills (Wetherwax 1993)—with scattered populations in Merced, Madera, and Fresno Counties (California Natural Diversity Database 2008). It has been reported from 87 occurrences, one of which has been extirpated (California Natural Diversity Database 2008).

The project region is within the geographic range of Boggs Lake hedge-hyssop and contains suitable habitat for the species. The species has been documented at

one location within the project region (California Natural Diversity Database 2008).

Pincushion Navarretia

Pincushion navarretia (*Navarretia myersii* ssp. *myersii*) is state listed as rare and is a CNPS List 1B species. It occurs in vernal pools along the east edge of the Central Valley from Placer to Merced Counties (California Natural Diversity Database 2008). It typically grows in small to medium-sized vernal pools (Dittes and Guardino 2002).

The project region is within the geographic range of pincushion navarretia and contains suitable habitat for the species. The species has been documented at 13 locations, four of which are within the project region (California Natural Diversity Database 2008).

Shining Navarretia

Shining navarretia (*Navarretia nigelliformis* subsp. *radians*) is state listed as rare and is a CNPS List 1B species. It typically grows in clay flats in annual grasslands, although it also occurs in heavy clay soils on grassy slopes, vernal swales, and vernal pools (California Natural Diversity Database 2008). Although it had been considered to be endemic to the interior South Coast Ranges (Day 1993), shining navarretia recently has been reported from many occurrences in eastern Merced County (California Natural Diversity Database 2008).

The project region is within the geographic range of shining navarretia and contains habitat that is suitable for the species. The species has been documented at 54 locations, 29 of which are within the project region (California Natural Diversity Database 2008).

Merced Phacelia

Merced phacelia (*Phacelia ciliata* var. *opaca*) is state listed as rare and is a CNPS List 1B species. It is reported to occur in heavy clay soils in grasslands. Only seven occurrences are known, and all are within eastern Merced County (California Natural Diversity Database 2008).

The project region is within the geographic range of Merced phacelia and contains suitable habitat for the species. All known occurrences are within the project region (California Natural Diversity Database 2008).

Sanford's Arrowhead

Sanford's arrowhead (*Sagittaria sanfordii*) is state listed as rare and is a CNPS List 1B species. It is distributed at scattered locations in the Central Valley and Coast Ranges, where it occurs in freshwater marsh, sloughs, canals, and other slow-moving perennial water habitats (California Natural Diversity Database 2008). It has been reported from 58 occurrences, 17 of which are historical and seven of which have been extirpated or potentially extirpated (California Natural Diversity Database 2008).

The project region is within the geographic range of Sanford's arrowhead and contains habitat that is apparently suitable for the species. One historical occurrence has been reported from within the project region (California Natural Diversity Database 2008).

Methods of Analysis

Potential impacts on special-status species were analyzed by developing GIS layers of land cover/habitat types that provide suitable habitats for special-status species. The analysis quantified the number of acres of suitable land cover/habitat types (marsh communities, other wetlands, natural vegetation, field and row crops, and irrigated pasturelands) that would be permanently converted, as well as the number of acres that would be conserved in the project region. These GIS layers were combined with layers delineating the Proposed Action (including both development and conservation lands) to examine the potential impacts associated with implementation of the Proposed Action.

The following data sources were used to create the GIS data layers.

- Wetland inventories and delineations (EIP Associates 2000, 2002b; Gibson & Skordal 2008).
- California Department of Water Resources Land Use Dataset (2001).

Effects of the Proposed Action

Implementation of the Proposed Action would result in the permanent conversion of approximately 880 acres of native vegetation (consisting mostly of grasslands), 657 acres of irrigated pastureland, 1,084 acres of row and field agricultural land, 16 acres of marsh habitat, and approximately 47 acres of other wetland habitats (Table 4-1). The project footprint also includes a 1-acre patch of riparian habitat, a 1-acre area containing an agricultural ditch, a 5-acre man-made pond, and 75 acres of developed land.

However, implementation of the Proposed Action would also result in the permanent protection of over 26,000 acres of habitat, consisting primarily of grasslands and vernal pool habitats.

Table 4-1. Distribution of Habitat Types in the Proposed UC Merced Project Area

Cover Type	UC Merced Campus	Community North	Community South	Total Proposed Action	Conservation Lands
Native Vegetation					
Annual Grassland	527	331	16	874	24,204
Drainages	2	3	0	5	137
Riparian	0	0	1	1	20
Clay playa	0	0	0	0	334
Mima mound	0	0	0	0	55
Irrigated Pasture	179	477	1	657	76
Row and Field Crops	0	0	1,084	1,084	1
Orchard	0	0	0	0	3
Marsh	10	6	0	16	49
Other Wetlands					
Vernal Pool/Swale Ecosystems	26	14	<1	40	1,616
Seasonal Wetlands	4	2	<1	6	34
Ponds	5	0	0	5	71
Ditch	0	0	1	1	0
Developed	62	0	13	75	39
Totals	**815**	**833**	**1,118**	**2,766**	**26,639**

Note: This table presents data described in the *Methods of Analysis* section.
The data presented in this table are from multiple sources.

Areas classified as native vegetation and pasturelands contain grassland. Grasslands provide foraging and nesting habitat for special-status raptors and other migratory birds, including northern harrier, short-eared owl, western burrowing owl, and grasshopper sparrow. Special-status raptors and other migratory birds for which grasslands provide only foraging habitat include white-tailed kite, northern harrier, golden eagle, Swainson's hawk, mountain plover, loggerhead shrike, and Oregon vesper sparrow. Grasslands also provide denning and foraging habitat for American badger and foraging habitat for pallid bat. Special-status plants known to occur in grassland communities include Hoover's calycadenia, stinkbells, shining navarretia, and Merced phacelia.

Agricultural lands in the project region consist of row and field crops and orchards/ vineyards. Row and field crops provide foraging habitat for special-status raptors and other migratory birds, including white-tailed kite, northern harrier, Swainson's hawk, and loggerhead shrike. Orchards/vineyards provide fewer foraging opportunities for special-status raptors and other migratory birds.

Marsh and pond communities provide potential habitat for western pond turtle, giant garter snake, and tricolored blackbird. Northern harriers and short-eared owls typically utilize marshes for foraging. Marsh communities are also suitable for Sanford's arrowhead.

Wetland habitats include vernal pools, clay playas, swales, seasonal wetlands, and canals. Vernal pools and seasonal wetlands in the project region provide potential habitat for western spadefoot. Vernal pools, clay playas, seasonal wetlands, and swales in the project region provide suitable habitat for several special-status plant species: Henderson's bentgrass, dwarf downingia, Boggs Lake hedge-hyssop, and pincushion navarretia. Canals in the region provide potential habitat for two special-status animals (giant garter snake and western pond turtle) and suitable habitat for one special-status plant (Sanford's arrowhead).

Chapter 5
UC Merced and Merced County Conservation Strategy

This Conservation Strategy is intended to provide a clear framework for the conservation of sensitive habitats and their associated plant and animal species affected by development of the Proposed Action. To that end, the Conservation Strategy describes how UC Merced and the County are implementing the commitments (Parameters) that they made through the ESA compliance process and its associated 2002 BO (U.S. Fish and Wildlife Service 2002). Moreover, the Conservation Strategy compiles and summarizes the information and the mitigation approaches contained in a number of separate reports prepared by UC Merced and the regulatory agencies into a single reference document in order to guide future conservation actions in the study area by UC Merced, the County, landowners, nonprofit organizations, and other public agencies.

Parameter 1a of the 2002 BO requires the preparation and implementation of a comprehensive strategy that:

> Incorporates the Conservation Measures for the San Joaquin kit fox, vernal pool plant species and branchiopods, and other protected species to guide the development and implementation of specific conservation for the Proposed Actions and as needed to assure that other development within the Study Area is consistent with the Conservation Strategy as described in Parameter 1b . . .

This chapter presents strategies and Conservation Measures that UC Merced has developed for the conservation of San Joaquin kit fox, vernal pool plants and branchiopods, and other protected species in the project region in relation to the project. These strategies and Conservation Measures address land acquisition, adaptive management and monitoring of conservation lands, and avoidance and minimization of adverse effects associated with development in the project area. As a package, they describe the mechanisms by which the County and UC Merced, through the project, will implement Parameters 1–3 of the 2002 BO (U.S. Fish and Wildlife Service 2002).

This chapter provides general guidance for the conservation efforts of UC Merced and the County as they comply with the requirements of ESA consultation for the Proposed Action. The guidance is structured to show conformance with the Parameters and Conservation Measures set forth in the 2002 BO (U.S. Fish and Wildlife Service 2002). The strategies, Conservation Measures, and actions being taken by UC Merced and the County are divided

into strategies common to all species, strategies specific to San Joaquin kit fox, strategies specific to vernal pool grasslands and associated species, and strategies for other special-status species.

UC Merced Mitigation Program

As noted above, the 2002 BO (U.S. Fish and Wildlife Service 2002) requires implementation of certain Parameters intended to ensure that the projects proposed by UC Merced and the County will avoid jeopardy to listed species by minimizing, avoiding, or compensating for impacts to those species that might otherwise occur. In addition to the Parameters, the project incorporates the Conservation Measures described in the 2002 BO and later in this chapter. Many of these Conservation Measures were originally proposed and adopted by the UC Merced in connection with its environmental review of the previous LRDP under CEQA (URS Corporation 2002). The Conservation Strategy expands upon the Conservation Measures originally proposed in UC Merced and the County's CEQA documents and applies them specifically to the project.

The strategies and Conservation Measures described below have been developed by synthesizing the guidance provided in numerous documents that relate to conservation of natural resources in the project region and beyond. The relevant documents are listed below.

- *Recovery Plan for Upland Species in the San Joaquin Valley, California* (U.S. Fish and Wildlife Service 1998).
- *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Vernal Pool Recovery Plan) (U.S. Fish and Wildlife Service 2005).
- *Final Biological Opinion on the Proposed University of California Merced Campus, Phase 1 and Campus Buildout* (U.S. Fish and Wildlife Service 2002).
- *Biological Assessment CWA Section 404 Permit Applications for UC Merced Campus Project and County of Merced Infrastructure in Support of UC Merced Campus Project* (EIP Associates 2002a).
- *Supplement to the Biological Assessment for the UC Merced Campus Project* (Jones & Stokes 2002a).
- *Resource Mitigation Plan for Federally Listed Species That May Be Affected by the Establishment of the University of California, Merced* (Jones & Stokes 2002b).
- *County of Merced Infrastructure Project in Support of UC Merced Project Habitat Mitigation Plan* (EIP Associates 2002b).
- *Compensatory Wetland Mitigation and Monitoring Plan* (Gibson & Skordal 2005).
- *LRDP Environmental Impact Report, Mitigation Monitoring and Reporting Program* (URS Corporation 2002b).

- *County of Merced University Community Plan* (EIP Associates 2004b).
- *County of Merced University Community Plan final environmental impact report* (EIP Associates 2004a).
- *Report of Science Advisors for the Eastern Merced County Natural Community Conservation Plan Habitat Conservation Plan, Part 1* (Noss et al. 2002).

In addition, the strategies and Conservation Measures were developed to meet all applicable regulatory standards, as listed below:

- Avoid, minimize, and compensate for take of federally listed species (ESA Section 7 standard).
- Avoid destruction or adverse modification of designated critical habitat for applicable species (ESA Section 7 standard).
- Conserve, protect, restore, and enhance any endangered or threatened species and its habitat (California Fish and Game Code Section 2081 standard [CESA]).
- Provide no net loss of functions and values of jurisdictional wetlands (CWA Section 404 and California Regional Water Quality Control Board standards).
- Reduce impacts of the project on special-status species and sensitive biological resources to a level below significance (CEQA standard).

UC Merced has committed to the preservation of vernal pool-dominated grasslands in eastern Merced County at a mitigation ratio of 10 to 1 in accordance with the LRDP, the LRDP EIR, the Resource Mitigation Plan, 2002 BA, and 2002 and 2008 Supplements to the BA. UC Merced also has committed to enhancement, restoration, and creation activities as required under the Resource Mitigation Plan. This effort has resulted in preservation of more than 26,000 acres of vernal-pool dominated grasslands that also provide habitat for other special-status species (e.g., San Joaquin kit fox) in eastern Merced County. Moreover, UC Merced has committed to implement certain avoidance, minimization, management, and monitoring measures as set forth in the LRDP EIR, the Resource Mitigation Plan, the BAs, and the BO.

The County has adopted avoidance, minimization, and mitigation measures for future development that apply to the Community South portion of the University Community, in accordance with the UCP and its associated EIR and Supplemental EIR and the 2002 BO. Future specific development projects within the Community South area will be required to implement the following measures to comply with the County's EIR mitigation measures applicable to the UCP and to comply with the terms of the 2002 BO and any subsequent state and federal permits applicable to the UCP area:

- Impact avoidance and minimization through project design and construction-related BMPs.

- Habitat preservation, creation, restoration, and/or enhancement to achieve no net loss of value or function, including habitat value for Colusa grass, San Joaquin Valley Orcutt grass, and vernal pool tadpole shrimp, at a ratio of 3:1.
- Habitat preservation for grasslands, in association with conserved wetlands, at a ratio of no less than 9 acres of upland preserved for each acre of wetland preserved.
- Long-term monitoring and adaptive management of land to be conserved.

In addition, the County will require compensatory mitigation at a 1:1 mitigation ratio in the form of conservation easements for the loss of agricultural land resulting from the development of Community North and other individual development projects covered by the UCP.

Consistency with Recovery Plans and Contribution to Recovery

As required by Parameter 1b, the individual strategies and Conservation Measures that are the heart of this Conservation Strategy are designed to be consistent with and contribute to implementation of the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998) and the Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005). They are also based on the results of analyses of the distribution of and threats to all federally protected species in the vicinity of the UC Merced Campus (Chapters 2 and 3) and on other recently recommended approaches to conservation in the region (Noss et al. 2002).

The Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998, pg. 183) includes the following generalized recovery guidelines and a success criterion for the San Joaquin kit fox:

- Secure and protect specified recovery areas from incompatible uses.
- Approve and implement management plans for recovery areas that include survival of the species as an objective.
- Conduct population monitoring in specified recovery areas until evidence shows stable or increasing populations in core and satellite areas during one precipitation cycle.

The Upland Species Recovery Plan also includes site-specific protection requirements to meet delisting criteria. For kit fox in the eastern Merced County region (part of the northern range and valley edges identified in the Upland Species Recovery Plan), the protection level is set at 80% of existing potential habitat (U.S. Fish and Wildlife Service 1998, pg. 188). More specific guidance regarding the maintenance of linkage areas around the San Joaquin Valley edge (Recovery Task 5.3.1) specifies that 90% of existing natural lands should be preserved and that grazing and other compatible land uses should be maintained (U.S. Fish and Wildlife Service 1998, pg. 223). The Proposed Action would

convert approximately 1% of the natural lands remaining in the northeast valley edge identified in the Upland Species Recovery Plan to incompatible uses while simultaneously conserving approximately 7% of the natural lands remaining in the northeast valley edge (see Chapter 2).

The Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005, pg. III–84) identifies general criteria relating to the recovery of vernal pool species. These criteria relate to habitat protection, adaptive habitat management and monitoring, status surveys, research, and participation and outreach. The Vernal Pool Recovery Plan further identifies the following actions specific to the project region:

- Protect 95% of the suitable vernal pool habitat within the Madera core area of the Southern Sierra Foothills Vernal Pool Region.
- Conduct standardized vernal pool habitat assessments.
- Manage, restore, and monitor vernal pool habitat for recovery of vernal pool species.
- Collect sources for seed/cyst banking.
- Reintroduce species to soil types from which status surveys indicate the species has been extirpated.
- Conduct status surveys and status reviews for covered vernal pool species.
- Conduct research on vernal pool species that provides guidance on species ecology, habitat management, threats, genetic structure, and population viability.
- Form working groups for the Southern Sierra Foothills Vernal Pool region and develop participation plans for private landowners and state and local agencies.

Implementation of the Proposed Action would convert approximately 1,107 acres of suitable vernal pool habitat in the Madera core area of the Southern Sierra Foothills Vernal Pool Region to incompatible uses. This acreage is equivalent to less than 1% of the suitable habitat in the Madera core area identified in the Vernal Pool Recovery Plan. Implementation of the Proposed Action will result in conservation of approximately 26,639 acres of lands supporting vernal pool habitat in the project region. The acreage conserved represents approximately 11% of the Madera core area (see Chapter 3).

The Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005, Table III-1) provides additional species-specific criteria on protection of occurrences throughout the recovery plan area. For succulent owl's-clover, Colusa grass, and San Joaquin Orcutt grass, the protection criteria are 90% of occurrences. For Conservancy fairy shrimp, protection is sought for 100% of occurrences. The midvalley and vernal pool fairy shrimp criteria are protection of 80% of occurrences. Finally, the protection criteria for vernal pool tadpole shrimp are 80% of occurrences and 100% of reintroduced populations.

The effects of implementation of the Proposed Action on these species are summarized in Table 5-1 (see Table 3-6 for acreage values).

Table 5-1. Summary of Percentages of Known Occupied Habitat for Conservation Species that are Affected and Conserved under the Proposed Action

Species	% of Regional Occupied Habitat Affected	% of Regional Occupied Habitat Conserved
Succulent owl's-clover	2.3	51
Colusa grass	0.0	55
San Joaquin Valley Orcutt grass	0.0	10
Conservancy fairy shrimp	0.0	13
Vernal pool fairy shrimp	2.6	48
Midvalley fairy shrimp	4.1	50
Vernal pool tadpole shrimp	1.3	4.4

The information above indicates that implementation of the proposed action is consistent with the general and species-specific recovery criteria outlined in the two recovery plans. Compensatory mitigation incorporated into the project will protect large areas of habitat occupied by the species targeted in the recovery plans, consistent with the recovery plan objectives (Airola 2008a). A discussion of how this Conservation Strategy and UC Merced actions contribute to the recovery of vernal pool species and the San Joaquin kit fox is included below under relevant strategies.

Conservation Strategies and UC Merced Actions

The conservation strategies pertain to three general categories: avoidance and minimization, land acquisition, and adaptive management. To facilitate implementation, they are arranged by resource area and are discussed in the order shown below:

- Conservation Strategies for All Species
  - Strategy 1: Avoid and Minimize Losses of Habitats Supporting Target Species
  - Strategy 2: Incorporate Site-Specific Measures into Development Projects
  - Strategy 3: Protect and Manage Large Contiguous Areas in the Project Region
  - Strategy 4: Secure Conservation Easements that Provide for Effective Management
  - Strategy 5: Develop and Implement Management Plans for Conserved Lands

- Strategy 6: Develop and Implement Adaptive Management Measures to Attain Measurable Objectives
- Strategy 7: Develop and Implement a Monitoring Program Sufficient to Support Adaptive Management
- Strategy 8: Incorporate Studies to Address Key Uncertainties into Adaptive Management

- Strategies Specific to San Joaquin Kit Fox
  - Strategy 9: Manage a Corridor across the Project Region to Allow the Potential for Continuous Residence and Dispersal of San Joaquin Kit Fox
- Strategies Specific to Vernal Pool Grasslands and Associated Special-Status Species
  - Strategy 10: Represent all Geomorphic Surfaces and Habitats Occupied by Target Species on These Surfaces
  - Strategy 11: Sustain Populations of the Rarer and More Specialized Target Species at Occupied Sites
  - Strategy 12: Compensate for Losses of Wetlands and Target Species with Comparable Habitat that Contributes to Land Conservation Strategies
- Strategies for Other Sensitive Habitats and Special-Status Species
  - Strategy 13: Conserve Habitat Essential to the Survival and Preservation of Other Special-Status Species

Conservation Strategies for All Species

The following conservation strategies apply to most or all of the species addressed in this document and fall into the three broad categories noted above: avoidance and minimization, land acquisition, and adaptive management and monitoring. The relationship of these conservation strategies to the Proposed Action and to future development within the UCP area is discussed below.

Avoidance and Minimization

UC Merced has developed and is implementing a series of avoidance and minimization measures for project development in compliance with Parameter 2f of the 2002 BO (Appendix A). Many of the actions described below were included in the *Resource Mitigation Plan for Federally Listed Species that May Be Affected by the Establishment of the University of California, Merced* (RMP) (Jones & Stokes 2002b).

Strategy 1: Avoid and Minimize Losses of Habitats Supporting Target Species

Description

Development projects in the study area should be located to minimize loss and degradation of natural vegetation, and to minimize cumulative and growth-inducing effects causing loss or degradation of natural vegetation. These types of effects should be addressed through the permitting and approval processes summarized below.

- **CWA and NEPA.** Projects that require a permit under CWA Section 404 will need to demonstrate that they are implementing the least environmentally damaging practicable alternative and must address impacts on federally listed species. They must also comply with NEPA.
- **ESA and CESA.** Compliance with these acts may be triggered by other approval processes or as individual requirements (i.e., for actions consistent with existing zoning that do not affect jurisdictional waters of the United States). ESA compliance for actions affecting federally listed species will require avoidance of jeopardy to species and implementation of avoidance, minimization, and compensation measures for take of federally listed species (except plants).
- **CEQA/Local Land Use Approvals.** Actions requiring discretionary approval by state and local agencies require compliance with CEQA. Major discretionary actions that may trigger CEQA could include rezoning of land uses by the City of Merced or the County and construction projects by water supply, utility, or transportation agencies. CEQA requires identification of project impacts and avoidance, minimization, and compensation for significant impacts on special-status species.

  During these approval processes, the County and the state and federal regulatory agencies (DFG, the Corps, and USFWS) should, in addition to evaluating the direct and indirect effects of projects on target species, evaluate proposed projects for consistency with this Conservation Strategy.

To be consistent with Strategy 1, several requirements must be satisfied. First, the project must cause no direct effects on Conservancy fairy shrimp; and indirect effects must be minimized and avoided to the maximum extent practicable, as described in Parameter 2e of the BO. Second, the project must avoid and minimize effects on San Joaquin Valley Orcutt grass, Colusa grass, succulent owl's-clover, hairy Orcutt grass, Hoover's spurge, Greene's tuctoria, and Hartweg's golden sunburst, to the maximum extent practicable, as described in Parameter 2f of the BO. Third, UC Merced and the County must provide evidence that groundwater pumping and stormwater discharges will not affect listed species, as described in Parameter 3b of the BO. Fourth, withdrawals from the Merced River must be within the confines of the 1995 Operations Criteria and Plan biological opinion, as described in Parameter 3b of the 2002 BO (U.S. Fish and Wildlife Service 2002).

Merced County Actions

To ensure that other projects in the study area achieve consistency with Strategy 1, the County has provided written assurance to USFWS and the Corps that it will require compliance with the ESA, as described in Parameter 3a of the 2002 BO (U.S. Fish and Wildlife Service 2002), for all discretionary projects permitted by the County within the study area. Additionally, the County committed to certain mitigation measures set forth in the final UCP EIR (EIP Associates 2004a) that apply to future development projects within the Community South area in order to achieve consistency with the requirements of the 2002 BO.

UC Merced Actions

UC Merced has emphasized avoidance and minimization of loss of habitats supporting the target species as part of the project design process. Project boundaries have been redesigned several times to reduce impacts on sensitive biological resources. The northern boundary to the UC Merced Campus has been moved to reduce effects on the clay playa east of Lake Yosemite; the campus has been moved and reduced to avoid the watershed of the vernal pool occupied by Conservancy fairy shrimp and to maintain a 250-foot setback from this watershed; and the entire Proposed Action has been redesigned to minimize fragmentation of habitat.

Currently, the Corps is evaluating several alternatives to identify the least environmentally damaging practicable alternative for the project, as required by CWA Section 404. This effort is intended to ensure that the selected alternative avoids and minimizes losses of aquatic resources habitat to the extent practicable and in so doing avoids and minimizes effects on habitat supporting threatened and endangered species. In addition, all new UC Merced construction projects will incorporate a suite of specific design, construction, and operation measures that will further avoid and minimize impacts on target species. These are described in Strategy 2 below.

Strategy 2: Incorporate Site-Specific Measures into Development Projects

Description

The permitting and approval processes for new development in the study area (CWA, NEPA, ESA, CESA, and CEQA/local land use approvals) should identify avoidance and minimization measures to be implemented to address each of the mechanisms by which development can affect wetlands and special-status species on adjacent lands during and after construction. Development activities may affect habitat on adjacent lands through the action of the mechanisms listed below.

- Altering light and noise levels.
- Altering hydrology.
- Causing damage through toxicity associated with herbicides, pesticides, and rodenticides.

- Introducing pet and human disturbance (including trash dumping).
- Increasing habitat for native competitors or predators.
- Introducing invasive nonnative species.

Measures can be incorporated into project designs, construction practices, and the operations and maintenance of the resulting development to reduce these effects. For the project, all such measures must be approved by USFWS and the Corps, as described in Parameters 2a, 2c, 2e, and 2f of the 2002 BO (U.S. Fish and Wildlife Service 2002).

Design Measures

In concept, all movements of people, animals, and materials—as well as the transmission of light and sound—may be altered by a project's design. For example, stormwater drainage and irrigation runoff can be controlled through facilities that reduce alterations to current hydrology. Similarly, lighting can be designed to reduce the escape of light into habitat; and fencing can be used to reduce several detrimental effects, especially disturbance by humans and pets. Accordingly, practicable measures for reducing appreciable effects on wetlands and special-status species habitats should be incorporated into project designs.

For the project to be consistent with this strategy, UC Merced and the County will incorporate such measures. Examples are listed below.

- Design stormwater and irrigation systems so that no unnatural runoff is delivered to surrounding lands, and discharges to streams mimic the natural pattern of runoff into these systems.
- Construct perimeter fencing to discourage human and pet disturbance of adjacent habitat areas.
- Design lighting to minimize escape of light into habitat areas.

Construction Measures

Construction activities may result in specific effects that differ from the operations and maintenance (O&M) effects of completed projects; consequently, construction activities require their own set of avoidance and minimization measures. Development projects in the study area that may result in effects on special-status species should be subject to the following types of avoidance and minimization measures, as necessary. These measures were previously incorporated into Phase 1 construction.

- **Incorporate species protection obligations into construction contracts.** All contracts between a project proponent and contractors, construction management firms, and subcontractors should include the provisions identified as terms and conditions in USFWS-approved construction plans for protecting listed species and habitats. Specific penalties for violations should be identified in construction contracts; penalties could include warnings, removal of individual violators from the project, termination of contracts, and payment of damages.

- **Conduct environmental sensitivity training.** Prior to initiating work at construction sites, environmental sensitivity training should be conducted for all construction personnel. The goals of the training should be to describe the species and habitats at risk, their importance, the measures being implemented to conserve them, and the obligations of construction personnel.
- **Implement best management practices (BMPs).** Standard construction BMPs should be incorporated into construction designs, plans, and specifications; contractors should be required to employ these BMPs during construction. These practices should include dust-control measures; erosion reduction and sediment control (e.g., use of silt screens, sediment fences, weed-free straw bales, sand bags, water bars); and restricted equipment refueling and maintenance practices. A spill-response plan should be prepared for the construction site to ensure prompt capture and cleanup of any accidental releases of fuels or any other hazardous materials in use at the site.
- **Implement preconstruction surveys and avoidance and minimization measures to minimize take of species.** Measures, including preconstruction surveys, should be implemented to minimize take of listed species, particularly San Joaquin kit fox and California tiger salamander. Measures to minimize effects on kit fox should be consistent with USFWS (1999) *Standardized Recommendations for Protection of the San Joaquin Kit Fox prior to or during Ground Disturbance*. Measures to minimize effects on California tiger salamander should be consistent with USFWS (2003) *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander—October 2003*. Implementation of these measures will be coordinated with DFG and USFWS. The following two measures are of particular importance.
  - Conduct winter surveys at vernal pools and ponds on the project site and in areas within 1.3 miles of the project site from which tiger salamanders could access the site.
  - For construction activities within 1.3 miles of occupied breeding ponds, erect drift fences (or other effective salamander barriers) around the construction area before February in the winter prior to the start of construction to exclude breeding salamanders from the construction site.
- **Fence project boundaries and sensitive resources.** Temporary or permanent fencing should be installed by contractors under the direction of environmental monitors prior to initiation of construction activities along the boundaries of construction areas and adjacent areas of suitable habitat for special-status species. These fences should be installed to prevent construction vehicles from straying into these adjacent habitats.
- **Discourage introduction and establishment of invasive species.** To discourage establishment of invasive species on conservation lands, construction contracts should include requirements that any plant materials, seeds, or other organic material (e.g., hay) used during project construction for erosion control or revegetation of disturbed areas be free of invasive

species. Furthermore, earthmoving equipment should be washed to remove vegetative material and nonnative organisms before being brought on site.

- **Conduct environmental monitoring when necessary.** If necessary to ensure successful implementation of measures during construction, an environmental monitor should be designated, and monitoring reports should be submitted to USFWS documenting the implementation and effectiveness of avoidance and minimization measures. This monitoring and reporting should include a post-construction period sufficient to verify completion of conservation requirements related to construction, including any necessary remedial measures.

Operations and Maintenance Measures

O&M of developed land uses could have chronic effects on adjacent wetlands and special-status species habitats. To avoid and minimize these effects, future development projects in the study area should implement avoidance and minimization measures as needed to achieve the objectives listed below.

- **Reduce human disturbance.** These measures should increase awareness of the conservation value of wetlands and grasslands as habitat for threatened and endangered species through use of signage and interpretive displays and trails.
- **Reduce disturbance caused by pets.** These measures should include leash laws and animal control programs to reduce pet effects, particularly the free ranging of dogs and cats onto adjacent areas of habitat for special-status species.
- **Discourage or limit the spread of invasive species.** In addition to programs directly controlling the spread of invasive plants, measures could be implemented to discourage or prohibit the use in landscaping of plant species with the potential to invade wetland and grassland vegetation. O&M activities, including any research conducted on campus lands, should be monitored for potential introduction of nonnative animal species. This should include thorough cleaning of maintenance and research equipment prior to entering the campus proper.
- **Reduce effects of herbicides, pesticides, and rodenticides.** Discourage or limit the application of herbicides, pesticides, and rodenticides on developed lands adjacent to habitat for special-status species, particularly the use of those compounds with the potential for greater effects.
- **Minimize habitat for predators and competitors of target species.** Evaluate and, if practicable, enact measures to reduce habitat value of developed lands for predators and competitors (e.g., coyote, red fox) of target species (e.g., kit fox).

UC Merced Actions

UC Merced has committed to avoidance and minimization measures to be implemented during the design, construction, and O&M stages of the project; and those measures applicable to Phase 1 have been implemented. The measures are described in detail in the RMP (Jones & Stokes 2002b), which was prepared in

conjunction with the 2002 Supplemental BA (Jones & Stokes 2002a). The RMP measures are incorporated into the recommendations in this Conservation Strategy.

To ensure project consistency with the construction measures described above, UC Merced and the County are preparing and will implement a Construction Mitigation Plan approved by USFWS, the Corps, and DFG. This plan will describe all avoidance and minimization measures that will be incorporated during construction, as well as the protocols for monitoring implementation of those measures.

To ensure the project's consistency with the operations and maintenance measures described above, measures approved by USFWS, the Corps, and DFG will be incorporated into the various elements of the overall campus facilities management program (e.g., work program descriptions, training programs) and implemented. The University Environmental Manager will be responsible for ensuring that these requirements are integrated into the campus O&M program. The County will be responsible for ensuring that these requirements are included in any community development plan.

Land Acquisition

Land acquisition is a major element in UC Merced's strategy for long-term conservation of the habitats and species affected by campus development. This Conservation Strategy promotes the protection of sensitive resources through a combination of land acquisition (in fee title or conservation easement) and sound land management. These elements, in combination with the conservation principles and other strategies identified in this chapter, provide a framework to achieve long-term protection of eastern Merced County's sensitive biological resources. Lands purchased or under conservation easement for the project are listed in Table 1-1 and shown in Figure 1-4.

Strategy 3: Protect and Manage Large Contiguous Areas in the Project Region

Description

Conserving existing or potential kit fox dispersal corridors and entire complexes of vernal pools will require maintaining extensive areas of habitat that are of adequate size to achieve their goals (U.S. Fish and Wildlife Service 1998; Noss et al. 2002). Principles of conservation biology indicate that the shape of reserve lands should be configured where possible to minimize the edge effects (i.e., keep core areas relatively free of detrimental effects associated with surrounding lands, such as altered hydrology, pesticide drift, and predation by nonnative species).

For example, if some detrimental effects of adjacent activities extend as far as 200 meters (656 feet) into a conserved area, as might be the case for vernal pool species, a square preserve that is surrounded by lands dedicated to such activities would need to be larger than 53 acres to support an acre of unaffected (i.e., core) habitat. Similarly, if effects of adjacent land uses extended 0.5 mile (approximately 800 meters) into conserved areas, as could some effects on San Joaquin kit fox, a conserved area surrounded by detrimental uses would need to be larger than 700 acres to support an acre of core habitat. Because core areas larger than 100 acres are desirable for conservation of San Joaquin kit fox and vernal pool ecosystems, conserved areas should consist of large contiguous parcels (i.e., more than 1,000 contiguous acres) wherever possible. Although not directly required by the Parameters, this general principle applies recent recommendations for regional conservation and is a "major element" of the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998).

Achieving the species protection goals of this Conservation Strategy requires that a substantial portion of the project region, particularly the central and southern portions, be maintained and managed for conservation values. Strategy 3 will contribute to fulfillment of recovery criteria for vernal pool species through protection of suitable vernal pool habitat within the Madera core area of the Southern Sierra Foothills Vernal Pool Region. It also will contribute to fulfillment of recovery plan objectives for San Joaquin kit fox by protecting suitable habitat along the northeastern San Joaquin Valley edge. This maintenance of conservation values in the project region in an effective, cost-efficient, and publicly supported manner requires use of a variety of land acquisition and regulation tools. Examples of available conservation mechanisms follow.

Fee Title Acquisition and Dedication

Acquiring lands in fee title and dedicating them to conservation purposes provides the highest level of protection and allows the greatest flexibility to manage lands for conservation values and adapt to changing circumstances. This approach is applicable in areas with particularly high conservation values and where the need for intensive management is greatest. However, the higher costs associated with fee title acquisition make this approach impractical on a regional scale and could lead to conflicts with landowners (precipitating a lack of willing sellers).

To ensure that future fee title acquisition and dedication of conservation lands is appropriate, both UC Merced and the County must receive advance USFWS review and approval of acquisitions, as described in Parameter 2a of the BO.

Conservation Easements

Because of their cost effectiveness and compatibility with traditional land uses (i.e., grazing), conservation easements are an effective tool for establishing an extensive area of conserved land, and are most appropriate where intensive management is unnecessary. In the project region, conservation easements are particularly appropriate given the value of cattle grazing as a management tool. The project region's considerable biodiversity has persisted under the current

grazing regime. In addition, appropriate grazing may aid conservation by maintaining the stock ponds used by California tiger salamander and by reducing competition from nonnative plants and the residual matter resulting from their growth.

To ensure consistency of the project with these guidelines, all conservation easements secured after August 19, 2002, must be reviewed and approved by USFWS prior to acquisition, as described in Parameter 2a of the BO.

Compatible General Plan and Zoning Designations

Lands protected through General Plan and zoning designations will not receive the level of conservation management and monitoring as those that have been acquired in fee title for conservation purposes (i.e., UC Merced and TNC Conservation Lands) or those protected by conservation easements. Nonetheless, compatible General Plan and zoning designations provide some protection to conservation values, at essentially no cost. Furthermore, any future attempts to change these designations or approve projects after zoning changes may be required to address compliance with CWA Section 404, ESA, CESA, CEQA, and NEPA—among other laws and regulations.

In the Merced County General Plan (Merced County 1990), the Foothill Pasture designation and the corresponding zoning designation (A-2 Exclusive Agricultural) are compatible with maintaining most conservation values. These General Plan and zoning designations do not allow urban development; specify a large minimum parcel size (i.e., 160 acres); and are intended to facilitate grazing, wildlife habitat, and recreational land uses. Furthermore, standard livestock grazing practices appear to be consistent with the maintenance of most conservation values for the more common vernal pool species and San Joaquin kit fox and, to some extent, for the more rare and specialized vernal pool species. Consequently, retaining lands in the project region in the Exclusive Agricultural zoning designation will provide a base level of protection with substantial conservation value.

UC Merced Actions

Conservation lands acquired to date encompass a substantial portion of habitat in the project region, and additional land is under compatible land use policy. A total of 9,498 acres of lands (CST, VST Preserve, Myers Easterly, and CNR) have been acquired in fee title by UC Merced and dedicated to conservation management. In addition, UC Merced has, in cooperation with the WCB, TNC, and CRT, conserved over 17,000 acres through the acquisition of conservation easements. In total, conservation easements and fee title acquisitions have been secured for 26,639 acres (Table 1-1), representing more than one-eighth of the remaining natural vegetation in the project region.

With one exception (the Carlson property), conservation lands acquired to date are greater than 1,000 contiguous acres; most are contiguous with other conservation lands and are bordered by compatible land uses (Figure 1-4). Most other grasslands with vernal wetlands in the project region are located on land designated as Foothill Pasture in the Merced County General Plan (Merced

County 1990) and zoned Exclusive Agricultural; conversion of these lands to developed land uses would require formal approval by the County.

Strategy 4: Secure Conservation Easements That Provide for Effective Management

Description

Strategy 4 recommends acquisition of conservation easements to establish conserved areas because they are cost effective and compatible with traditional land uses (e.g., grazing). To provide for effective conservation, these easements must prohibit incompatible land uses and allow for retention and monitoring of conservation values and, where appropriate, enhancement, restoration, or creation of habitat values.

Typical incompatible uses include:

- Land subdivision.
- Non-ranching commercial uses.
- Transfer of development rights.
- Development of natural resources (energy, minerals, aggregate).
- Disposal or storage of hazardous materials or refuse.
- Alteration of watercourses or degradation of water quality.
- Impairment of water rights.
- Off-road vehicle use, except for ranching operations.
- Introduction of plant and animal species.
- Plowing, disking, land leveling, irrigation, or other alterations, except disking for fire control.
- Conversion to crops, orchards, or vineyards.
- Creation of junkyards.
- Destruction of native vegetation (except by grazing).
- Timber harvesting.

Depending on the terms of the conservation easement, monitoring, enhancement, restoration, or creation activities may include the following:

- Conducting evaluations of wetland quantity and quality, evaluations of habitat quantity and quality, surveys for threatened and endangered species, and monitoring of any extant populations of such species.
- Monitoring compliance with the terms of the easement and taking actions necessary to achieve compliance with the terms of the easement.
- Installing and maintaining signage.

- Using controlled burning, pesticides, or other means to control invasive plants (if grazing is found to be ineffective).
- Modifying grazing regimes.
- Enhancing wetland habitat.
- Fencing riparian habitats.

The specific easement language necessary to allow monitoring, enhancement, and restoration actions will differ among sites depending on conservation values (e.g., special-status species present), surrounding land uses, and the specific goals and objectives for the conserved area. Accordingly, the requirements for easement language should be determined on a case-by-case basis.

To ensure consistency of the project with these guidelines, all conservation easements secured after August 19, 2002, must be reviewed and approved by USFWS prior to acquisition, as described in Parameter 2a of the 2002 BO (U.S. Fish and Wildlife Service 2002).

UC Merced Actions

As noted above, UC Merced, in cooperation with the WCB, TNC, and CRT, has secured over 17,000 acres in conservation easements. The easements restrict incompatible uses and allow monitoring for compliance with the terms of the easement.

Adaptive Management

The ability to adaptively manage conservation lands is a critical element of this Conservation Strategy. The 2002 BO requires adaptive management and monitoring (Parameter 1b), and UC Merced committed to this effort in the RMP (Jones & Stokes 2002b). This commitment to adaptive management applies to UC Merced–owned Conservation Lands (CNR, VST Preserve, and Myers Easterly; all of which are Tier 1 properties, as described in Chapter 1). Management and monitoring of conservation lands not under the control of UC Merced are being conducted in accordance with their individual easements.

Strategy 5: Develop and Implement a Management Plan for UC Merced Conserved Lands

Description

The management plan developed for conservation lands adjacent to UC Merced (VST Preserve, CST, Myers Easterly, and CNR) and other conservation lands protected through acquisition of conservation easements (Tier 2 lands) (Airola 2008b) will be implemented to ensure that their conservation values are maintained and enhanced. Strategy 5 contributes to the recovery of vernal pool species by managing and monitoring vernal pool habitat on UC Merced conservation lands for the primary purpose of conservation management. The

strategy also allows for management of the land as dispersal and residence habitat for San Joaquin kit fox. The MPCL addresses all of the elements listed below:

- Management goals and objectives.
- Maps and descriptions of the management areas; compensation habitat within the site; and any areas to be enhanced, restored, or used for habitat creation.
- A description of the baseline conditions.
- Description of how the conservation land meets any compensation requirements.
- Descriptions of the mechanisms (e.g., conservation easement, deed restrictions) to protect habitat in perpetuity, and land use restrictions that prevent incompatible activities.
- Identification of the parties responsible for implementing the management plan.
- Description of permitted and restricted recreational, educational, and scientific activities, and protocols for approving specific research and educational uses.
- Methods for controlling/eliminating unwanted or illegal uses of the property.
- Details regarding planned habitat restoration/enhancement measures.
- Grazing management practices.
- Fuel management practices.
- Practices for controlling nonnative plants and animals.
- Monitoring protocols and procedures for archiving, distributing, and reporting monitoring data.
- Adaptive management measures to adjust management on the basis of monitoring results and procedures for reporting adaptive management actions.
- Funding assurances for restoration/enhancement, long-term monitoring, management, and reporting.

The project is consistent with this strategy because the MPCL developed for conservation lands is consistent with these guidelines, financial assurances for long-term monitoring and management have been developed (Chapter 7). The plan will be subject to stakeholder comment through the environmental process and will be approved by USFWS and the Corps. It will be fully implemented, as described in Parameters 2a and 2d of the 2002 BO (U.S. Fish and Wildlife Service 2002).

UC Merced Actions

For conservation easements acquired in connection with the project, UC Merced has committed to working with the easement holders and landowners regarding land management practices that are consistent with this Conservation Strategy. A

management plan consistent with the requirements outlined in the RMP (Jones & Stokes 2002b), the 2002 BA (EIP Associates 2002a), and the 2002 Supplemental BA (Jones & Stokes 2002a) has been developed for conservation lands (Airola 2008b). Strategy 5 supports the kit fox recovery plan criteria of approving and implementing management plans for recovery areas. It also will contribute to the recovery actions identified in the Vernal Pool Recovery Plan by managing, restoring, and monitoring a large area of vernal pool grassland habitat for the recovery of vernal pool species.

Strategy 6: Develop and Implement Adaptive Management Measures to Attain Measurable Objectives

Description

Uncertainty is an unavoidable component of managing natural systems because of the inherent variability in these systems and gaps in the knowledge of their functions. Adaptive management strives to reduce some of that uncertainty and improve management over time. It is an iterative process of evaluating and refining management based on the results of management activities and the status of the managed resource. Adaptive management measures should be seamlessly integrated with any monitoring plans, describe how monitoring data will trigger revisions of management practices (i.e., the feedback loops between monitoring and management), and how adaptive management decisions will be made and reported to resource agencies.

Strategy 6 contributes to the recovery of vernal pool species through the requirement to develop and implement adaptive management measures that guide management, restoration, and monitoring of large areas of vernal pool grassland habitat for the recovery of vernal pool species. It also will contribute to recovery plan goals for kit fox by prescribing adaptive management measures that ensure successful management of habitats for kit fox dispersal and residence.

The objectives established by a proposed management plan should be consistent with the species-specific recovery criteria identified in the Vernal Pool Recovery Plan and with the Upland Species Recovery Plan criteria related to management with an objective of survival of kit fox.

The project is consistent with this strategy because a management plan with adaptive management measures and monitoring requirements has been prepared for UC Merced Conservation Lands (VST Preserve, Myers Easterly, and CNR) that is consistent with these guidelines. This plan will be reviewed and approved by USFWS. Adaptive management measures applicable to project construction, operations, and maintenance have been developed and implemented for the Phase 1 Campus and will be developed and implemented for the campus and Community North, as specified in the RMP (Jones & Stokes 2002b), 2002 BA (EIP Associates 2002), 2002 BA Supplement (Jones & Stokes 2002), 2002 BO (U.S. Fish and Wildlife Service 2002), 2008 BA Supplement (Airola 2008a), and *Management Plan for Conservation Lands and the Adjacent Campus Buildout Lands for the University of California Merced* (MPCL) (Airola 2008b).

UC Merced Actions

UC Merced has developed adaptive management measures in the RMP (Jones & Stokes 2002b) and in the MPCL (Airola 2008b).

Strategy 7: Develop and Implement a Monitoring Program Sufficient to Support Adaptive Management

Description

Because adaptive management decisions are based on monitoring data, the design of monitoring measures and programs has a substantial influence on the effectiveness of adaptive management efforts. The general objectives of monitoring programs are listed below.

- Provide information sufficient to support adaptive management decisions.
- Ensure logistical and technical feasibility.
- Maximize efficiency of monitoring protocols.
- Summarize and interpret data in a manner that is scientifically rigorous and responsive to management needs.
- Archive and distribute data with metadata adequate to support future use of the data.

To fulfill these objectives, monitoring plans should include descriptions of the components listed below.

- Indicators to be monitored.
- Protocols for monitoring these indicators (including sampling designs with frequency of monitoring).
- Designs of additional studies addressing key uncertainties (if any are to be conducted).
- Content and frequency of reports summarizing monitoring data.
- Metadata that will be distributed and archived with the monitoring data.

Monitoring plans for conserved lands in the project region may differ in their indicators and protocols, but all should include periodic reconnaissance surveys to verify compliance with the terms of conservation easements as well as surveys to document the status of habitats occupied by target species. They also may include focused monitoring to address key uncertainties and the effectiveness of enhancement or restoration efforts. The frequency and intensity of these monitoring efforts will depend on site-specific circumstances.

Metadata describe the data summarized in reports, maps, or computer files (e.g., data collection methods, units of measurement for recorded values). National standards for metadata, such as those in the National Spatial Data Infrastructure, should be followed where applicable.

The project is consistent with this strategy because a management plan with monitoring requirements and adaptive management measures has been prepared for UC Merced Conservation Lands. The plan will be reviewed and approved by USFWS. Implementation of the monitoring plans will contribute to the recovery of vernal pool species and kit fox by providing information on habitat conditions, habitat responses to management, and species status assessments on Conservation Lands.

UC Merced Actions

UC Merced has developed a monitoring program in the MPCL (Airola 2008b).

Strategy 8: Incorporate Studies to Address Key Uncertainties into Adaptive Management

Description

In addition to evaluating progress toward measurable objectives, adaptive management should identify key uncertainties affecting management decisions and support monitoring procedures and experiments as needed to reduce or eliminate those uncertainties.

Some key uncertainties that may pertain to the conservation of threatened and endangered species in the project region are listed below.

- The distribution and abundance of species in the project region (particularly San Joaquin kit fox and midvalley fairy shrimp).
- The magnitude of effects on vernal pools associated with adjacent developed lands.
- Appropriate grazing regimes for sustaining and enhancing threatened and endangered species habitat (especially those that occupy deeper pools and ponds (Airola 2008b).
- Appropriate procedures for distinguishing inter-annual variability from long-term trends in the abundance and distribution of vernal pool species.

Studies addressing these uncertainties would improve the effectiveness of conservation efforts in the project region. Consistency of the project with this strategy requires design, implementation, and analysis and peer review of such studies. The MPCL (Airola 2008b) allows such studies to be conducted on UC Merced Conservation Lands.

UC Merced Actions

UC Merced, as a research and teaching institution, has conducted research and monitoring to reduce uncertainties affecting management, and has committed to conducting additional research and monitoring to reduce such uncertainties. For example, during 2003, UC Merced conducted additional surveys to reduce uncertainties regarding the distribution of succulent owl's-clover, which resulted in the discovery of several new occurrences of this species. Also, during Phase 1 construction, UC Merced monitored adjacent vernal pools to reduce uncertainty

regarding construction effects on water quality in pools. UC Merced's management commitments for UC Merced Conservation Lands include monitoring studies addressing nonnative species, hydrologic disruption, and effectiveness of measures to prevent disruption of ecosystem functions. UC Merced's commitments include regular monitoring of grazing intensity and habitat conditions useful in evaluating effects of grazing on vernal pool species. The results of these studies could contribute to the recovery of vernal pool species and San Joaquin kit fox by providing much needed information on these species and their habitat needs and responses to management practices in the project region.

Strategies Specific to San Joaquin Kit Fox

The long-term status of San Joaquin kit fox in eastern Merced County could be positively affected by implementation of the general conservation strategies described earlier in this chapter. The land acquisition and the avoidance and minimization strategies are especially relevant to protecting individual kit fox and preserving both residence and dispersal habitat along the eastern edge of the San Joaquin Valley. The specific conservation measure described below provides further guidance regarding the need to maintain a movement corridor in the project region for San Joaquin kit fox.

Land Acquisition

Strategy 9: Contribute to Establishment of a Protected Corridor across the Project Region to Allow the Potential for Continuous Residence and Dispersal of San Joaquin Kit Fox

Description

Parameter 1b of the 2002 BO (U.S. Fish and Wildlife Service 2002) requires that the Conservation Strategy be consistent with and contribute to implementation of the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998), as well as any future federal recovery planning efforts. The recovery plan specifies the need to protect 90% of existing natural lands along the northeastern valley edge in San Joaquin, Stanislaus, Merced, and Madera Counties for San Joaquin kit fox residence and dispersal. The recovery plan also identifies the objective of maintaining a suitable corridor along Sandy Mush Road for movement of kit foxes from valley floor habitats to eastern Merced County. Parameter 2b, in accordance with the recovery plan, also calls for UC Merced to protect a corridor north and east of the project area and to ensure that such acquisitions are "consistent with the establishment of a connection to the Sandy Mush Road area."

To provide an effective dispersal corridor for San Joaquin kit fox, a contiguous corridor of conserved or compatibly managed areas traversing the length of the project region is needed. Such a corridor of conserved areas is feasible to maintain in the eastern half of the region because converted, potentially degraded, and highly threatened lands are concentrated in the western half of the region.

The corridor should be identified on the basis of the expected patterns of movement of kit foxes, as inferred from known patterns of use by the species for different terrains and habitats (see Chapter 2). This determination also should consider the specific on-the-ground conditions that may inhibit or preclude movement through certain areas. At the broadest level of assessment, the corridor should provide suitable habitat for kit fox residence and allow efficient movement of dispersing kit foxes through the project region. Moreover, it should be wide enough to be buffered from adjacent disturbances.

UC Merced Actions

In addition to conversion of approximately 2,444 acres of kit fox residence and dispersal habitat in eastern Merced County, implementation of the Proposed Action will result in conservation of over 26,000 acres of natural lands, the majority of which is suitable for kit fox residence and dispersal. These acquisitions contribute to the Upland Species Recovery Plan objective to conserve 90% of existing natural lands along the northeastern valley edge from San Joaquin to Madera Counties (U.S. Fish and Wildlife Service 1998) and to the objective to contribute to the recovery plan's objective to establish a corridor that maintains the potential for dispersal from valley floor habitats to and along the project region (i.e., the Sandy Mush Road Corridor) (U.S. Fish and Wildlife Service 1998). Strategies Specific to Vernal Pool Grasslands and Associated Special-Status Species

Implementation of the general conservation strategies described earlier in this chapter would contribute to the long-term improvement of the status of vernal pool grasslands in eastern Merced County. Land acquisition and adaptive management strategies address preservation of contiguous areas in the San Joaquin Valley that support vernal pool grasslands and associated species, while the proposed avoidance and minimization strategies address the risk of local extirpation of the more rare and specialized vernal pool species.

The habitat-specific conservation measures discussed below provide guidance regarding the preservation of geomorphic surfaces and habitat types on conservation lands, the protection of known populations of the rarer and more specialized vernal pool species, and compensation for losses through conservation of comparable habitat. These vernal pool-associated conservation measures and strategies respond directly to Parameters 2c, 2e, and 2f of the 2002 BO (U.S. Fish and Wildlife Service 2002).

Land Acquisition

Strategy 10: Represent all Geomorphic Surfaces and Habitats Occupied by Target Species on These Surfaces

Description

The lands that are conserved to compensate for project development should protect biologically meaningful examples of the full range of geomorphic surfaces that are present in the project region (see Table 3-3). The selection of these lands also should ensure that examples of the full range of surfaces that each target species occupies are conserved. These geomorphic surfaces represent the range of physical habitat types that exist in eastern Merced County. Conserving occupied habitat across the range of physical habitats will contribute to the long-term viability of populations and to the conservation of genetic diversity.

Implementing Strategy 10 will require conservation of multiple large parcels concentrated in the central and southern portions of the project region. Multiple large parcels will be necessary because of the extensive area of geomorphic surfaces. Their regional patterns of distribution preclude single properties, even those encompassing several thousand acres, from representing the full range of physical habitat conditions in the project region. The emphasis on the central and southern portions of the region is dictated by the presence of dense vernal pool complexes and the distribution of the rarest vernal pool plant species, five of which are absent from the northern portion of the project region.

Implementation of Strategy 10 is also consistent with recent recommendations for effective long-term regional conservation (Noss et al. 2002).

UC Merced Actions

Conservation lands acquired in connection with the project support vernal pools, swales, and clay playas on all of the major geomorphic surfaces supporting these wetlands in the project region (Table 3-3). In total, the conservation lands support from less than 1% to more than 40% of these wetlands on each type of geomorphic surface (Appendix C). These conservation lands also support substantial areas of habitat occupied by succulent owl's-clover, vernal pool fairy shrimp, and California tiger salamander across the range of physical habitats (Table 3-7 and Appendix C). They also support habitat occupied by Colusa grass, San Joaquin Valley Orcutt grass, Conservancy fairy shrimp, midvalley fairy shrimp, and vernal pool tadpole shrimp—but on a more limited set of geomorphic surfaces, partly because these species are more limited in their distributions.

Strategy 11: Sustain Populations of the Rarer and More Specialized Target Species at Occupied Sites

Description

Parameter 2f in the 2002 BO specifies that UC Merced will, to the maximum extent practicable, avoid and minimize effects on the following seven federally listed species: succulent owl's clover, Hoover's spurge, San Joaquin Valley Orcutt grass, Colusa grass, hairy Orcutt grass, Greene's tuctoria, and Conservancy fairy shrimp.

Surveys conducted since the 2002 BO (Appendix D) was issued have identified several occurrences of succulent owl's clover and Colusa grass in vernal pools in the project region.

Hoover's spurge has not been documented to occur in the project region, but suitable habitat exists and the species may be present. The remaining four species are presumably extant at just one to six known sites in the project region (California Natural Diversity Database 2008).

The rare species identified in Parameters 2e and 2f of the 2002 BO are more specialized than other vernal pool species and consequently more vulnerable to local extirpation. These species are associated with larger vernal wetlands, and in some cases artificial wetlands or ponds, that remain inundated for a greater portion of the year than do most other vernal pools, swales, and clay playas. There is some evidence that, because of this association, they are more likely to be adversely affected by grazing than other species (Robins and Vollmar 2002). Furthermore, most of these species generally occupy just a single vernal wetland at individual occurrences identified in the CNDDB (2008), in contrast to the tens or even hundreds of wetlands occupied at a single occurrence by other species, such as succulent owl's-clover and vernal pool fairy shrimp. This limited distribution leaves these species much more vulnerable to local extirpation due to habitat loss or degradation.

To be consistent with this conservation strategy, the project must not directly affect Conservancy fairy shrimp, as described in Parameter 2e of the 2002 BO (U.S. Fish and Wildlife Service 2002). In addition, the project must avoid and minimize effects on the other rarer, more specialized species, as described in Parameter 2f.

UC Merced Actions

UC Merced is supporting this goal by avoiding and minimizing effects of the UC Merced Campus and Community North on known populations of the rarer and more-specialized target species. UC Merced is further supporting this goal by acquiring Conservation Lands containing wetland habitats occupied by succulent owl's clover, San Joaquin Valley Orcutt grass, Colusa grass, and Conservancy fairy shrimp.

Reconfiguration of the project footprint in 2008 resulted in avoidance of all known populations of Colusa grass and San Joaquin Valley Orcutt grass. An

estimated 156 acres of occupied habitat for Colusa grass (55% of the regional occupied habitat) and 16 acres of occupied habitat for San Joaquin Valley Orcutt grass (10% of the regional occupied habitat) are now protected within UC Merced–owned Conservation Lands (Tables 3-6 and 5-1; Figures 3-9 and 3-10).

The remaining five rarer vernal pool species are not known to occur within the new project footprint. The UC Merced Conservation Lands support 13% of the documented occupied habitat for Conservancy fairy shrimp in the region (Table 3-6). As these estimates are based partly on surveys of a sample of the available habitat, it is possible that additional undetected populations of some of these species may occur on Conservation Lands.

Management and monitoring actions for Conservation Lands incorporated into the MPCL give particular attention to populations of San Joaquin Valley Orcutt grass, Colusa grass, and Conservancy fairy shrimp (Airola 2008b).

Strategy 12: Compensate for Losses of Wetlands and Target Species with Comparable Habitat That Contributes to Land Conservation Strategies

Description

Development projects in the project region that result in unavoidable loss of habitat supporting target species should be required to implement measures to acquire, maintain, restore, and enhance conservation values on lands that support the affected species—in accordance with existing permitting and approval processes. These measures should be consistent with this Strategy 12. Compensation lands should be managed to ensure that they provide wetland functions and values and species habitats comparable to the habitat for which they provide compensation. The appropriateness of such conservation measures (in terms of effects of project actions and effectiveness of protection and enhancement measures) should be evaluated on a project-by-project basis.

In accordance with the previously described existing permitting and approval processes, restoration of vernal wetlands (i.e., vernal pools, swales, and clay playas) is normally part of compensation where it is determined to be feasible by the Corps and USFWS. Any proposal for wetland enhancement, including the final configuration of proposed wetlands (e.g., size, shape, and depth), should be based on the completion of soils, hydrologic, and other studies confirming the feasibility of the enhancement proposal and should include Corps-approved measures intended to facilitate occupancy by special-status and other wetland-dependent species (e.g., plantings, collection of topsoil, and inoculation of target area). Compensation wetlands should be located in areas that are protected in perpetuity and should be evaluated for a period of at least 5 years to ensure conformance with success criteria (e.g., target habitat characteristics, success of plantings) to be developed in conjunction with the Corps and other agencies.

For the Proposed Action to be consistent with this strategy, several specific requirements must be satisfied. First, the applicability of lands for conservation

of protected species will be reviewed by USFWS as described in Parameter 2a of the 2002 BO (U.S. Fish and Wildlife Service 2002). Lands will not be suitable for compensation if they are not preserved in perpetuity or if they lack sufficient buffers to protect populations from potential perturbations. Second, ratios of conservation lands to affected lands must be at least equal to those described in Parameter 2c of the 2002 BO (U.S. Fish and Wildlife Service 2002). For listed plant species, conservation lands must be within a 10-mile radius of affected lands, to the extent feasible. Third, the extent and nature of proposed conservation lands, together with any avoidance and minimization measures, require approval by USFWS and the Corps, as described in Parameter 2c of the 2002 BO (U.S. Fish and Wildlife Service 2002). Fourth, as described in Parameter 2f of the 2002 BO (U.S. Fish and Wildlife Service 2002), UC Merced and the County will develop and implement a restoration plan focusing on areas where suitable degraded habitat is still present or on other suitable areas to compensate for effects on vernal pools and associated habitats as well as any other wetlands. This plan will include appropriate monitoring and adaptive management measures, together with adequate financial assurances, and will require review and approval by USFWS and the Corps (U.S. Fish and Wildlife Service 2002).

Development projects in the project region that occur within designated critical habitat for the recovery of vernal pool species may affect those species. Accordingly, such projects should be required to implement measures that are consistent with the Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005). Development projects within the UCP area also will be required to comply with the UCP EIR mitigation ratios (EIP Associates 2004a).

The California tiger salamander was federally listed and critical habitat was designated after issuance of the 2002 BO. Therefore, the species was not addressed explicitly in the 2002 BO, but the general provisions for avoidance, minimization, and compensation for project impacts apply to the species.

UC Merced Actions

As part of satisfying these and other requirements, UC Merced has prepared an RMP for the UC Merced Campus (Jones & Stokes 2002b), and the County has prepared an HMP for the Infrastructure Project (EIP Associates 2002b). These mitigation plans have been prepared with USFWS and DFG involvement, and incorporate the conservation measures approved by USFWS and the Corps. The County HMP provides an example of the habitat mitigation plans that will be required for future individual development projects proposed within the UCP area.

UC Merced has prepared and submitted to USFWS, DFG, and the Corps for their review and approval a detailed *Compensatory Wetland Mitigation and Monitoring Plan* (Gibson & Skordal 2005) for onsite and offsite wetland preservation, enhancement, and restoration efforts. The goal of the *Compensatory Wetland Mitigation and Monitoring Plan* is to ensure that the project will result in no net loss of wetland functions and to ensure that take and other effects on listed species dependent on these habitats are fully offset. It is

based on a holistic watershed-level approach involving a wide range of aquatic habitats and their surrounding upland environments. The *Compensatory Wetland Mitigation and Monitoring Plan* includes measures to meet the following objectives:

- Ensure that UC Merced will preserve a minimum of 10 acres of vernal pool grassland for each acre of vernal pool grassland developed or filled.
- Evaluate and incorporate existing easement protections and other enhancement activities on preserved lands as needed to achieve the requirement for no net loss of wetland functions.
- Restore wetlands by reestablishing or enhancing areas where the vernal pool signature is still present, to achieve a minimum acreage ratio of 1:1 replacement for vernal pools and other seasonal wetlands that would be filled by the project. If the 1:1 replacement ratio cannot be met through restoration of degraded seasonal wetland habitats, meet the ratio through creation of such habitats in other suitable areas.

In accordance with the conservation requirements specified in the *Compensatory Wetland Mitigation and Monitoring Plan*, UC Merced will subsequently prepare a Wetland Restoration/Creation Site Design Plan for each conservation site. Each such plan will include a wetland delineation, and any necessary permits under CWA Section 404 will be applied for and received prior to work initiation.

The conservation lands acquired to date contain habitats that are comparable to those that would be affected by buildout of the project, contribute to land conservation goals, and meet or exceed required mitigation ratios. For target species, the mitigation acreage ratios exceed the typically required 3:1 ratio, are consistent with Parameter 2c of the 2002 BO (U.S. Fish and Wildlife Service 2002), and meet or exceed the ratios in the 2002 BA (EIP Associates 2002a).

The project area does not include lands designated as critical habitat for vernal pool species (70 FR 46923). Critical habitat for vernal pool species does occur within conservation lands, specifically the CST, Robinson, Chance, Cunningham, Carlson, and Nelson properties. Critical habitat for succulent owl's-clover, Colusa grass, Greene's tuctoria, San Joaquin Valley Orcutt grass, Conservancy fairy shrimp, vernal pool fairy shrimp, and vernal pool tadpole shrimp occurs in the project region (71 FR 7117).

Although critical habitat for the California tiger salamander occurs within the project footprint, the reconfiguration of the project footprint in 2008 reduced the amount of occupied habitat and designated critical habitat for the California tiger salamander that would be affected by the project.

Other Special-Status Species

Land Acquisition

Strategy 13: Conserve Habitat Essential to the Survival and Preservation of Other Special-Status Species

Description

Throughout the project region, habitat essential to the survival and preservation of other special-status species (discussed in Chapter 4) should be conserved to the greatest extent possible. Implementation of the general conservation strategies described earlier in this chapter is expected to contribute to the long-term improvement of sensitive habitats in eastern Merced County and the species they support. Habitat types considered especially important to these special-status species include freshwater marshes, ditches and canals, streams, rivers, ponds, various wetland communities, riparian corridors, oak woodlands, elderberry savannahs, cliffs, and grasslands.

Freshwater marsh dominated by tules and cattails, willows, blackberries, thistles, and nettles provide nesting opportunities for tricolored blackbirds. Marshes are preferred foraging areas for northern harriers and provide high-quality foraging for a variety of other special-status raptors and migratory birds. Marsh habitats as well as sloughs, ditches, and canals are utilized by giant garter snakes. Water bodies, including ponds, marshes, rivers, streams, and irrigation ditches are essential to western pond turtles. Riparian corridors can provide nest trees suitable for white-tailed kites and Swainson's hawks. Oak woodlands with open canopies often are used for nesting by Swainson's hawks and white-tailed kites. Elderberry shrubs, typically those in elderberry savannahs, are the required host plant for valley elderberry longhorn beetle; the preservation of these shrubs is crucial to the continued recovery of this species. Cliffs provide essential nesting habitat for bald eagles, golden eagles, and prairie falcons and roosting habitat for pallid bats. Alkali and desert scrub habitats are the preferred habitat of blunt-nosed leopard lizards. Grasslands provide important habitat for a number of other special-status species in the project region, including nesting habitat for a number of ground-nesting birds; foraging habitat for raptors, other migratory birds, and pallid bats; and denning habitat for American badgers.

UC Merced Actions

Conservation lands acquired in connection with the project encompass a substantial portion of sensitive habitats in the project region. A total of 9,498 acres of lands (CNR, CST, VST Preserve, and Myers Easterly) have been acquired in fee title by UC Merced and TNC and have been dedicated to conservation management. These lands, in concert with the Tier 2 properties have conserved a total of 26,639 acres, or more than one-eighth of the remaining unconverted land in the project region.

This page intentionally left blank.

Chapter 6

Management and Monitoring Program for Conservation Lands

The primary means of mitigating impacts of the Proposed Action on habitats of federally listed species are acquisition of lands in fee title and establishment of conservation easements on appropriate properties to permanently protect, maintain, and enhance habitat values. *Conservation Lands* are lands acquired specifically to mitigate impacts resulting from implementation of the Proposed Action.

Parameter 2a in the 2002 BO (U.S. Fish and Wildlife Service 2002) requires preparation of a Resource Mitigation Plan and Habitat Mitigation Plan to describe management strategies and financial assurances for monitoring and management of Conservation Lands and a strategy for addressing indirect effects of the UC Merced Campus and infrastructure and related road improvement projects project on Conservation Lands. The document prepared to meet this requirement is the MPCL (Airola 2008b).

The MPCL addresses management policies and actions for UC Merced's Conservation Lands, other lands with conservation ownership (Tier 1 lands), and private lands with acquired conservation easements (Tier 2 lands). Lands are referred to as *Conservation Lands* because active management (beyond simple preservation) is required. The indirect effects o f the UC Merced Campus and University Community are evaluated in the 2002 BO (U.S. Fish and Wildlife Service 2002), the 2008 BA Supplement (Airola 2008a), and this Conservation Strategy; the mitigation for these effects is discussed in the 2008 BA Supplement and MPCL.

The Conservation Strategy, which has been prepared iteratively with extensive agency input, provided guidance for preparing the MPCL. This chapter summarizes management and monitoring provisions for Conservation Lands, and the financial assurances for conducting this work—which have been addressed in greater detail in the MPCL.

Types of Mitigation Lands

This Conservation Strategy identifies two types of Conservation Lands: lands owned in fee title by UC Merced, UCLC, and TNC and that are immediately adjacent to the UC Merced Campus (i.e., Tier 1 properties—VST Preserve, CNR,

Myers Easterly, and CST); and other lands in the region protected under conservation easements as compensation for the project (i.e., Tier 2 properties—the Robinson, Chance, Carlson, Nelson, and Cunningham properties) (see Table 1-1 and Figure 1-4).

Resource management and land conservation entities often consider fee title acquisition superior to conservation easements because acquisition provides for the greatest control over management actions and allows managers greater flexibility to change management actions in the face of new or unanticipated threats to conservation values. However, fee title acquisition entails significantly greater costs both in terms of initial acquisition and ongoing management and maintenance. Conservation easements, on the other hand, allow more lands to be conserved for the same amount of money, while keeping management and maintenance costs lower.

Both Tier 1 and Tier 2 mitigation lands will be managed according to the MPCL (Airola 2008b). This plan allows for research, monitoring, and adaptive management actions on Tier 1 lands to ensure long-term viability of the properties' resources. Management of Tier 2 properties is established through easement conditions specific to each individual property. These easement conditions specify permitted uses; prohibited uses; allowable maintenance, repair, and replacement activities; and livestock grazing requirements for each site. The easements also allow the individual easement holders, for each property, TNC or CRT, to monitor compliance with easement conditions.

Goals and Objectives of the Management and Monitoring Program

The Conservation Strategy is a conservation plan designed to support issuance of an incidental take permit under the ESA. The purpose of the Conservation Strategy is to minimize and mitigate the expected loss of habitat values that result from implementing the Proposed Action and other projects in the region and to promote biological conservation in eastern Merced County that is consistent with the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998).

Accordingly, the purpose of the MPCL is to meet UC Merced's environmental commitments and agency permit requirements for conservation and enhancement of mitigation lands and habitat for associated species of conservation concern. Specifically, the MPCL guides the management of Conservation Lands over the life of the plan.

UC Merced adopted the following principles to guide preparation of the MPCL (Airola 2008b):

- Comprehensively address all management needs by providing clear and practical policy-level direction to on-the-ground managers.

- Meet requirements in permits and environmental documents to emphasize protection of wetlands and biological resources.
- Anticipate future campus growth in evaluating effects of management decisions and actions.
- Accommodate other uses (research, educational, recreation) to the extent feasible consistent with the primary goals and with available budgetary and management resources.
- Emphasize early problem detection and response to issues before they become large problems.
- Actively collaborate and communicate with adjacent landowners and the University Community.
- Adopt an adaptive approach to management based on observation, monitoring, and research.

Elements of Management Plan for Conservation Lands

The MPCL (Airola 2008b) sets forth specific guidelines regarding land management and monitoring activities for all Tier 1 and Tier 2 Conservation Lands. The plan focuses greatest attention on lands that are owned and will be managed by UC Merced, including the VST Preserve, CNR, and the Myers Easterly property.

The main portion of the management plan addresses UC Merced Conservation Lands. UC Merced has no direct control over the CST lands owned by TNC or Tier 2 lands. Management and protection requirements for Tier 2 lands are specified in the conservation easements.

The MPCL was prepared to meet requirements stated in the 2002 BO (U.S. Fish and Wildlife Service 2002) and in previous drafts of this Conservation Strategy. The key elements of the plan are summarized below.

Description of Conservation Lands

The MPCL describes the location, size, ownership, and management status of Conservation Lands. It also describes the relationship of Conservation Lands to the regional landscape and community, including regional conservation for the San Joaquin kit fox and vernal pool species.

Overview of Area Resources and Management

The MPCL provides an overview of existing biological resources on UC Merced Conservation Lands, CST, and Tier 2 lands. The plan provides a summary of the status of key habitats and species of conservation concern. This information is provided in brief form, because it is provided in detail in this Conservation Strategy.

The MPCL also introduces other natural and cultural resources and existing land uses, because management for conservation purposes must consider these other resource values. It briefly describes cultural and visual resource values, and describes ongoing land uses and management programs, including livestock grazing, fire control and management, prevention of unauthorized uses, research and educational uses, and recreation.

Plan Purpose and Planning Principles

The MPCL outlines the basis for and substance of commitments to be incorporated into the plan, including those from the 2002 BA, 2002 Supplemental BA, RMP, 2002 BO, conservation easements, and this Conservation Strategy.

Management Program Direction

Direction and guidance for management of Conservation Lands is presented for each major resource and land use program. The major programs are grazing, fire protection and use, control of unauthorized uses, integrated pest management, research and educational uses, habitat protection and enhancement, recreation and other public uses, cultural and visual resources, and inter-jurisdictional coordination. Goals, objectives, and management guidelines are provided for each program. All management direction is oriented toward protecting and enhancing habitat values for conservation species. The MPCL emphasizes policy and guidance toward grazing management and integrated pest management programs, which are discussed in more detail below.

Grazing Management

Grazing management is detailed in an appendix to the MPCL that describes grazing history, existing grazing resources and practices, and range improvements; and outlines a detailed grazing management plan. The grazing plan includes a description of management responsibilities and management goals, the criteria for lessee selection, and the lease provisions. Lessee selection favors entities with demonstrated ability and performance to meet the conservation goal rather than maximizing lease revenue. Soils and rainfall

information were used to predict grazing capacity, which was checked against recent livestock stocking levels and range conditions.

The grazing plan recommends grazing by cattle from late fall-early winter through late spring, with annual timing determined by visual inspection of range conditions. Maximum grass heights are set at 2-12 inches, except for exceedances allowed during brief periods in the height of the growing season. The minimum amount of residual dry matter (RDM) left at the end of the grazing season is set at an average of 800 lbs per acre, consistent with the requirements of the 2002 BO (U.S. Fish and Wildlife Service 2002). Special grazing management and monitoring are prescribed for the few wetland areas that support San Joaquin Valley Orcutt grass and Colusa grass.

The average annual grazing capacity for UC Merced lands was determined in the grazing plan based on use by yearling cattle, because the UC Merced lands lessee grazes replacement heifers for a dairy operation on these lands. The average grazing capacity for the prescribed grazing season was approximately 2,400 yearlings, which is higher than the 2007 stocking rate of 1,500 yearlings. The 2007 stocking rate was adjusted to below the average grazing capacity by the lessee due to the lack of rainfall and available forage. Such adjustments also would occur by prescription under the grazing strategy for UC Merced Conservation Lands.

Integrated Pest Management

The MPCL recognizes control of invasive species as a key need for long-term protection of Conservation Lands. Important pest species include noxious weeds and non-native vertebrates. Plan guidance for UC Merced Conservation Lands includes identification of potential pest species, key threatened resources, modes of introduction and dispersal, critical control actions, critical control points for actions, and monitoring priorities.

Management direction emphasizes meeting objectives to minimize the introduction of exotic species; monitoring and control pest species through early detection and treatment; preventing establishment of weed sources on campus and community lands; and coordinating with local, regional, and state control efforts. Management guidelines include preventing pest plant species introductions through use of use of weed-free livestock feeds and erosion control materials (for adjacent construction); cleaning plant material from equipment, vehicles, and footware; and prohibiting purposeful introductions of exotic species and use of invasive species in campus and community landscaping.

Integrated pest management guidance includes details regarding monitoring and adaptive management. Monitoring for invasive plants will focus on critical control point sites, including those Conservation Lands immediately adjacent to the UC Merced Campus, livestock concentration areas, firebreaks, areas adjacent to canals, and burned areas. Monitoring also is required of campus lands, especially disturbed areas that could be sources for dispersal of pest species.

Monitoring for vertebrate pests is focused on aquatic and wetland habitats for non-native fish, amphibians, and aquatic reptiles—and more broadly, over all lands for feral or free-ranging dogs and cats, red foxes, and wild pigs. All of these monitoring efforts lead to adaptive management actions to control pest species.

Monitoring, Reporting, and Adaptive Management

The MPCL describes methods and requirements for monitoring and reporting on adherence with the plan and other compliance documents, and for initiating adaptive management actions. Monitoring addresses establishment of baseline conditions, which are based on existing resource information. Compliance monitoring will use an annual reporting checklist to verify that required actions were taken. Effectiveness monitoring will evaluate how well the plan and its component management action met its ultimate conservation goals, so that practices can be adjusted adaptively. Specific monitoring activities that will be conducted are identified, along with their frequencies (annual, regularly on a non-annual basis, or in response to certain incidents or triggering conditions). Monitoring reports will be submitted annually to the USFWS, the Corps, and the DFG. Monitoring reports will identify recommendations for management adaptations.

Adaptive management applies primarily to UC Merced Conservation Lands. Management of CST and Tier 2 lands will be governed by existing and impending conservation easements, which do not have a strong adaptive component.

The adaptive management component of the MPCL identifies the process for using monitoring results to adjust management programs, including the means by which permitting agencies will be notified and involved in approving changes. Minor changes in management and monitoring actions (i.e., those consistent with the plan's direction and thereby consistent with the underlying environmental commitments and permit requirements) can be made by UC Merced, following notification of the regulatory agencies. Proposed changes in MPCL direction will require concurrence or approval of the regulatory agencies.

Plan Funding and Implementation

The MPCL presents a funding overview for implementing the management and monitoring program for UC Merced Conservation Lands, based on costs of individual activities that occur on an annual, regular non-annual, and irregular basis. The funding program and a secure source of funds for conducting management and monitoring will include endowment funding, potentially augmented by annual operating funds and grazing lease revenues. The precise funding approach will be approved by the permitting agencies.

Chapter 7
Funding

This chapter addresses the funding requirements for this Conservation Strategy, as required by the 2002 BO (U.S. Fish and Wildlife Service 2002). The 2002 BO requires funding for the following activities:

- Administration of the conservation program outlined in the Conservation Strategy,
- Acquisition of Conservation Lands,
- Implementation of habitat restoration requirements, and
- Management and monitoring of Conservation Lands.

Implementation of the Conservation Strategy requires funding the short- and long-term administration of UC Merced's conservation effort. This effort, from a funding standpoint, comprises land acquisition, management and monitoring of Conservation Lands, and habitat restoration efforts.

Administration

UC Merced's Director of Environmental Affairs is charged with administering the conservation program. This position is funded through UC Merced's annual operating budget. The Director of Environmental Affairs will be responsible for the efforts listed below:

- Ensuring that all technical studies and/or reports are conducted and submitted to the appropriate resource agency;
- Coordinating UC Merced's land acquisition efforts (fee title purchases and conservation easements);
- Ensuring adherence to the management, monitoring, and reporting requirements of the MPCL (Airola 2008b);
- Interfacing with the resource agencies concerning the overall implementation effort; and
- Managing the habitat restoration program.

Land Acquisition

On December 4, 2001, the David and Lucile Packard Foundation funded a $12 million grant, which, among other transactions, enabled acquisition of the VST Preserve. The grant secured lands that have been incorporated into the northern portion of the proposed campus, while remaining lands were designated for conservation purposes, including the 1,307-acre CNR and the 5,030-acre VST Preserve. The VST Preserve has been permanently protected through a granting of a conservation easement to TNC, and UC Merced has committed to granting a conservation easement on the CNR. UC Merced also committed to long-term conservation management for these lands (see *Management and Monitoring* below).

In addition to the conservation funding provided by the Packard Foundation, Assembly Bill 1740 (approved by Governor Gray Davis on June 30, 2000), appropriated $30 million for the "acquisition of sensitive habitat related to the University of California Merced Grasslands Projects." In accordance with this appropriation, DFG, USFWS, EPA, and the Corps have approved expenditure of these funds for the conservation of properties as mitigation for the impacts of the project. This funding was used to acquire the 3,070-acre CST property and conservation easements on 17,141 acres of Tier 2 mitigation lands.

The 91-acre Myers Easterly property originally was conveyed from the Flying M Ranch to UCLC, to serve as a site for mitigating the pre-existing wetland impacts of the Phase 1 Campus site. Subsequently, the site was determined to be unsuitable for wetland creation and restoration. The Myers Easterly property will be protected through a conservation easement and managed for conservation values, as outlined in the 2008 BA Supplement and the Conservation Lands Management Plan. An alternative site for wetland restoration and creation will be acquired but has not yet been selected.

The remaining appropriation will be used to purchase the wetland mitigation site. Together, these purchases will meet the goals and objectives of this Conservation Strategy and will be consistent with the Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005) and the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998).

In accordance with Parameter 2a of the BO, UC Merced will collaborate with USFWS and other resource agencies in selecting any acquired properties. UC Merced expects to initiate these future land acquisitions upon the Corps' issuance of a Record of Decision regarding the CWA Section 404 permit application.

Habitat Restoration

UC Merced has committed to create or restore an amount of wetlands equal to the total area of wetlands affected by the project, as documented in the

Compensatory Wetland Mitigation and Monitoring Plan (Gibson and Skordal 2008). The cost of designing, constructing, and monitoring the wetlands will be funded by UC Merced.

Management and Monitoring

Management and monitoring of UC Merced's Conservation Lands will be conducted by UC Merced's Sierra Nevada Research Institute (SNRI), under the direction of UC Merced's Director of Environmental Affairs. SNRI will be responsible for implementing the MPCL (Airola 2008b).

A $1.4 million endowment provided to UC Merced from the Hewlett Foundation for mitigation purposes provides earnings that will be used to pay for management and monitoring activities on UC-owned Conservation Lands. This fund will be tracked independently, as are all dedicated funds within the UC General Endowment Pool, a $5 billion balanced portfolio of equities and fixed-income securities that has had an annualized net total return of 10.59% for the 10 years prior to June 30, 2005.

As noted in Chapter 6 and the MPCL, discussions are ongoing between UC Merced and USFWS, DFG, and TNC to ensure that a stable secure funding source is available to implement management and monitoring.

This page intentionally left blank.

Chapter 8
Facilitating Regional Conservation

Need for Regional Conservation

The ranges of sensitive plant and animal species and their associated habitats that are being affected by development of the Proposed Action are not confined to the project area or the project region. These predominantly grassland and scrubland habitats and their associated species once extended along a wide expanse of the Central Valley. Their current distributions are a function of changing land use patterns over the history of European involvement in California. Fragmentation of populations and reduction in habitats are major threats to the long-term existence of these resources, as explained in the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998) and the Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005). To plan properly for the long-term conservation of these species, a regional approach is needed to respond to the potential for further population fragmentation and habitat isolation. This chapter of the Conservation Strategy is intended to place the UC Merced and the County conservation efforts in the context of regional conservation efforts for San Joaquin kit fox and vernal pool ecosystems and associated species.

Regional Goals and Objectives

The regional goals and objectives for conservation of San Joaquin kit fox and vernal pool ecosystems are clearly stated in their respective recovery plans. Regional goals and objectives for other special-status species are not as clearly documented by the agencies responsible for their management and conservation.

San Joaquin Kit Fox

The Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998) states that "The overall objectives of this recovery plan are to delist…San Joaquin kit fox…" (i.e., remove the species from the list of federally protected threatened and endangered species). This objective applies to the taxon throughout its range in the San Joaquin Valley and therefore is a regional objective.

The interim goal of the plan (U.S. Fish and Wildlife Service 1998) for San Joaquin kit fox is to:

> …Stabilize and protect populations and to conduct research necessary to refine reclassification and recovery criteria and subsequently reclassify…San Joaquin kit fox from endangered to threatened. Reclassification will be appropriate when each taxon is no longer in danger of extinction throughout a significant portion of its range.

The Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998) also provides specific guidance for maintaining a viable dispersal corridor for kit fox in the project region. One of the recovery actions is to:

> Maintain and enhance movement of kit foxes between the Mendota area, Fresno County, natural lands in western Madera County, and natural lands along Sandy Mush Road and in the wildlife refuges and easement lands of Merced County. Specifically, maintain and enhance the Chowchilla or Eastside Bypass and the natural lands along this corridor through acquisition, easement, or safe harbor initiatives.

This corridor goal extends beyond the project region, but activities in the project region are central to the success of maintaining connectivity between existing populations of kit fox in the middle of the valley and usable grassland habitat along the eastern edge of the valley from San Joaquin to Fresno Counties.

Vernal Pool Ecosystems and Associated Species

The Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005) states that the overall goal for conservation of vernal pool ecosystems and associated species is to:

> Achieve and protect in perpetuity self-sustaining populations throughout the full ecological, geographical, and genetic range of each listed species by ameliorating or eliminating the threats that caused the species to be listed.

The reference to “the full ecological, geographical, and genetic range” clearly enunciates the regional nature of USFWS’s conservation strategy for vernal pool species.

The interim goals for the Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005) are listed below:

- Stabilize and protect populations so further decline in species status and range are prevented.
- Conduct research necessary to refine reclassification (i.e., downlisting) and recovery criteria.
- Reclassify to threatened (i.e., downlist) those taxa currently federally listed as endangered. Reclassification will be appropriate when each taxon is no longer in danger of extinction throughout a significant portion of its range.

Other Special-Status Species

No specific goals and objectives have been developed for the conservation of other special-status species found in eastern Merced County. A habitat conservation plan (HCP), as provided for in the ESA, has not been prepared for the area. The current Merced County General Plan provides for protection of some habitats and species in Goal 1 of its Open Space/Conservation chapter, which states, "Habitats which support rare, endangered, or threatened species are not substantially degraded" (Merced County 1990). While this open space goal does not directly address non-listed species, it does support consideration of wetland and other sensitive habitats in the process of making land use decisions in the county.

Role of UC Merced's Conservation Strategy in Regional Conservation

This Conservation Strategy has been developed in compliance with the USFWS BO (U.S. Fish and Wildlife Service 2002) that addresses a limited amount of land development within a prescribed study area (Figure 1-2). UC Merced's Conservation Strategy provides a framework for conservation efforts in a much broader eastern Merced County region. Other landowners, developers, and agencies may find the conservation strategies and mitigation measures in this document helpful as a guide for future land use changes that might occur within the region but outside the study area.

San Joaquin Kit Fox

Chapters 2 and 5 address UC Merced's actions to offset the effects of implementing the proposed action on lands suitable for kit fox residence and dispersal. While the potential effects of the Proposed Action are confined within the study area shown in Figure 1-2, the proponent's plans for conservation of kit fox habitat extend across the project region (shown in Figure 1-1). The actions being taken by UC Merced and others to establish Conservation Lands are being driven by USFWS's stated desire to treat kit fox survival in the area as a larger regional issue.

Figure 2-3 depicts the relationship between Conservation Lands acquired as a part of the project and the kit fox dispersal corridor described in the Upland Species Recovery Plan (U.S. Fish and Wildlife Service 1998). The location and extent of these conserved lands will clearly benefit the long-term preservation of the sought-after corridor. Land acquisitions and easements completed in support of the Proposed Action or in support of the recovery objectives for San Joaquin kit fox also support development of an open space link between the eastern Merced County grasslands and the Sandy Mush Road corridor that extends west into valley habitat occupied by kit fox.

The following UC Merced actions have contributed to the recovery of San Joaquin kit fox in the project region:

- Implemented project design, construction, and operation measures that avoid or minimize effects on kit fox and its habitat.
- Acquired 9,406 acres of land in fee title that provides suitable residence and dispersal habitat for kit fox and dedicated these lands to conservation management.
- Secured conservation easements for an additional 16,255 acres of large continuous areas of land that provides suitable residence and dispersal habitat.
- Developed a specific management and monitoring plan for lands acquired in fee title and for which easements have been acquired (Airola 2008b) that will maintain and enhance the conservation value of these lands.

The following additional actions will be taken to contribute to recovery:

- Implement the management plan for Conservation Lands, including management and monitoring of UC Merced Conservation Lands using indicators, protocols, and study designs that will allow for successful adaptive management. Conduct research and monitoring to reduce uncertainties affecting successful resource management.

Vernal Pool Ecosystems and Associated Species

Chapters 3 and 5 address the relationship between the Proposed Action and lands that support vernal pool ecosystems and their associated plant and wildlife species. Like the effects on kit fox habitat, the project's effects on vernal pool ecosystems were addressed in the 2002 BO within a defined study area northeast of Merced (Figure 1-2). However, this Conservation Strategy provides for actions with much broader implications for the eastern Merced County region. The Conservation Lands established to date in support of the Proposed Action extend across the region and are focused on properties that support significant areas of wetlands and vernal pools (Figures 1-4 and 3-3a).

The land acquisition program described in this Conservation Strategy supports and advances the goals of the Vernal Pool Recovery Plan (U.S. Fish and Wildlife Service 2005). The lands protected through fee title purchase or the placement of conservation easements represents varied geographic and ecologic conditions for vernal pool species, as discussed in Chapter 3. Large acreages of the Mehrten, Laguna, and Riverbank Formations and North Merced Gravels are included within conserved lands. Smaller acreages of Turlock Lake and Recent Alluvium surfaces also are protected. The management and monitoring components of this Conservation Strategy, as enacted through the MPCL (Airola 2008b) will support the recovery plan goals of refining reclassification and recovery criteria for this sensitive ecosystem.

The following UC Merced actions have contributed to the recovery of vernal pool species in the project region:

- Implemented project siting, design, construction, and operation measures that avoid or minimize effects on vernal pool ecosystems.
- Acquired 9,498 acres of land in fee title and dedicated these lands to conservation management.
- Secured conservation easements over an additional 17,141 acres of large continuous areas of land that support vernal pool ecosystems.
- Conserved in total over 26,000 acres of land that includes all of the major geologic units that have been documented to support vernal pool ecosystems.
- Developed an adaptive management and monitoring program for 26,639 acres of land acquired in fee title by UC Merced that will maintain and enhance the conservation value of these lands.
- Developed the Compensatory Wetland Mitigation and Monitoring Plan to guide future wetland restoration.

The following actions will be taken to contribute to recovery:

- Implement the management plan for UC Merced Conservation Lands using indicators, protocols, and study designs that will allow for successful adaptive management. Conduct research and monitoring to reduce uncertainties affecting successful resource management.
- Implement the Compensatory Wetland Mitigation and Monitoring Plan to ensure restoration of 1 acre of suitable vernal pool and swale habitat for every acre lost.

Other Special-Status Species

Although, the Conservation Strategy is focused on federally listed plant and wildlife species, the actions outlined in this document will clearly benefit other special-status species as well. Preservation of wetland and grassland habitats on Conservation Lands and the avoidance and minimization policies developed to guide future development are beneficial to the long-term conservation of numerous bird and mammal species discussed in Chapter 4. Other special-status species also will likely benefit from the Conservation Strategy's contribution to encouraging a coordinated approach for conserving additional lands for their habitat values across the eastern Merced County region.

Land Acquisition and Protection in the Region

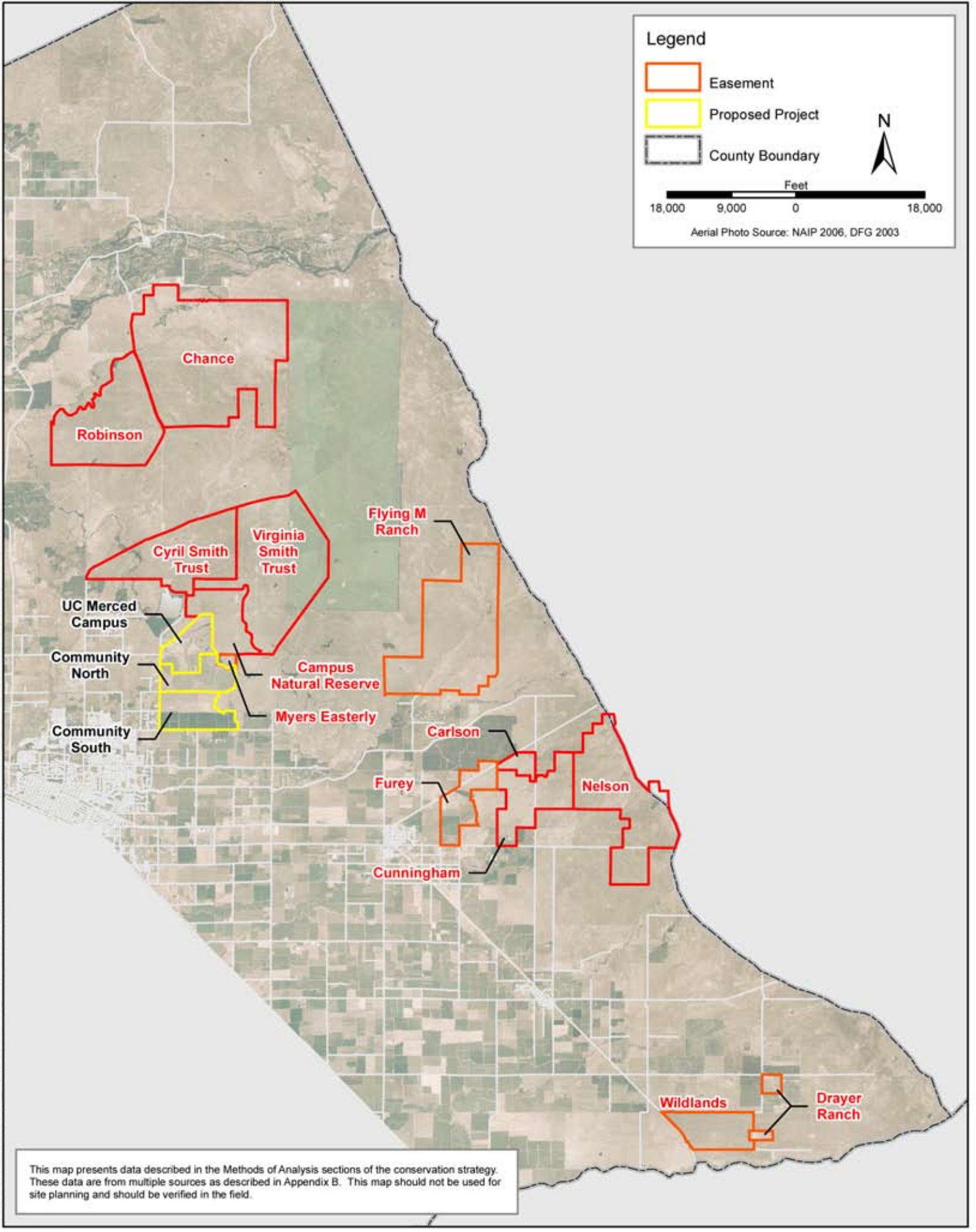
The existing conditions and threats to natural land cover in the project region, along with lands that are currently under some form of protection, are shown in Figure 3-7a. Land conversion for urban and agricultural uses (the brown areas in

Figures 3-7a and b) has been the primary cause of habitat loss in eastern Merced County. These two land uses continue to pose the highest threat of additional land conversion (the dark green areas in Figures 3-7a and b) in the region. These high threats are clustered on the eastern edges of existing development around Merced and Atwater and in the predominantly agricultural areas southeast and northwest of Merced. Land acquisition and protection associated with the project has initiated both a local and a regional (Figure 8-1) program to permanently maintain lands that are critical to the long-term survival of the species that occupy vernal pool wetlands and surrounding grasslands. This program, initiated by UC Merced, should be continued by other entities in eastern Merced County in a manner consistent with the strategies and conservation measures set forth in this Conservation Strategy.

Conservation of natural resource values in the project region should continue through fee title land purchases, development of permanent land protection easements with willing landowners, and enforcement of land use policies and restrictions that limit the encroachment of incompatible land uses in the eastern Merced County grasslands and vernal pool ecosystems. Other programs, such as establishment of agricultural conservation easements, also should be pursued. The policies that guide the management of these conserved lands should allow for adaptive management and monitoring of resources. Such adaptive management would foster better understanding of the conditions that support the sensitive habitats and populations of the area, and allow for adjustments in management practices if warranted. The geographic pattern of additional land conservation efforts should be consistent with the maintenance of a dispersal corridor for San Joaquin kit fox and the protection of large land holdings with significant vernal pool complexes.

Other Management Plans

UC Merced developed the MPCL (Airola 2008b), which is consistent with this Conservation Strategy and will guide ongoing and future land use and management activities, including livestock grazing; integrated pest management; fire protection and management; research, educational, and recreational uses; and protection from unauthorized uses. The plan will allow for adaptive management and monitoring of resources and land use activities in an effort to ensure that ongoing land uses are maintaining and enhancing the long-term natural resource values of the properties. Regional consistency in the goals and specific management prescriptions applied to conserved lands for UC Merced Conservation Lands and other acquired lands will provide greater assurances to the resource agencies (USFWS, DFG) that the regional needs of the species addressed in this Conservation Strategy will be met.



ICF Jones & Stokes

Figure 8-1
Lands Protected From Conversion in the Project Region

Future Actions, Data Collection, and Studies Required for Regional Conservation

Although the actions of UC Merced and the County have initiated a regional conservation program in eastern Merced County, much remains to be accomplished to fully understand and protect the sensitive wildlife and plant species in the area. Regional conservation efforts would be strengthened through the actions listed below:

- Implement adaptive management and monitoring programs for lands set aside for conservation of natural resources.
- Collect information on population size and viability for the species occurrences in protected vernal pool ecosystems of the project region.
- Conduct long-term studies of the effects of livestock grazing on grasslands and vernal pool ecosystems of the project region.
- Further analyze the relationships between geologic formations and the rare or specialized vernal pool plants and animals in the region.
- Establish additional Conservation Lands that protect the Sandy Mush Road corridor and allow San Joaquin kit fox dispersal.
- Establish additional Conservation Lands that include large, contiguous areas of intact vernal pool habitat to preserve the range and status of threatened and endangered vernal pool species in the project region.

This page intentionally left blank.

Chapter 9
References Cited

Printed References

Ahl, J. S. B. 1991. Factors affecting contributions of the tadpole shrimp, *Lepidurus packardi*, to its oversummering egg reserves. *Hydrobiologia* 212: 137–143.

Airola, D.A. 2008a. *Supplement to Biological Assessment for the University of California, Merced Campus and University Community North.* September. (ICF J&S 05650.05). Sacramento, CA. Prepared for University of California, Merced, Physical Planning, Design and Construction Office, Merced, CA.

Airola, D. A. 2008b. *Management Plan for Conservation Lands and Adjacent Campus Buildout Lands for the University of California, Merced*. July. Prepared for University of California Merced Physical Planning, Design and Construction Office, Merced, CA. Sacramento, CA.

Alexander, D. G., and R. Schlising. 1997. *Vernal Pool Ecology and Vernal Pool Landscape Management as Illustrated by Rare Macroinvertebrates and Vascular Plants at Vina Plains Preserve, Tehama County, California.* Report to the California Department of Fish and Game. Redding, CA. 193 pages.

Alvarez, J. A. 2004. Overwintering larvae in the California tiger salamander (*Ambystoma californiense*). *Herpetological Review* 35:344.

American Ornithologists' Union. 1983. *Checklist of North American Birds.* 6th edition. Lawrence, KS: Allen Press.

Anderson, P. R. 1968. The reproductive and developmental history of the California tiger salamander. M.A. thesis. Fresno State College. Fresno, CA.

Atsatt, P. R., and D. R. Strong. 1970. The population biology of annual grassland hemiparasites. I. The host environment. *Evolution* 24:278–291.

Bainbridge, S. 2002. San Joaquin and adjacent Sierra Foothills vernal pool geomorphic classification and conservation prioritization. Submitted by Jepson Herbarium to Region 4 and Habitat Conservation Branch. Department of Fish and Game. Fresno, CA.

Baldwin, K. S., and R. A. Stanford. 1987. Life History notes: *Ambystoma tigrinum californiense* predation. *Herpetological Review* 18(2):33.

Barry, S. J., and H. B. Shaffer. 1994. The status of the California tiger salamander (*Ambystoma californiense*) at Lagunita: a 50-year update. *Journal of Herpetology* 24(2); 159–164.

Beedy, E. C., and W. J. Hamilton, III. 1997. *Tricolored Blackbird Status Update and Management Guidelines*. (Jones & Stokes Associates 97-099). Sacramento, CA. Prepared for U.S. Fish and Wildlife Service, Migratory Birds and Habitat Programs and California Department of Fish and Game, Bird and Mammal Conservation Program. Portland, OR, and Sacramento, CA.

Belk, D., and M. Fugate. 2000. Two new *Branchinecta* (*Crusteaca Anostraca*) from the southwestern United States. *The Southwestern Naturalist* 45: 111–117.

Berry, W. H., J. H. Scrivner, T. P. O'Farrell, C. E. Harris, T. T. Kato, and P. M. McCue. 1987. *Sources and Rates of Mortality of the San Joaquin Kit Fox, Naval Petroleum Reserve #1, Kern County, CA, 1980–1986.* (Rep. No. EGG 10282-2154). Goleta, CA: EG&G Energy Measurements.

Brendonck, L. 1996. Diapause, quiescence, hatching requirements—what we can learn from large freshwater branchiopods (Crustacea, Branchiopoda, Anostraca, Notostraca, Conchostraca). *Hydrobiologia* 320(1–2): 85–97

Burt, W. H., and R. P. Grossenheider. 1980. *Peterson Field Guide: Mammals.* 3rd edition. Boston, MA: Houghton Mifflin Co.

California Department of Fish and Game. 1978a. Bird species of special concern in California, golden eagle. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/hcpb/cgi-bin/read_one.asp?specy=birds&idNum=35>. Accessed: October 20, 2006.

California Department of Fish and Game. 1978b. Bird species of special concern in California, short-eared owl. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/hcpb/cgi-bin/read_one .asp?specy=birds&idNum=70>. Accessed: October 25, 2006.

California Department of Fish and Game. 1978c. Bird species of special concern in California, burrowing owl. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/hcpb/cgi-bin/read_one .asp?specy=birds&idNum=65>. Accessed: October 25, 2006.

California Department of Fish and Game. 1986. Mammalian species of special concern in California, American badger. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/hcpb/cgi-bin/read_one .asp?specy=mammals&idNum=74>. Accessed: October 24, 2006.

California Department of Fish and Game. 1994a. Amphibian and reptile Species of Special Concern in California, western spadefoot. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/ hcpb/cgi-bin/read_one.asp?specy=reptiles&idNum=75>. Accessed: October 17, 2006.

California Department of Fish and Game. 1994b. Amphibian and reptile species of special concern in California, western pond turtle. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/ hcpb/cgi-bin/read_one.asp?specy=reptiles&idNum=8>. Accessed: October 7, 2006.

California Department of Fish and Game. 1994c. Amphibian and reptile species of special concern in California, California horned lizard. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/ hcpb/cgi-bin/read_one.asp?specy=reptiles&idNum=15>. Accessed: October 27, 2006.

California Department of Fish and Game. 1995. *Staff Report on Burrowing Owl Mitigation.* Sacramento, CA.

California Department of Fish and Game. 2000a. The status of rare, threatened, and endangered animals and plants in California, Swainson's hawk. Habitat Conservation Planning Branch. Available: <http://www.dfg.ca.gov/hcpb/ cgi-bin/read_one.asp?specy= birds&idNum=33>. Accessed: October 27, 2006.

California Department of Fish and Game. 2000b. *Grassland Bird Conservation Plan.* California Partners in Flight.

California Department of Fish and Game. 2008. Special animals list. Available: <http://www.dfg.ca.gov/biogeodata/cnddb/pdfs/SPAnimals.pdf>. Updated February 2008.

California Department of Water Resources. 2001. California Department of Water Resources, Division of Planning and Local Assistance, land use data. Revised: December 27, 2001. Available: <http://www.waterplan.water .ca.gov/landwateruse/landuse/ludataindex.htm>

California Native Plant Society. 2001. *California Native Plant Society Inventory of Rare and Endangered vascular Plants of California.* 6th edition. Sacramento, CA: California Native Plant Society Press.

California Natural Diversity Database. 2008. RareFind 3, Version 3.0.3 (February 2, 2008). Search of eastern Merced County. Sacramento, CA: California Department of Fish and Game.

Chuang, T. I., and L. R. Heckard. 1991. Generic realignment and synopsis of subtribe Castillejinae (Scrophulariaceae—Tribe Pediculareae). *Systematic Botany* 16:644–666.

CNPS. See California Native Plant Society.

Crampton, B. 1976. Rare grasses in a vanishing habitat. *Fremontia* 4(3):22–23.

Day, A. G. 1993. Navaretia. Page 848 in J. C. Hickman (ed.), *The Jepson Manual: Higher Plants of California*. Berkeley, CA: University of California Press.

Dittes, J. C., and J. L. Guardino. 2002. Rare plants. Pages 55–150 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

EIP. See EIP Associates.

EIP Associates. 1993. *Draft Habitat Conservation Plan San Joaquin Kit Fox western San Joaquin County.* Preliminary Draft. June 25. Prepared for San Joaquin County Community Development Department. San Francisco, CA: EIP Associates.

EIP Associates. 1999a. *UC Merced/University Community Plan Area Federally-Listed Vernal Pool Crustaceans 1998/1999 Wet Season Survey Report.* September. (10255-00.MB.) Prepared for University of California and Merced County. Sacramento, CA.

EIP Associates. 1999b. *UC Merced/University Community Plan area 1999 Special-Status Plant Survey Report.* October. (10-255-01.MB.) Prepared for University of California and Merced County. Sacramento, CA.

EIP Associates. 2000. *UC Merced/University Community Plan area draft wetland delineation report.* Prepared for the University of California and Merced County. Sacramento, CA.

EIP Associates. 2001a. *County of Merced University Community Plan – A Plan for a Sustainable and Livable Community.* Draft. August. Prepared for Merced County. Sacramento, CA.

EIP Associates. 2001b. *County of Merced University Community Plan Draft Environmental Impact report.* August. Prepared for County of Merced. Sacramento, CA.

EIP Associates. 2001c. *UC Merced/University Community Plan Area Federally-Listed Vernal Pool Crustaceans 1999/2000 Wet Season Survey Report.* January. (10345-04.mb.) Prepared for University of California and Merced County. Sacramento, CA.

EIP Associates. 2001d. *University Community Plan Area 2001 Special-Status Mammals Survey Report.* August. Prepared for Merced County. Sacramento, CA.

EIP Associates. 2001e. *UC Merced Phase 1 and University Community Plan Areas California Tiger Salamander Year 2001 Standard Aquatic Survey Report.* August. Prepared for University of California and Merced County. Sacramento, CA.

EIP Associates. 2001f. *UC Merced/University Community Plan 2001 special-status plant survey report.* August. (10300-13.JH.) Prepared for University of California and Merced County. Sacramento, CA.

EIP Associates. 2002a. *Biological Assessment CWA Section 404 Permit Applications for UC Merced Campus Project and County of Merced Infrastructure in support of UC Merced Project.* February 8. (10300-11.bb.) Prepared for University of California, Merced and County of Merced Public Works Department. Sacramento, CA.

EIP Associates. 2002b. *County of Merced Infrastructure Project in Support of UC Merced Project Habitat Mitigation Plan.* Prepared for University of California, Merced and County of Merced Public Works Department. February 8. Sacramento, CA.

EIP Associates. 2004a. *County of Merced University Community Plan final environmental impact report.* November 2004. Prepared for County of Merced. Sacramento, CA.

EIP Associates. 2004b. *County of Merced University Community Plan.* December. Prepared for Merced County. Sacramento, CA.

Eng, L. L., D. Belk and C. H. Eriksen. 1990. Californian Anostraca: distribution, habitat, and status. *Journal of Crustacean Biology* 10:247–277.

Erickson, R. A. 2008. Oregon vesper sparrow (*Pooecetes gramineus affinis*). Pages 377–381 in W. D. Shuford and T. Gardali (eds.), *California Bird Species of Special Concern: A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California.* Camarillo, CA: Western Field Ornithologists and Sacramento, CA: California Department of Fish and Game.

Eriksen, C. H., and D. Belk. 1999. *Fairy Shrimps of California's Puddles, Pools, and Playas.* Eureka, CA: Mad River Press.

Eriksen, C. H., and R. J. Brown. 1980. Comparative respiratory physiology and ecology of phyllopod crustacean. II. Anostraca. *Crustaceana* 39:11–21.

Feaver, P. E. 1971. Breeding pool selection and larval mortality of three California amphibians: *Ambystoma tigrinum californiense* (Gray), Hyla regilla (Baird and Girard), and *Scaphiopus hammondi hammondi* (Girard). M.A. thesis, Fresno State College. Fresno, CA.

Gallagher, S. P. 1996. Seasonal occurrence and habitat characteristics of some vernal pool branchiopoda in Northern California, U.S.A. *Journal of Crustacean Biology* 16: 323–329.

Gibson & Skordal. 2005. *Compensatory Wetland Mitigation and Monitoring Plan*. Prepared for University of California Merced. February. Sacramento, CA.

Griggs, F.T. 1974. Systematics and ecology of the Genus Orcuttia (Gramineae). M.A. thesis, Botany Department, California State University, Chico, CA. Quoted in Stone et al. 1988.

Griggs, F. T. 1980. *Population studies in the genus* Orcuttia *(Poaceae).* Ph.D. dissertation. University of California. Davis, CA. 98 pages.

Griggs, F. T. 1981. Life histories of vernal pool annual grasses. *Fremontia* 9(1): 14–17.

Griggs, F. T., and S. K. Jain. 1983. Conservation of vernal pool plants in California. II. Population biology of rare and unique grass genus *Orcuttia*. *Biological Conservation* 27:171–193.

Hall, F. A. 1983. Status of the San Joaquin kit fox, *Vulpes macrotis mutica*, at the Bethany wind turbine generating site, Alameda County, California; unpublished report. Sacramento, CA: California Dept. Fish and Game.

Hathaway, S. A., and M. A. Simovich. 1996. Factors affecting the distribution and co-occurrence of two southern California Anostracans (Branchiopoda), *Branchinecta Sandiegonensis* and *Streptocephalus Woottoni*. *Journal of Crustacean Biology* 16(4): 669–677.

Heckard, L. R. 1977. *Rare Plant Status Report:* Orthocarpus succulentus *(Hoover) Hoover*. California Native Plant Society. Sacramento, CA. 3 pages.

Helm, B. 1998. *Biogeography of eight large branchiopods endemic to California.* Pages 124–139 in C.W. Witham, E. T. Bauder, D. Belk, W. R. Ferren, Jr., and R. Ornduf (eds.), *Ecology, conservation, and management of vernal pool ecosystems—proceedings from a 1996 conference*. Sacramento, CA: California Native Plant Society. 285 pages.

Helm, B. P. and J. E. Vollmar. 2002. Large Branchiopods. Pages 151–190 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Hickman, J. C. (ed.). 1993. *The Jepson Manual: Higher Plants of California.* Berkeley, CA: University of California Press.

Holland, R. F. 1987. What constitutes a good year for an annual plant? Two examples from the Orcuttieae. Pages 329–333 in T.S. Elias (ed.), *Conservation and management of rare and endangered plants*. Sacramento, CA: California Native Plant Society. 630 pages.

Holland, R. F. 1998. *No net loss? Changes in Great Valley Vernal Pool Distribution from 1989 to 1997.* Sacramento, CA: California Department of Fish and Game, Natural Heritage Division. 16 pages.

Hoover, R. F. 1941. The genus *Orcuttia*. *Bulletin of the Torrey Botanical Club* 68: 149–156.

Horne, F. 1967. Effects of physical-chemical factors on the distribution and occurrence of some southeastern Wyoming phyllopods. *Ecology* 48(3): 472–477.

Jennings, M. R., and M. P. Hayes. 1994. *Amphibian and reptile species of special concern in California.* California Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, CA.

Johnson, D. E. 1978. Systematics of Eriophyllinae (Compositae). Ph.D. dissertation, University of California, Berkeley. Berkeley, CA.

Johnson, D. E. 1993. *Pseudobahia*. Pages 328–329 in J. C. Hickman (ed.), *The Jepson Manual: Higher Plants of California.* Berkeley, CA: University of California Press.

Jones & Stokes. 2002a. *Supplement to the biological assessment for the UC Merced Campus Project.* (J&S 01-549.) Prepared for University of California, Merced, and the County of Merced Department of Public Works. Sacramento, CA.

Jones & Stokes. 2002b. *Resource Mitigation Plan for Federally Listed Species that May Be Affected by the Establishment of the University of California, Merced*. February. (J&S 01-549.) Prepared for the University of California, Merced. Sacramento, CA.

Jones & Stokes. 2003. *University of California Merced Campus, Phase 1 Construction – Environmental Mitigation Monitoring.* Letter report to Cay Goude, U.S. Fish and Wildlife Service. Sacramento, CA. April 24.

Keeley, J. E. 1998. C_4 photosynthetic medications in the evolutionary transition from land to water in aquatic grasses. *Oecologia* 116:85–97.

King, J. L., M. A. Simovich, and R. C. Brusca. 1996. Species richness, endemism and ecology of crustacean assemblages in northern California vernal pools. *Hydrobiologia* 328: 85–116.

Koopman, M.E., B. L. Cypher, and J. H. Scrivner. 2000. Dispersal patterns of San Joaquin kit foxes. *Journal of Mammalogy* 81(1):213–222.

Laabs, D. M., and M. L. Allaback. 2002. Small Mammals. Pages 313–336 in *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Laabs, D. M., S. G. Orloff, and M. L. Allaback. 2002. Pond and Stream-Breeding Amphibians. Pages 191–230 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Longhurst, A. R. 1955. A Review of the Notostraca. *Bulletin of the British Museum (Natural History)* 3(1):1–57.

Loredo, I., and D. Van Vuren. 1996. Reproductive ecology of a population of the California tiger salamander. *Copeia* 1996:895–901.

Loredo, I., D. Van Vuren, and M. L. Morrison. 1996. Habitat use and migration behavior of the California tiger salamander. *Journal of Herpetology* 30(2):282–285.

Lynch, J. E. 1972. *Lepidurus couesii* Packard (Notostraca) redescription with a discussion of specific characters in the genus. *Crustaceana* 23:43–49.

Marty, J. T. 2005. Effects of cattle grazing on diversity in ephemeral wetlands. *Conservation Biology* 19:1626–1630.

Merced County. 1990. *Year 2000 General Plan.* Adopted by the Board of Supervisors December 4, 1990. Merced, CA.

Montanucci, R. R. 1970. Analysis of hybridization between *Crotaphytus wislizenii* and *Crotaphytus silus* (Sauria: Iguanidae) in California. *Copeia* 1970:104–123.

Ness, B. D. 1993. *Fritillaria.* Page 1195 in J. C. Hickman (ed.), *The Jepson Manual: Higher Plants of California*. Berkeley, CA: University of California Press.

Noss, R. et al. 2002. *Report of Science Advisors for the Eastern Merced County Natural Community Conservation Plan Habitat Conservation Plan.* Part I. November. Prepared for the County of Merced. Merced, CA.

Orloff, S. G. 2002a. *Aquatic Reptiles.* Pages 233–252 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Orloff, S. G. 2002b. *Medium to Large Animals.* Pages 337–384 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Orloff, S., F. Hall, and L. Spiegel. 1986. Distribution and habitat requirements of the San Joaquin kit fox in the northern extreme of their range. *Transactions of the Western Section of the Wildlife Society* 22:60–70.

Pierson, E. D. and W. E. Rainey. 2002. *Bats.* Pages 385–400 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Platenkamp, G. A. 1998. *Patterns of vernal pool biodiversity at Beale Air Force Base.* Pages 151–160 in C.W. Witham, E.T. Bauder, D. Belk, W.R. Ferren, Jr., and R. Ornduff (eds.), Ecology, conservation, and management of vernal pool ecosystems - proceedings from a 1996 conference. Sacramento, CA: California Native Plant Society.

Preston, R. E., and M. S. Park. No date. *Eryngium.* (submitted). B. G. Baldwin et al. (eds.) *The Jepson Manual: Higher Plants of California, Second edition*. University of California Press. Berkeley, CA.

Reeder, J. R. 1965. The tribe Orcuttieae and the subtribes of the Pappophoreae (Gramineae). *Madroño* 18:18–28.

Reeder, J. R. 1982. Systematics of the tribe Orcuttieae (Gramineae) and the description of a new segregate genus, *Tuctoria. American Journal of Botany* 69:1082–1095.

Reese, E. A., T. T. Kato, W. H. Berry, and T. P. O'Farrell. 1992. Ground Penetrating Radar and Thermal Images Applied to San Joaquin Kit Fox (*Vulpes macrotis mutica*) at Camp Roberts Army National Guard Training Site, CA. (U.S. Dept. of Energy Topical Report, EG&G/EM Santa Barbara Operations No. EGG 10617-2162.) Springfield, VA: National Technical Service.

Robins, J. D., and J. E. Vollmar. 2002. Livestock grazing and vernal pools. Pages 401–430 in J .E. Vollmar (ed.), *Wildlife and rare plant ecology of eastern Merced County's vernal pool grasslands.* Berkeley, CA: Vollmar Consulting.

Rogers, C. 2001. Revision of the Nearctic *Lepidurus* (Notostraca). *Journal of Crustacean Biology* 21(4): 991–1006.

Shaffer, H. B., R. N. Fisher, and S. E. Stanley. 1993. *Status Report: The California tiger salamander (*Ambystoma californiense*).* Final report to the California Department of Fish and Game, Inland Fisheries Division. (Contracts FG 9422 and FG 1383). Rancho Cordova, CA.

Shuford, W. D., and T. Gardali (eds.). 2008. *California Bird Species of Special Concern: A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California.* Camarillo, CA: Western Field Ornithologists and Sacramento, CA: California Department of Fish and Game.

Stebbins, R. C. 1959. *Reptiles and Amphibians of the San Francisco Bay Region.* Berkeley and Los Angeles: University of California Press. 72 pp.

Stebbins, R. C. 1985. *A Field Guide to Western Amphibians and Reptiles*. 2nd edition. Houghton Mifflin Company. New York, NY.

Stebbins, J. C. 1991. *Status Survey of* Pseudobahia bahiifolia and Pseudobahia peirsonii *(Asteraceae) in the San Joaquin Valley, California.* Report to the U.S. Fish and Wildlife Service. Sacramento, CA. 88 pages.

Stebbins, R. C. 2003. W*estern Reptiles and Amphibians.* 3*rd* edition. Houghton, Mifflin Co. Boston, MA.

Stone, R. D., W. B. Davilla, D. W. Taylor, G. L. Clifton, and J. C. Stebbins. 1988. *Status Survey of the Grass Tribe* Orcuttieae *and* Chamaesyce hooveri *(Euphorbiaceae) in the Central Valley of California.* 2 volumes. U.S. Fish and Wildlife Service Technical Report. Sacramento, CA. 124 pp.

Storer, T. I. 1925. A synopsis of the Amphibia of California. *University of California Publications in Zoology* 27:1–342.

Twitty, V. C. 1941. Data on the life history of *Ambystoma tigrinum. Copeia* 1 (March 1941):1–4.

UC Merced. See University of California, Merced.

Unitt, P. 2008. Grasshopper sparrow (*Ammodramus savannarum).* Pages 393–399 in W. D. Shuford and T. Gardali (eds.), *California Bird Species of Special Concern: A Ranked Assessment of Species, Subspecies, and Distinct Populations of Birds of Immediate Conservation Concern in California.* Camarillo, CA: Western Field Ornithologists and Sacramento, CA: California Department of Fish and Game.

University of California, Merced. 2001. *Public Draft Long Range Development Plan.* August 4. Merced, CA.

University of California, Merced. 2002. *Long Range Development Plan.* January 17. Merced, CA

URS. See URS Corporation.

URS Corporation. 1999. *Special Status Branchiopod Wet Season Survey Report, Campus Parkway Project.* November. Merced, CA.

URS Corporation. 2000. *Special Status Branchiopod 1999–2000 Wet Season Survey Report, Campus Parkway Project.* November. Merced, CA.

URS Corporation. 2001a. *Long Range Development Plan Draft Environmental Impact Report*. Prepared for University of California at Merced, and County of Merced. Merced, CA.

URS Corporation. 2001b. *Natural Environment Study/Biological Assessment; Merced Campus Parkway.* Prepared for Merced County Department of Public Works and Caltrans. District 10. April. Merced, CA.

URS Corporation. 2002a. *Long Range Development Plan Final Environmental Impact Report.* (SCH No. 2001021065.) Prepared for University of California at Merced and County of Merced. August. Merced, CA.

URS Corporation. 2002b. *LRDP Environmental Impact Report, Mitigation Monitoring and Reporting Program*. (Table 1 in the Long Range Development Plan Final Environmental Impact Report.) Prepared for University of California Merced and County of Merced. August. Merced, CA.

USFWS. See U.S. Fish and Wildlife Service.

U.S. Fish and Wildlife Service. 1983. *The San Joaquin Kit Fox Recovery Plan.* Portland, OR.

U.S. Fish and Wildlife Service. 1984. *Valley Elderberry Longhorn Beetle Recovery Plan.* Portland, OR.

U.S. Fish and Wildlife Service. 1998. *Recovery Plan for Upland Species of the San Joaquin Valley, California.* Region 1. Portland, OR. 319pp.

U.S. Fish and Wildlife Service. 1999. *Standardized Recommendations for Protection of the San Joaquin Kit Fox prior to or during Ground Disturbance.* June. Prepared by the Sacramento U.S. Fish and Wildlife Service Office. Sacramento, CA.

U.S. Fish and Wildlife Service. 2002. *Final Biological Opinion on the Proposed University of California Merced Campus, Phase 1 and Campus Buildout.* August 19. (1-1-02-I-2926.) Sacramento, CA. 192 pages.

U.S. Fish and Wildlife Service. 2003. *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander*. October.

U.S. Fish and Wildlife Service. 2005. *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon.* Portland, OR.

U.S. Fish and Wildlife Service. 2006a. List of endangered and threatened species that may occur in or be affected by projects in Merced County. Available: <http://sacramento.fws.gov/es/spp_list.htm>. Accessed: October 5, 2006.

U.S. Fish and Wildlife Service. 2006b. Sacramento Fish and Wildlife Office species account for giant garter snake (*Thamnophis gigas*). Available: <http://www.fws.gov/sacramento/es/animal_spp_acct/giant_garter_snake .htm>. Accessed: October 17, 2006.

Vollmar, J. E. (ed.). 2002. *Wildlife and Rare Plant Ecology of Eastern Merced County's Vernal Pool Grasslands.* Berkeley, CA: Vollmar Consulting.

Vollmar Consulting. 2008. *Special Status Species Survey Report, 2007 and 2008 Field Seasons: Robinson Ranch Conservation Easement Property, Northeastern Merced County, California.* May. Berkeley, CA: Vollmar Consulting. Prepared for University of California, Merced.

Warrick, G. D., and B. L. Cypher. 1998. Factors affecting the spatial distribution of San Joaquin kit foxes. *The Journal of Wildlife Management* 62(22):707–717.

Wetherwax, M. 1993. Fritillaria. Page 1033 in J. C. Hickman (ed.), *The Jepson Manual: Higher Plants of California*. Berkeley, CA: University of California Press.

Wheeler, L. C. 1941. Euphrobia subgenus Chamaesyce in Canada and the United States exclusive of Florida. *Rhodora* 43:97–154, 168–05, 223–86.

Zeiner, D. C., F. Laudenslayer, K. E. Mayer, and M. White. 1988. *Amphibians and reptiles.* Volume I of *California Wildlife.* Sacramento, CA: California Department of Fish and Game.

Zeiner, D. C., F. Laudenslayer, K. E. Mayer, and M. White. 1990a. *Birds.* Volume II of *California Wildlife.* Sacramento, CA: California Department of Fish and Game.

Zeiner, D. C., F. Laudenslayer, K. E. Mayer, and M. White. 1990b. *Mammals.* Volume III of *California Wildlife*. Sacramento, CA: California Department of Fish and Game.

Personal Communications

Goude, Cay. Assistant field supervisor. U.S. Fish and Wildlife Service, Sacramento Office. September 27, 2006—meeting.

Jones, Susan. San Joaquin Valley branch chief. U.S. Fish and Wildlife Service, Sacramento Office. January 3, 2007—meeting.

Glossary

2002 Proposed Project. One of two alternatives proposed by UC Merced in 2002, the *2002 Proposed Project* consisted of a campus, infrastructure project, and university community. This alternative was reviewed in the 2004 Clean Water Act Section 404b(1) Alternatives Analysis for the UC Merced Campus and Community North (see Alternative 6 below).

404 project. The *404 project*, also referred to as the University's Proposed Project, is that portion of the Proposed Action addressed in the revised Department of the Army permit application—the approximately 815-acre UC Merced Campus and 833-acre University Community North.

Adaptive management. *Adaptive management* is an approach to natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies and incorporating new knowledge into management approaches based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices (definition taken from http://waterusgs.gov/owq/cleanwater/ufp/glossary.html).

Adjacent campus buildout. The portion of the 2008 *campus buildout* that is located adjacent to the Conservation Lands, and is subject to the management activities contemplated in the *Management Plan for Conservation Lands and Adjacent Campus Buildout Lands for the University of California, Merced*.

Alternative 6 (2002 Proposed Project). *Alternative 6* consists of a 2,000-acre UC Merced Campus located in eastern Merced County. This alternative site is generally east and south of Yosemite Lake and bounded by Lake Road on the west and Yosemite Avenue on the south. The Fairfield Canal forms a portion of the site's eastern boundary. The UC Merced Campus would include a 910-acre Main Campus, a 340-acre Campus Land Reserve, and a 750-acre Campus Natural Reserve. The 910-acre Main Campus would consist of an approximately 157-acre academic core, 23 acres of student support services, 250 acres of student housing, 90 acres of faculty housing, 56 acres of campus support, 39 acres of on-campus research, 148 acres of athletics and recreation, and 147 acres of parking. The 340-acre Campus Land Reserve would remain undeveloped and available to meet potential future needs for the campus. The 750-acre Campus Natural Reserve would remain in an undeveloped state and be dedicated to conservation and limited controlled research and educational activities.

This alternative includes an approximately 2,133-acre University Community adjacent to and in support of the UC Merced Campus. The community would be

located directly south of the campus and would include development of a mixed-use town center comprising retail, office, entertainment, civic, cultural, and residential uses. The University Community also would consist of residential villages with a mix of housing types and varying densities, a research park, community services and local retail, schools, recreation and park space, and a system of open space amenities. The community would be sized to accommodate the growth that will be generated by the campus and would also include basic roadway and utility infrastructure necessary to support development of the campus.

This alternative is identified as Alternative 4 in the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report and as Supplemental On-Site Alternative 3 in the Supplemental 404(b)(1) Alternatives Analysis.

Bellevue Ranch Alternative. Formerly referred to as "Off-Site Alternative 2," the *Bellevue Ranch Alternative* is located primarily on land commonly identified as the Bellevue Ranch north of the city of Merced's urban boundary. The campus portion of the site is generally bounded by Nevada Street on the north, G Street on the east, and Bellevue Road on the south. The western boundary is approximately one-quarter mile east of State Route 59. The community portion of the site is located immediately to the west and south of the proposed campus and is generally bounded by State Route 59 on the west, Cardella Road on the south, and G Street on the east. This alternative would encompass a campus area of approximately 711acres and an associated community area of approximately 2,000 acres. The site would be located approximately 1.5 miles from the Phase I campus.

This alternative is identified as Alternative 2 in the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report and as Supplemental On-Site Alternative 4 in the Supplemental 404(b)(1) Alternatives Analysis.

Buffer. The area surrounding developed lands, converted lands, or proposed project footprint that may be indirectly disturbed by human use.

Buffer distance. The *buffer distance* is the distance from areas of disturbance (e.g., roads, developed uses) at which degradation may occur. In the context of the Conservation Strategy and the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report, the buffer distance used for mapping land status and degradation to species habitat was 200 meters. In the context of the functional assessment, it was assumed that wetland functions within 500 meters of disturbances could be affected to varying degrees.

Campus buildout. The *campus buildout* is the portion of the UC Merced Campus that is not included in the Phase 1 Campus area. This area is defined based on the Proposed Action and the existing Phase 1 Campus area as of March 2008. Note: the Phase 1 Campus area and the campus buildout are included in the University's Proposed Project.

Campus Land Reserve. A 340-acre area identified in the 2002 Proposed Project that adjoined the east and north sides of the UC Merced Campus between the campus and the Campus Natural Reserve. The former Campus Land Reserve is now part of the Campus Natural Reserve, which is to be protected and managed as Conservation Lands.

Campus Natural Reserve. A 1,307-acre area dedicated to open space, conservation, scientific research, and related uses. This area lies between the UC Merced Campus and the Virginia Smith Trust Preserve. The current Campus Natural Reserve includes all lands formerly designated as Campus Natural Reserve, lands formerly referred to as Campus Land Reserve, and portions of the 2002 Proposed Project that were removed from the UC Merced Campus during the reconfiguration of the campus and University Community in 2007.

Community North. The northern 833 acres of the University Community adjacent to the UC Merced Campus. These lands are owned by the University Community Land Company **(**partnership between the University of California and the Virginia Smith Trust) and are included within the 404 project as described in the Clean Water Act Section 404 permit application.

Community South. The southern 1,118-acre portion of the University Community. These lands are owned by LWH Farms LLC.

Compliance monitoring. Monitoring activities conducted on conserved lands to ensure that easement conditions or other management restrictions are being met.

Conservation easement. An encumbrance placed on a property to preclude development. Typically, conservation easements allow current land uses to continue and specify uses that are unacceptable; specific conditions are normally negotiated between the landowner and the purchaser of the easement.

Conservation Lands. Lands acquired and preserved to mitigate impacts associated with construction of the proposed project. Conservation Lands comprise both Tier 1 and Tier 2 properties.

Cyril Smith Trust lands. The westernmost of the Tier 1 properties. The Cyril Smith Trust lands are owned and managed by The Nature Conservancy.

Critical habitat. *Critical habitat* is designated by U.S. Fish and Wildlife Service pursuant to the federal Endangered Species Act in rulings published in the Federal Register. It is habitat that has been determined to be essential to the survival and recovery of federally listed species.

Disturbance Index. The *Disturbance Index* is a relative rating of the degree to which anthropogenic disturbances can reduce the collective functions of certain types of wetlands (vernal pools, swale wetlands and clay slope wetlands) used as a basis for functional assessment.

Documented occupied habitat. Suitable habitat for a target species where individuals or populations have been reliably documented to occur. In the

context of vernal pool species, *documented occupied habitat* is all suitable habitat that occurs within 200 meters of a documented species observation.

Downtown Merced Alternative. The *Downtown Merced Alternative* site is located in downtown Merced. The campus portion of the site generally straddles State Route 99 from Thornton Road on the west to the intersection of State Route 99 and Childs Avenue on the east. The width of the campus is approximately one-quarter mile on either side of State Route 99, the northern and southern boundaries of which are generally 16th Street and 11th Street, respectively. The community portion of the site consists of existing commercial, public, and residential uses surrounding the proposed campus within downtown Merced and is generally bounded by Olive Avenue on the north, McKee Road on the east, Childs Avenue on the south, and Thornton Road and Highway 59 on the west.

For purposes of the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report, this alternative is not being considered for analysis. This alternative is identified as Supplemental Off-Site Alternative 2 in the Supplemental 404(b)(1) Alternatives Analysis.

Fairy shrimp. Crustaceans of the Order Anostraca. Includes vernal pool fairy shrimp, midvalley fairy shrimp, Conservancy fairy shrimp, and California linderiella.

Fee title acquisition. Outright purchase of property in all its rights.

Functional assessment. *Functional assessment* is an evaluation of the capacity of a wetland or group of wetlands to perform certain biological, chemical and physical functions relative to other wetlands or the same type.

Functional Capacity Index. The *Functional Capacity Index* is a numerical expression of the expected relative ability of a given wetland to perform a collective suite of functions.

Functional Capacity Units. *Functional Capacity Units* are the product of a given wetland's *Functional Capacity Index* times its area.

Geographic information system. The *geographic information system* is a system of digital geographic data management that allows multiple attributes to be compiled and analyzed in a system of layers. It is central to mapping such characteristics as habitat suitability, land cover, and foreseeable future conditions such as zoning or proposed development; accordingly, it is an invaluable tool for large-scale and long-term resource management planning.

Hydrogeomorphic Model. The *Hydrogeomorphic Model* is a wetland classification system that is based on geomorphic setting, water source, and hydrodynamics.

Incidental take authorization. Authorization issued by the U.S. Fish and Wildlife Service to allow for *take* of a federally listed species incidental to otherwise lawful activities.

Infrastructure Project. A system of facilities and roadways to support the main campus and to connect the UC Merced Campus to the University Community as proposed in 2002. The former infrastructure project has been incorporated into the Proposed Action.

Invasive species. *Invasive species* are plants or animals that, upon introduction to an area where they do not naturally occur, are likely to become established and supplant native species. These species are of concern to land managers because they can disrupt ecosystems, outcompete native species, cause economic damage, and impair biodiversity.

Jurisdictional wetlands. Wetlands (e.g., vernal pools) subject to regulation by the U.S. Army Corps of Engineers under Section 404 of the federal Clean Water Act.

Land cover. A term used in mapping to denote a particular type of vegetation or other surficial characteristic (e.g., developed land).

Land status. In the context of this Conservation Strategy, *land status* is defined as either *converted*, *potentially degraded*, or *presumably intact*. These categories are defined in Chapter 3, *Vernal Pool Ecosystems and Associated Special-Status Species in the Project Region*. Land status is used in concert with level of threat to inform the long-term regional planning process.

Level of threat. *Level of threat* is a measure of potential for future harm assessed on the basis of current land use, zoning, and the existence of conservation easements. Level of threat is used in concert with land status to inform the long-term regional planning process.

Linkage corridor. A corridor to be established or maintained between existing areas of occupied or suitable habitat. In the context of this Conservation Strategy, linkage corridors are part of evaluating, acquiring, and conserving habitat for San Joaquin kit fox.

Long-Range Development Plan. The planning document describing the development of the UC Merced Campus and the associated Campus Land Reserve and Campus Natural Reserve. A final Environmental Impact Report for the Long-Range Development Plan for the 2002 Proposed Project was certified on January 17, 2002. The 2002 development plan would be amended as part of the Proposed Action.

Metadata. Metadata describe the data summarized in reports, maps, or computer files (e.g., data collection methods, units of measurement for recorded values). Such information is necessary to maximize the utility of a dataset, as well as to ensure continuity in ongoing data collection such that results of monitoring are meaningful.

Myers Easterly. A 91-acre site that was originally proposed for use in creating vernal pools to offset habitat losses resulting from the unpermitted construction of the Merced Hills Golf Club, which occurred prior to University Community

Land Company ownership. The Merced Hills Golf Club site was used for construction of the Phase 1 Campus. Myers Easterly, a Tier 1 Property, is owned by the University Community Land Company; The Nature Conservancy holds a conservation easement on these lands.

No Action Alternative. The *No Action Alternative* would result from the Department of the Army denial of the permits that have been requested by UC Merced to fill waters of the United States, including wetlands, to implement the Proposed Action. From the applicant's perspective, the No Action Alternative would mean that the full buildout of the Proposed Action would not occur at the requested location—except for Phase I (which opened in fall 2005)—or the Proposed Action could be put on hold, abandoned altogether, or built in a manner that does not fully meet the project purpose.

This alternative is identified as Alternative 5 in the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report and as Supplemental On-Site Alternative 2 in the Supplemental 404(b)(1) Alternatives Analysis.

This alternative is identified as Alternative 1 in the Environmental Impact Statement/Environmental Impact Report and as Supplemental On-Site Alternative 1 in the Supplemental 404(b)(1) Alternatives Analysis.

No Build Alternative. The *No Build Alternative* assumes no construction would occur, irrespective of whether the Department of the Army issues or denies a permit for the fill of waters of the United States. Under this alternative, neither the campus nor the university community would be developed.

This alternative is identified as Alternative 6 in the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report and as Supplemental On-Site Alternative 5 in the Supplemental 404(b)(1) Alternatives Analysis.

Phase 1 Campus. The *Phase 1 Campus* is approximately 104 acres and is the portion of the UC Merced Campus that does not require a 404 permit and has been approved for construction. The majority of the Phase 1 Campus has been constructed.

Phase 2 Campus. An approximately 400-acre portion of the UC Merced Campus buildout and Community North. UC Merced has developed additional details on the specific buildings and facilities that would be constructed in the Phase 2 Campus.

Potentially degraded habitat. Suitable habitat occurring within potentially degraded land.

Potentially degraded land. Lands occurring within the buffer distance of urban development, agricultural development, roads, or other sources of degradation.

Primary habitat. A descriptor developed for mapping habitat suitability for San Joaquin kit fox. *Primary habitat* is habitat that exhibits the characteristics suitable to support kit fox denning, reproduction, and dispersal.

Proposed Action. The development of a major research university in Merced County that will support up to 25,000 full-time equivalent students and an associated community. This is the collective term used to describe the UC Merced Campus and entire University Community (including both the Community North and Community South) and associated Conservation Lands

Project footprint. The area encompassing the three project components (the UC Merced Campus, Community North, and Community South.

Project location. Lake Road, Merced, California.

Project region. The 550-square-mile portion of Merced County east of State Route 99.

Project site. The project site is located in eastern Merced County, approximately 2 miles northeast of the limits of the city of Merced. The site is southeast of Lake Yosemite and east of Lake Drive, and Yosemite Avenue forms the southern project site boundary**.**

Recovery. Improvement of a listed species' status (e.g., distribution, population size) such that removal from protection of the federal Endangered Species Act is warranted.

Residual dry matter. *Residual dry matter* is the old plant material (litter) left on the ground and usually measured just before the start of a new growing season. It is commonly measured in pounds per acre.

Secondary habitat. In the context of San Joaquin kit fox, *secondary habitat* is habitat that is only suitable for kit foxes to use while moving from one area of primary habitat to another. It is suitable for temporary uses, such as foraging and movement, but not suitable for reproduction or long-term occupation.

Special-status species. For the purposes of this Conservation Strategy, *special-status species* are those plants and animals that are legally protected under the California Endangered Species Act, federal Endangered Species Act, or other regulations, or are considered sufficiently rare by the trustee agencies or the scientific community to warrant special consideration. A complete definition is provided in Chapter 4.

Study area. The area evaluated in the 2002 Supplemental Biological Assessment and 2002 Biological Opinion to consider impacts of possible alternative locations for the UC Merced Campus.

Tadpole shrimp. Crustaceans of the Order Notostraca, which includes vernal pool tadpole shrimp.

Tier 1 properties. Lands owned in fee title by the University of California and The Nature Conservancy located immediately adjacent to the campus. Tier 1 properties will be managed according to a management plan currently in preparation. These properties are being used to mitigate the impacts of the University's Proposed Project on wetlands, threatened and endangered species, and other species of conservation concern. Tier 1 properties comprise the Virginia Smith Trust Preserve, Cyril Smith Trust lands, Myers Easterly, and Campus Natural Reserve.

Tier 1a properties. Tier 1 properties that are to be owned and managed by University of California. Lands within the Virginia Smith Trust Preserve, the Campus Natural Reserve, and Myers Easterly are Tier 1a Lands.

Tier 1b properties. Tier 1 properties comprise the Cyril Smith Trust property, which will be protected through a comprehensive conservation easement. Lands within the CST area are considered Tier 1b properties.

Tier 2 properties. Lands for which conservation easements, rather than fee title ownerships, have been acquired to serve as mitigation for the University's Proposed Project. Tier 2 properties remain privately owned and managed for conservation purposes through easement conditions specific to each individual property. Tier 2 lands consist of the Robinson, Chance, Carlson, Nelson, and Cunningham properties.

University Community Land Company LLC. A limited liability not-for-profit corporation consisting of the University of California and Virginia Smith Trust. The University Community Land Company owns the Community North, Myers Westerly, and Myers Easterly properties.

UC Merced Campus. A major research university in Merced County that will support up to 25,000 full-time equivalent students. The *UC Merced Campus* includes the Phase 1 Campus, Phase 2 Campus, and campus buildout.

University Community. A contiguous community that supports the UC Merced Campus that would be constructed to provide housing, retail, research park, entertainment venues, schools, park space, and other services to the new campus. The northern portion of the University Community (Community North) would be approved for development jointly with the UC Merced Campus by the University of California and the University Community Land Company. The southern portion of the University Community (Community South) is not under the ownership or control of the University of California and would be separately developed.

University Community Plan. The plan approved by the County of Merced as part of the Merced County General Plan. The University Community Plan defines the former design, land use, and development regulations for the University Community. This plan was included in the Department of the Army permit application for the 2002 Proposed Project that set forth former design and specifications for the University Community.

University's Proposed Project. The project proposed by the University of California for development of the UC Merced Campus and the Community North, with associated mitigation actions, as described in its revised U.S. Department of the Army permit application.

Vernal pool crustaceans. Crustaceans that commonly occur in vernal pools. Includes fairy shrimp, tadpole shrimp, clam shrimp, water fleas (Cladocera), seed shrimp (Ostracoda), and copepods (Copedpoda).

Vernal pool ecosystem. Vernal pool ecosystems are seasonally wet areas that form in topographic depressions and fill with rain water each winter. They are noted for supporting a suite of highly specialized flora and fauna.

Virginia Smith Trust. A legally established trust of the Smith family that donated lands to be used for the UC Merced Campus and mitigation (the Virginia Smith Trust Preserve and Campus Natural Reserve).

Virginia Smith Trust Preserve. The 5,030-acre Virginia Smith Trust Preserve lies east of the Cyril Smith Trust property. The land is owned by the University of California and has been committed to conservation management as mitigation for development of the UC Merced Campus. The area has previously been referred to as the Virginia Smith Trust Remainder, reflecting that it is the undeveloped portion of the lands donated by the Virginia Smith Trust to the University of California for the UC Merced Campus.

Wetland Creation. *Wetland Creation* is a type of compensatory mitigation involving the creation of a new wetland at a location where wetlands do not now nor previously existed.

Wetland Enhancement. *Wetland Enhancement* is a type of compensatory mitigation involving the rehabilitation and/or improvement of overall wetland function as a result of specific measures and/or management actions.

Wetland Restoration. *Wetland Restoration* is a type of compensatory mitigation involving the re-creation of previously existing wetlands and/or wetland landscapes.

Wetland Functions. *Wetland Functions* are the biological, physical and chemical processes that occur within wetlands. Wetland function is different from wetland value which equates to the relative worth society may place on one or more functions.

Yosemite Avenue Alternative. Formerly referred to as "Alternative 20", the *Yosemite Avenue Alternative* consists of a campus and an associated 2,000-acre community identified by UC Merced. This alternative is also being reviewed in the Corps of Engineers' Clean Water Act Section 404b(1) Alternatives Analysis and UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report for the UC Merced Campus and Community North (404 project).

This alternative is identified as Alternative 2 in the UC Merced and UCP Administrative Draft Environmental Impact Statement/Environmental Impact Report and as Supplemental On-Site Alternative 4 in the Supplemental 404(b)(1) Alternatives Analysis.

Appendix A

Requirements and Parameters of the Biological Opinion

Appendix A-1
Parameters from the Biological Opinion

The following text is reproduced from the biological opinion.

The Parameters

As described above, the University and the County have agreed that the Parameters will apply to any Preferred Alternative that may be selected by the Corps within the Study Area. These Parameters are not, however, intended to control the Corps' analysis under the laws and regulations applicable to the Corps. Where applicable, these Parameters apply both to the development projects specifically proposed by the University, the County, and to other development occurring within the Study Area. In addition to the Parameters, the University and the County have proposed a number of additional "Conservation Measures" which, in many cases, will serve to implement the Parameters described and are considered part of the Proposed Actions. The Parameters are as follows:

1. Development of Conservation Strategy

    a. The Applicants will prepare and implement, in coordination with the Service and CDFG, a comprehensive strategy that incorporates the Conservation Measures for the San Joaquin kit fox, vernal pool plant species and branchiopods, and other protected species to guide the development and implementation of specific conservation for the Proposed Actions and as needed to assure that other development within the Study Area is consistent with the Conservation Strategy as described in parameter 1b, below.

    b. The Conservation Strategy will include monitoring and adaptive management measures and be consistent with and intended to implement the Recovery Plan for Upland Species of the San Joaquin Valley, California, and any future federal recovery planning efforts.

2. Parameters for Covered Projects

    a. All conservation actions described below will be developed and implemented by the appropriate party, including the CDFG where appropriate. These conservation actions include, among other things,

completion by the Applicants of the Conservation Strategy; completion of a review by the Service of all preserve lands which have been acquired (i.e., in fee or easement) to date to determine the applicability for conservation for protected species; advance Service review and approval of further fee or easement acquisitions; and completion of a Resource Mitigation Plan (to be prepared for the Main Campus as described below) and Habitat Mitigation Plan (to be prepared for the Infrastructure Project as described below) consistent with the parameters set forth herein. The Resource Mitigation Plan and Habitat Mitigation Plan will include, among other things and in addition to the measures set forth in the BA supplement, management strategies and financial assurances for the monitoring and management of preserve lands and a strategy for addressing indirect effects. All the above, including the terms and conditions of conservation easements and management plans, and the adequacy of funding assurances, will be subject to review and approval by the Corps and the Service.

b. The Applicants will develop, in coordination with the Service, Corps, and CDFG, a plan to address potential effects to the San Joaquin kit fox, which will be consistent with the Conservation Strategy and may be included in the Resource Mitigation Program and/or Habitat Mitigation Plan. This plan, at a minimum, will address a migration corridor to the north and northeast of the Proposed Actions (as presently proposed by the Applicants) to be protected and maintained through acquisitions and other possible actions (e.g., passage over canals). Any such acquisitions will be consistent with the establishment of a connection to the Sandy Mush Road area.

c. The extent and nature of proposed conservation, and any proposed ratios, for grassland and vernal pool species will be at least equivalent to those set forth in the BA and will be approved by the Service and the Corps together with any avoidance and minimization measures.

d. Management plans and adequate financial assurances for long-term monitoring and management of identified preserve lands will be provided to and approved by the Service and the Corps.

e. No direct impact to Conservancy fairy shrimp, including its watershed, will occur. Indirect effects to the Conservancy fairy shrimp will be minimized and avoided to the maximum extent practicable. Any unavoidable indirect effects to occupied Conservancy fairy shrimp habitat will be compensated through the preservation of habitat within areas approved by the Service and the Corps as set forth more specifically below and found in the BA supplement.

f. For San Joaquin Valley Orcutt grass, Colusa grass, fleshy owl's-clover, hairy Orcutt grass, Hoover's spurge, Greene's tuctoria, and Hartweg's golden sunburst, the University will, to the maximum extent practicable, avoid and minimize effects on these federally listed plant species through siting, design, and conservation measures. Any occupied

habitat of these seven listed species will be preserved within areas approved by the Service as set forth more specifically below in the Conservation Measures. For effects to vernal pools and associated habitats, as well as any other wetlands, the Applicants will develop and implement a restoration/creation plan focusing on areas where the vernal pool signature or suitable extirpated habitat is still present or other suitable areas. This plan will include appropriate monitoring and adaptive management measures, together with adequate financial assurances, to be reviewed and approved by the Service and the Corps.

3. Parameters Regarding Development and Other Discretionary Projects in the Study Area

   a. Merced County will provide written assurance to the Service and the Corps that for all discretionary projects permitted by the County within the Study Area, other than the Proposed Actions, that may result in take of a listed species, Merced County will require compliance with the Endangered Species Act. This provision will include projects served by state or federally-funded roadways or other infrastructure that may be developed to serve the Campus or the Campus Community.

   b. To ensure no effect on Merced River and delta species (which are not subject to this consultation), withdrawals from the Merced River resulting from the Covered Projects (i.e., for recharge purposes) will be within the parameters of the existing OCAP biological opinion and formal consultation. The Applicants will also provide evidence that groundwater pumping and stormwater discharges will not affect listed species.

Appendix A-2. UC Merced Checklist of 2002 Biological Opinion Requirements

Reference No.	Requirement	Parameter	BO Page	Where Addressed
1	Prepare and implement a comprehensive strategy that incorporates Conservation Measures for San Joaquin kit fox, vernal pool plants and branchiopods, and other protected species to guide development and implementation of specific conservation for the proposed actions	1a	9	Subject of this Conservation Strategy
2	Monitoring and adaptive management measures consistent with and implementing species recovery plans	1b, 2d	9, 10	Chapters 5 and 6
3	USFWS review of all preserve lands that have been acquired to date to determine the applicability for conservation of protected species	2a	10	Chapter 5, Strategy 3
4	USFWS review and approval of future fee or easement acquisitions	2a	10	Chapter 5, Strategy 3
5	Completion of a Resource Mitigation Plan (for Main Campus)	2a	10	Appendix E
6	Completion of a Habitat Mitigation Plan (for Infrastructure Project and Campus Community)	2a	10, 39–40	Appendix F
7	Long-term funding assurances for management and monitoring of preserve lands	2a, 2d	10	Chapter 7
8	Develop a plan to address potential effects on kit fox, including a migration corridor to the north and northeast of the proposed actions to be protected and maintained through acquisitions and other possible actions (e.g., passage over canals)	2b	10	Chapter 2; Chapter 5, Strategy 9
9	The extent and nature of proposed conservation, and any proposed ratios, for grassland and vernal pool species will be at least equivalent to those in the BA	2c	10	Appendix G
10	No direct impact on Conservancy fairy shrimp; indirect impacts will be minimized and avoided to the maximum extent practicable	2e	10–11	Chapter 5, Strategy 11
11	Avoid and minimize effects on seven listed vernal pool plants to the maximum extent practicable through siting, design, and conservation measures	2f	11	Chapter 5, Strategies 1 and 2
12	Develop and implement a restoration/creation plan for vernal pools and associated habitats and other wetlands, focusing on areas where the vernal pool signature is still present or other suitable areas; include	2f	11	Chapter 5, Strategy 12; Appendix G

Reference No.	Requirement	Parameter	BO Page	Where Addressed
	provisions for monitoring and adaptive management, and adequate financial assurances			
13	Written assurances from the County that all other projects in the study area will comply with the ESA	3a	11	Chapter 5, Strategy 1
14	Applicants will provide evidence that groundwater pumping and stormwater discharges will not affect Merced River and Delta species	3b	11	Chapter 5, Strategy 1
15	LRDP Biological Resource Policies and Mitigation Measures		13	Appendix H
16	Compensation measures for Phase 1		14	Chapter 5, Strategy 12; Appendix G
17	Campus siting measures		14–15	Chapter 5, Strategy 2
18	Campus design measures		16, 30–31	Chapter 5, Strategy 2
19	Construction mitigation plan for Phase 1		17–18, 31–35	Chapter 5, Strategy 2
20	Construction mitigation plan for Phase 2		17–18	Chapter 5, Strategy 2
21	Campus O&M prograM		18–19, 35–36	Chapter 5, Strategy 2
22	Project compensation plan		19–22	Chapter 5, Strategy 12; Appendix G
23	Compensatory Wetland Mitigation and Monitoring Plan		23–24	Chapter 5, Strategy 12; Appendix G
24	Compensation strategy for listed plants	1a	25–26	Chapter 5, Strategy 12
25	Compensation strategy for Conservancy fairy shrimp	1a	26–27	Chapter 5, Strategy 12
26	Compensation strategy for other protected vernal pool crustaceans	1a	27	Chapter 5, Strategy 12
27	Compensation strategy for San Joaquin kit fox	1a	27–28	Chapter 5, Strategies 3, 4, and 5
28	Management Strategies for UC-owned lands		19, 28–29	Chapter 5, Strategies 5–8; Chapter 6
29	Management strategies for WCB preserve lands		19, 29–30	Chapter 6

Appendix B

Metadata for GIS Data Layers

This appendix contains the metadata for the GIS data layers used in the analyses described in Chapter 2. This metadata is as provided with the data layers. Metadata was not available for all data layers. However, for data layers lacking metadata, much of the relevant information is presented in the related documents cited in Chapter 2.

Appendix B-1. Summary of Data Sources Regarding Distribution of Vernal Pool Species in the Project Region[1]

Species	Summary of Data Sources
Succulent owl's-clover *Castilleja campestris* ssp. *Succulenta*	1. Vollmar Consulting census of all wetlands within 19,600 acres of ranchland (2001). Species present in 631 wetlands. 2. EIP census of all wetlands within 3,500 acres of ranchland (1999), and random sample (stratified by watershed sub-basin) of 518 wetlands within 3,000 acres of ranchland (1999). Species present in 226 wetlands in censused area (out of > 4,800 wetlands) and in 62 of sampled vernal pools and swales. 3. Jones & Stokes random sample of 1,000 vernal pools and swales and 144 additional vernal pools and swales from throughout 7,100 acres (2003). (On UC Merced campus lands, sample was stratified by soil type.) Species present in 41 vernal pools and swales in random sample and in 40 of the additional vernal pools and swales. 4. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species present in 55 wetlands. 5. CNDDB specific occurrences not from above sources: 23 (from 1981, 1982, 1991, 1997, 1999 and 2000)
Colusa grass *Neostapfia colusana*	1. Vollmar Consulting census of all wetlands within 19,600 acres of ranchland (2001). Species was not observed. 2. EIP census of all wetlands within 3,500 acres of ranchland (1999), and random sample (stratified by watershed sub-basin) of 518 wetlands within 3,000 acres of ranchland (1999). Species present in 5 wetlands. 3. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species present in 4 wetlands. 4. CNDDB specific occurrences not from above sources: 20 (from 1980, 1981, and 1988)
San Joaquin Valley Orcutt grass *Orcuttia inaequalis*	1. Vollmar Consulting census of all wetlands within 19,600 acres of ranchland (2001). Species present in 4 wetlands. 2. EIP census of all wetlands within 3,500 acres of ranchland (1999), and random sample (stratified by watershed sub-basin) of 518 wetlands within 3,000 acres of ranchland (1999). Species present in 1 wetland. 3. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species present in 4 wetlands. 4. CNDDB specific occurrences not from above sources: 15 (from 1980, 1981, 1988, 1999 and 2000)
Conservancy fairy shrimp *Branchinecta conservatio*	1. Vollmar Consulting random sample (stratified by area of geologic surface) of 1,408 wetlands within 44,200 acres of ranchland (2001). Species present in 3 wetlands. 2. EIP random sample (stratified by watershed sub-basin) of 713 wetlands over 6,500 acres (1999) and a subsequent sample of an additional 125 larger vernal pools and 1 stockpond (2000). Species present in 1 wetland. 3. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species was not observed. 4. CNDDB specific occurrences not from above sources: None.

Species	Summary of Data Sources
Vernal pool fairy shrimp *Branchinecta lynchi*	1. Vollmar Consulting random sample (stratified by area of geologic surface) of 1,408 wetlands within 44,200 acres of ranchland (2001). Species present in 495 wetlands. 2. EIP sample of 713 wetlands within 6,500 acres of ranchland (1999). Species present in 636 wetlands. 3. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species present in 353 wetlands. 4. CNDDB specific occurrences not from above sources: 3 (from 1997, 1999 and 2000)
Midvalley fairy shrimp *Branchinecta mesovallensis*	1. Vollmar Consulting random sample (stratified by area of geologic surface) of 1,408 wetlands within 44,200 acres of ranchland (2001). Species present in 68 wetlands. 2. EIP random sample (stratified by watershed sub-basin) of 713 wetlands within 6,500 acres of ranchland (1999). Species present in 92 wetlands. 3. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species present in 12 wetlands. 4. CNDDB specific occurrences not from above sources: None.
Vernal pool tadpole shrimp *Lepidurus packardi*	1. Vollmar Consulting random sample (stratified by area of geologic surface) of 1,408 wetlands within 44,200 acres of ranchland (2001). Species present in 4 wetlands. 2. EIP random sample (stratified by watershed sub-basin) of 713 wetlands within 6,500 acres of ranchland (1999). Species present in 4 wetlands. 3. URS census of all wetlands within alternative alignments for the Campus Parkway Project (1999–2000). Species present in 234 wetlands. 4. CNDDB specific occurrences not from above sources: None.
California tiger salamander *Ambystoma californiense*	1. Vollmar Consulting stratified random sample of 280 large vernal pools and 79 stockponds throughout 44,200 acres (2001). Species was present in 2 of the vernal pools and 13 of the stockponds. 2. EIP Associates random sample (stratified by watershed sub-basin) of 713 wetlands throughout 6,500 acres of ranchland (1999–2000). Species was present in 18 of these wetlands (14 stockponds, 3 vernal pools and a swale). 3. URS census of wetlands in preliminary alignment alternatives for the Campus Parkway project (1999–2000). 4. CNNDB specific occurrences not from above sources: 1 (from 1994).

[1] The methods and results of these surveys are reported in EIP Associates 1999a, 1999b, 2001a, 2001b, and 2002, Vollmar Consulting 2001, and CNDDB 2008.

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

California tiger salamander, Ambystoma californiense *locatio*ns within Eastern Merced County

COVERAGE NAMES: cts
METADATA FILE: cts.txt
METADATA DATE: 2002.9.19

COVERAGE DESCRIPTION:

The 'CTS' layer is a point coverage which shows documented occurrences of California tiger salamander, Ambystoma californiense within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corporation, EIP Associates, and Vollmar Consulting for this species. Data was collected between 1998 and 2001.

Data were collected using different methods:
URS Corporation:
EIP Associates: Trimble ProXRS GPS units were used to navigate to and record locations of wetlands sampled for CTS during 2000 and 2001.
Vollmar Consulting:

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	36
Layer Size:	
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: CTS

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	Habitat				
	CTS				
	Bullfrog				
	Spadefoot				
	Pac_tree				
	Date				
	Obrserver				

Habitat: wetland habitat sampled
CTS: presence of California tiger salamander
Bullforg: presence of bullfrogs in wetland sampled
Spadefoot: presence of spadefoot toads in wetland sampled
Pac_tree: presence of pacific tree frog in wetland sampled
Date: date or season of survey
Observer: Source of data, environmental consulting firm that collected data.

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Conservancy fairyshrimp, *Branchinecta conservatio locatio*ns within Eastern Merced County

COVERAGE NAMES: brco
METADATA FILE: brco.txt
METADATA DATE: 2002.9.19

COVERAGE DESCRIPTION:

The 'BRCO' layer is a point coverage which shows documented occurrences of Conservancy fairyshrimp, Branchinecta conservatio within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corporation, EIP Associates, and Vollmar Consulting for this species.

URS Corporation: Pools were mapped using a Trimble Pro-XR GPS unit.
EIP Associates: Trimble Pro XRS GPS units were used to navigate to and record locations of vernal pools during fairy shrimp sampling between 1999 and 2001.
Vollmar Consulting: Trimble XC GPS units were used to map locations of pools sampled during 2001.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	4
Layer Size:	
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME brco

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	PoolID				
	Vis_num				
	Date				
	Shrimper				
	Comments				
	Habitat				
	Water_qua				
	BRCO				
	Observer				

PoolID: Pool identification number taken from survey data
Visit#: Sampling period during when species was found
Date: Date of collection
Shrimper: initials of biologist conducting surveys
Comments:
Habitat: vp = vernal pool
Water_qua: Water quality – turbid
BRCO: Presence of B. conservatio in pool
Observer: Source of data, environmental consulting firm that collected data.

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Vernal Pool Fairyshrimp, *Branchinecta lynchi* locations within Eastern Merced County

COVERAGE NAMES: brly
METADATA FILE: brly.txt
METADATA DATE: 2002.9.19

COVERAGE DESCRIPTION:

The 'BRLY' layer is a point coverage which shows documented Occurrences of vernal pool fairyshrimp, Branchinecta lynchi within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corporation, EIP Associates, and Vollmar Consulting for this species.

URS Corporation: Pools were mapped using a Trimble Pro-XR GPS unit.
EIP Associates: Trimble Pro XRS GPS units were used to navigate to and record locations of vernal pools during fairy shrimp sampling between 1999 and 2001.
Vollmar Consulting: Trimble XC GPS units were used to map locations of pools sampled during 2001.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	1,484
Layer Size:	525kb
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: brly

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	VP_id				
	SEASON				
	BRLY				
	OBSERVER				

VP_ID: Pool identification number taken from survey data
SEASON: Year surveys were conducted
BRLY: Presence of B.lynch in pool
Observer: Source of data, environmental consulting firm that collected data.

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Midvalley fairyshrimp, *Branchinecta mesovallensis* locations within Eastern Merced County

COVERAGE NAMES: brme
METADATA FILE: brme.txt
METADATA DATE: 2002.9.19

COVERAGE DESCRIPTION:

The 'BRME' layer is a point coverage which shows documented occurrences of Midvalley Fairyshrimp, Branchinecta mesovallensis within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corportion, EIP Associates, and Vollmar Consulting for this species.

URS Corporation: Pools were mapped using a Trimble Pro-XR GPS unit.
EIP Associates: Trimble Pro XRS GPS units were used to navigate to and record locations of vernal pools during fairy shrimp sampling between 1999 and 2001.
Vollmar Consulting: Trimble XC GPS units were used to map locations of pools sampled during 2001.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	172
Layer Size:	525kb
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: brme

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	VP_id				
	SEASON				
	BRME				
	OBSERVER				

VP_ID: Pool identification number taken from survey data
SEASON: Year surveys were conducted
BRME: Presence of B. mesovallensis in pool
Observer: Source of data, environmental consulting firm that collected data.

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Succulent owl's-clover, Castilleja campestris spp.succulenta locations within Eastern Merced County.

COVERAGE NAMES: Castilleja campestris
METADATA FILE: Castilleja campestris.txt
METADATA DATE: 2002.9.23

COVERAGE DESCRIPTION:

The ' Castilleja campestris ' layer is a point coverage which shows documented occurrences of succulent owl's-clover within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corporation, EIP Associates, and Vollmar Consulting for this species.

Data were collected using different methods:
URS Corporation:
EIP Associates: Trimble ProXRS GPS units were used to record plant locations between 1999 - 2001.
Vollmar Consulting: Plant occurrences were recorded with Trimble XRS GPS units.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	982
Layer Size:	
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: Castilleja campestris

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	SPECIES				
	FLOWERING				
	GRAZED				
	COMMENTS				
	DATE				
	TIME				
	NO_OF_IND				
	OBSERVER				
	LOCATION				
	POP_AREA				

SPECIES	Occurrence of Castilleja campestris
FLOWERING	specimens in flower
GRAZED	Area Grazed
COMMENTS	Notes linking to survey data
DATE	Date of observation
TIME	time of observation
NO_OF_IND	estimation of number of individual present
OBSERVER	company conducting surveys
LOCATION	general location of plant

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Vernal Pool Tadpole Shrimp, *Lepidurus packardi* locations within Eastern Merced County

COVERAGE NAMES: lepa
METADATA FILE: lepa.txt
METADATA DATE: 2002.9.19

COVERAGE DESCRIPTION:

The 'Lepa' layer is a point coverage which shows documented occurrences of vernal pool tadpole within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corporation, EIP Associates, and Vollmar Consulting for this species. Data was collected between 1998 and 2001.

URS Corporation: Pools were mapped using a Trimble Pro-XR GPS unit.
EIP Associates: Trimble Pro XRS GPS units were used to navigate to and record locations of vernal pools during fairy shrimp sampling between 1999 and 2001.
Vollmar Consulting: Trimble XC GPS units were used to map locations of pools sampled during 2001.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	172
Layer Size:	525kb
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: lepa

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	VP_id				
	SEASON				
	LEPA				
	OBSERVER				

VP_ID: Pool identification number taken from survey data
SEASON: Year surveys were conducted
LEPA: Presence of L. pakcardi in pool
Observer: Source of data, environmental consulting firm that collected data.

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Colusa grass, Neostapfia colusana locations within Eastern Merced County

COVERAGE NAMES: Neostapfia colusana
METADATA FILE: Neostapfia colusana.txt
METADATA DATE: 2002.9.23

COVERAGE DESCRIPTION:

The ' Neostapfia colusana ' layer is a point coverage which shows documented occurrences of Colusa grass within Eastern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corporation, EIP Associates, and Vollmar Consulting for this species.

Data were collected using different methods:
URS Corporation:
EIP Associates: Trimble ProXRS GPS units were used to record plant locations between 1999 - 2001.
Vollmar Consulting: Plant occurrences were recorded with Trimble XRS GPS units.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	5
Layer Size:	
Data Updated:	Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: Neostapfia colusana

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	Neostapfia				
	FLOWERING				
	GRAZED				
	COMMENTS				
	DATE				
	TIME				
	NO_OF_IND				
	OBSERVER				
	LOCATION				
	POP_AREA				

Neostapfia	Occurrence of species
FLOWERING	specimens in flower
GRAZED	Area Grazed
COMMENTS	Notes linking to survey data
DATE	Date of observation
TIME	time of observation
NO_OF_IND	estimation of number of individual present
OBSERVER	company conducting surveys
LOCATION	general location of plant

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

San Joaquin Valley Orcutt grass Orcuttia inaequalis locations within Eastern Merced County

Attribute Data was reduced to Species (Orcuttia_I), Comments, Date, and Observer, for Imaps site.

COVERAGE NAMES: Orcuttia ineaqualis
METADATA FILE: Orcuttia ineaqualis.txt
METADATA DATE: 2002.9.23

COVERAGE DESCRIPTION:

The ' Orcuttia ineaqualis ' layer is a point coverage which shows documented occurrences of San Joaquin Valley Orcutt grass within Easetern Merced County. This coverage was developed by compiling datasets from surveys conducted by URS Corportaion, EIP Associates, and Vollmar Consulting for this species.

Data were collected using different methods:
URS Corporation:
EIP Associates: Trimble ProXRS GPS units were used to record plant locations between 1999 - 2001.
Vollmar Consulting: Plant occurrences were recorded with Trimble XRS GPS units.

Data from EIP, URS and Vollmar consulting were reprojected from California State Plane, Zone 3, NAD83 into Teal Albers.
Original metadata sets from above referenced companies were not made available.

VITAL STATISTICS:

Datum:	NAD 27
Projection:	Albers
Units:	Meters
1st Std. Parallel:	34 00 00 (34.0 degrees N)
2nd Std. Parallel:	40 30 00 (40.5 degrees N)
Longitude of Origin:	-120 00 00 (120.0 degrees W)
Latitude of Origin:	00 00 00 (0.0 degrees)
False Easting (X shift):	0
False Northing (Y shift):	-4,000,000
Source:	
Source Media:	shapefiles
Source Projection:	CA State Plane
Source Units:	feet
Source Scale:	
Capture Method:	
Conversion Software:	Arcview
Data Structure:	Vector
ARCVIEW Coverage Type:	Point
Number of Features:	9
Layer Size:	

Data Updated: Not updated since creation

DATA DICTIONARY:

DATAFILE NAME: Orcuttia inaequalis

Non-standard Point attribute fields:

COLUMN	ITEM NAME	WIDTH	OUTPUT	TYPE	N.DEC
	Orcuttia_i				
	FLOWERING				
	GRAZED				
	COMMENTS				
	DATE				
	TIME				
	NO_OF_IND				
	OBSERVER				
	LOCATION				
	POP_AREA				

Orcuttia_i	Occurrence of species
FLOWERING	specimens in flower
GRAZED	Area Grazed
COMMENTS	Notes linking to survey data
DATE	Date of observation
TIME	time of observation
NO_OF_IND	estimation of number of individual present
OBSERVER	company conducting surveys
LOCATION	general location of plant

DATA QUALITY ASSESSMENT:

DATA CONTACT:

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

Chapter 1MCAG GIS-CD METADATA (Miscellaneous)

LAST UPDATE: 11/17/99

Provided by: Merced County Association of Governments
369 West 18th Street - Merced, CA – 95340

For more information, please contact Richard Green at
(209)723-3153 or FAX# (209)723-0322

==========

MCAG GIS COORDINATE SYSTEM

Projection: State Plane
Zone: 3326
Datum: NAD83
Units: Feet

==========

==========

\THEMES\MISC
(This directory is where all of the miscellaneous shape files for the Merced County are stored.)

THEME: lnduse98
DESCRIPTION: Land Use
ITEM INFO: DEFINITION:
Luname
ADA GIVENS PARK
APPLEGATE PARK
BEAR CREEK
BLACK RASCAL CREEK PARK
BURBANK PARK
BURBANK SCHOOL
C
CASTLE A.F.B.
CHENOWETH SCHOOL
FAHRENS CREEK
FAHRENS PARK
FG
FREMONT SCHOOL
GIVENS SCHOOL
GRACEY SCHOOL
H
HOOVER INT. SCHOOL
JOE HERB PARK

LAKE YOSEMITE
LOS BANOS MUNICIPAL AIRPORT
LOS BANOS RESERVOIR
MACIAS PARK
MC NAMARA PARK
MERCED COLLEGE
MERCED MUNICIPAL AIRPORT
MERCED UNION H.S. (EAST CAMPUS)
MERCED UNION H.S. (NORTH CAMPUS)
MUIR SCHOOL
O'NIEL FOREBAY
OUR LADY OF MERCY SCHOOL
PETERSON SCHOOL
RAHILLY PARK
RIVERA INT. SCHOOL
SAN LUIS RESERVOIR
SHEEHY SCHOOL
STEPHEN LEONARD PARK
TENAYA JR. HIGH SCHOOL
WEAVER SCHOOL
WRIGHT SCHOOL

Landuse

AGRICULTURE
COMMERCIAL
INDUSTRIAL
PARK
PUBLIC
RANGELAND / OTHER
RESIDENTIAL
VACANT
WATER

Chapter 2MCAG GIS-CD METADATA

LAST UPDATE: 11/17/99

Provided by: Merced County Association of Governments
369 West 18th Street - Merced, CA – 95340

For more information, please contact Richard Green at
(209)723-3153 or FAX# (209)723-0322

==========

MCAG GIS COORDINATE SYSTEM

Projection: State Plane
Zone: 3326
Datum: NAD83
Units: Feet

==========

==========

\THEMES\ATWATER

(This directory is where all of the ArcView shape files for the City of Atwater are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_atw.*
DESCRIPTION: General Plan for the City of Atwater

THEME: rda.*
DESCRIPTION: Redevelopment Area

THEME: rrc.*
DESCRIPTION: Rural Residential Centers

THEME: zon_atw
DESCRIPTION: Zoning for the City of Atwater

==========

==========

\THEMES\BASEMAP

(This directory contains the BASEMAP.APR project file. This file should be opened and immediately saved as a new project in the appropriate project directory. This project contains predetermined views and layouts for all cities, communities and the county of Merced. Also contained in this directory are

subdirectories needed to house all of the symbol, logo and annotation data used specifically for this project.

THEME: co_hwys.*
DESCRIPTION: Merced County Highways

THEME: hwysymbols.*
DESCRIPTION: ArcView symbol palette containing highway symbols

---

THEME: railroads.*
DESCRIPTION: Merced County Railroads

THEME: wildlife.*
DESCRIPTION: Wildlife Refuge Areas

==========

\THEMES\CENSUS

(This directory is where all of the ArcView shape files related to the 1990 (and future 2000) Census is stored)

THEME: bgroup90.*
DESCRIPTION: 1990 Census Block Groups

THEME: block90.*
DESCRIPTION: 1990 Census Blocks

THEME: tract90.*
DESCRIPTION: 1990 Census Tracts

==========

\THEMES\DOSPALOS

(This directory is where all of the ArcView shape files for the City of Dos Palos are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_dp
DESCRIPTION: General Plan for the City of Dos Palos

THEME: gp_dpy
DESCRIPTION: General Plan for the City of Dos Palos Y

THEME: zon_dp
DESCRIPTION: Zoning for the City of Dos Palos

THEME: zon_dpy
DESCRIPTION: Zoning for the City of Dos Palos Y

==========

==========

\THEMES\GUSTINE

(This directory is where all of the ArcView shape files for the City of Gustine are stored. This

includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_gu
DESCRIPTION: General Plan for the City of Gustine

THEME: zon_gu
DESCRIPTION: Zoning for the City of Gustine

==========

==========

\THEMES\LIVINGSTON

(This directory is where all of the ArcView shape files for the City of Livingston are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_li
DESCRIPTION: General Plan for the City of Livingston

THEME: rda
DESCRIPTION: Redevelopment Area for the City of Livingston

THEME: zon_li
DESCRIPTION: Zoning for the City of Livingston

==========

==========

\THEMES\LOSBANOS

(This directory is where all of the ArcView shape files for the City of Los Banos are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_lb
DESCRIPTION: General Plan for the City of Los Banos

THEME: rda
DESCRIPTION: Redevelopment Area for the City of Los Banos

THEME: zon_lb
DESCRIPTION Zoning for the City of Los Banos

\THEMES\LOSBANOS\INFRA

(This directory is where all of the City of Los Banos infrastructure shape files are stored.)

THEME: sewer
DESCRIPTION: Sewer lines

THEME: sewer2
DESCRIPTION: Sewer points

THEME: storm
DESCRIPTION: Storm drain lines

THEME: storm2

DESCRIPTION: Storm drain points

THEME: water
DESCRIPTION Water lines

THEME: water
DESCRIPTION Water points

==========

==========

\THEMES\MERCED

(This directory is where all of the ArcView shape files for the City of Merced are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_mer
DESCRIPTION: General Plan for the City of Merced

THEME: rrc
DESCRIPTION: Rural Residential Centers for the City of Merced

---

THEME: zon_mer
DESCRIPTION: Zoning for the City of Merced

\THEMES\MERCED\INFRA

(This directory is where all of the City of Merced infrastructure shape files are stored.)

THEME: bfp
DESCRIPTION: General Plan for the City of Merced

THEME: cb
DESCRIPTION: Catch Basins

THEME: detector
DESCRIPTION: Detectors

THEME: easement
DESCRIPTION: Right-of-way easements

THEME: fh
DESCRIPTION: Fire Hydrant

THEME: fhnum
DESCRIPTION: Fire Hydrant numbers

THEME: reduce
DESCRIPTION: ???

THEME: saband
DESCRIPTION: Abandoned sewer lines

THEME: sco
DESCRIPTION: Sewer clean outs

THEME: sdaband
DESCRIPTION: Abandon storm drain lines

THEME: sdline
DESCRIPTION: Storm drain lines

THEME: sdmh
DESCRIPTION: Storm drain man-holes

THEME: sline
DESCRIPTION: Sewer lines

THEME: smh
DESCRIPTION: Sewer man-holes

THEME: snums
DESCRIPTION: ???

THEME: sps
DESCRIPTION: Sewer pump stations

THEME: waband
DESCRIPTION: Abandoned water lines

THEME: wbo
DESCRIPTION: Water blow-offs

THEME: well
DESCRIPTION: Wells

THEME: wline
DESCRIPTION: Water lines

THEME: wm
DESCRIPTION: Water main

THEME: wv
DESCRIPTION: Water valve
==========

==========
\THEMES\COUNTY
(This directory is where all of the ArcView shape files for the County of Merced are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_co
DESCRIPTION: General Plan for the County of Merced

THEME: zon_co
DESCRIPTION: Zoning for the County of Merced
==========

\THEMES\MISC

(This directory is where all of the ArcView shape files for the City of Atwater are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: sudp
DESCRIPTION: Specific Urban Development Project Areas

THEME: soilwest
DESCRIPTION: General Soil Designation for West Merced County

THEME: soileast
DESCRIPTION: Soil Designation for East Merced County

THEME: roads
DESCRIPTION: Merced County Centerline Roads File

THEME: reserv
DESCRIPTION: Reservoirs in Merced County

THEME: railroad
DESCRIPTION: Railroads
ITEM INFO DEFINITION:

THEME: pls
DESCRIPTION: Public Land Survey Grid

THEME: lnduse
DESCRIPTION: Land Use

THEME: hydro
DESCRIPTION: Hydrology (Waterways)

THEME: fema
DESCRIPTION: FEMA Flood Layer

THEME: farmland
DESCRIPTION: Farmlands in Merced County

THEME : city_lmt
DESCRIPTION: City Limit Boundaries for Merced County
==========
==========

\THEMES\PARCEL

(This directory is where all of the ArcView shape files for the County of Merced are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: allbooks
DESCRIPTION: Parcels for Merced County

THEME: cntyaddr
DESCRIPTION: "VALID" County-wide Address File (Rough & Raw)
==========

==========
\THEMES\PROJECTS
(This directory is where all of the ArcView projects are stored.)

CENSUS

PROJECT: Census
DESCRIPTION: Extract Demographic Info, based upon CENSUS 1990 (U.S. Census Bureau)
for **up to 4 Block Groups** in any county in California.

SITE ANALYSIS

PROJECT: Ptanlys
DESCRIPTION: Overlay GIS layers with user-defined SITE (APN, Address) to extract site
info such as Flood Status, Tract Data, General Plan/Zoning Designations,...

PUBLIC NOTICE

PROJECT: Pubnot
DESCRIPTION: Prepares LABELS and MAPS for public notices of SITE (APN) areas…

SCRIPTS

PROJECT: Scripts
DESCRIPTION: In-house scripts which may be of interest to MEMBER JURISDICTIONS.
==========

CALIFORNIA DEPARTMENT OF FISH AND GAME (DFG) GIS METADATA

Merced County General Plan

COVERAGE NAMES: GENERALPLAN
METADATA FILE: generalplan.doc
METADATA DATE: 2002.09.26

Original data set: gp_co obtained from MCAG October 2002

Processing Steps:

1. Clipped data set to Eastern Merced County NCCP study area.
2. Reprojected data set into Teal Albers

```
VITAL STATISTICS:
Datum:                        NAD 27
Projection:                   Albers
Units:                        Meters
1st Std. Parallel:            34 00 00 (34.0 degrees N)
2nd Std. Parallel:            40 30 00 (40.5 degrees N)
Longitude of Origin:        -120 00 00 (120.0 degrees W)
Latitude of Origin:           00 00 00 (0.0 degrees)
False Easting (X shift):      0
False Northing (Y shift):     -4,000,000
```

3. Renamed dataset generalplan.shp

Kristi Fien
GIS Analyst
Wildlife Habitat Data Analysis Branch
California Department of Fish & Game
1807 13th Street Suite 202
Sacramento, CA 94585
916.327.4118

==== Original metadata====

Chapter 3MCAG GIS-CD METADATA (County of Merced)

LAST UPDATE: 07/18/01

Provided by: Merced County Association of Governments
369 West 18th Street - Merced, CA – 95340

For more information, please contact Richard Green at
(209) 723-3153 or FAX# (209) 723-0322

==========

MCAG GIS COORDINATE SYSTEM

Projection: State Plane
Zone: 3326
Datum: NAD83
Units: Feet

==========

==========

\THEMES\COUNTY
(This directory is where all of the ArcView shape files for the County of Merced are stored. This includes Redevelopment Area, General Plan & Zoning.)

THEME: gp_co
DESCRIPTION: General Plan for the County of Merced

ITEM INFO: GP	DEFINITION: GPNAME
A	Agricultural
A-R	Agricultural Reserve
AG	Agricultural
AR	Agricultural Reserve
ATWATER	Atwater
C	Commercial
COM	Commercial
CT	Commercial Transition
DOSPALOS	Dos Palos
FOOTHILL	Foothill
GC	General Commercial
GUSTINE	Gustine
HD	High Density Residential
HIC COM	Highway Interchange Commercial
HWY	Highway Commercial
IND	Industrial
IND-R	Industrial Reserve

INST	Institutional
LD	Low Density Residential
LIVINGSTON	Livingston
LOS BANOS	Los Banos
MD	Medium Density Residential
MERCED	Merced
NC	Neighborhood Commercial
PU	Public Use
R	Residential
REC	Recreational
RES	Residential
RR	Residential Reserve
RRC	Rural Residential Center
UR	Urban Reserve
VLD	Very Low Density Residential

Land Cover Draft Metadata

This file describes the data structure of the value attribute table and data base assembly process, including crosswalks to the source data. It does not represent complete formal metadata.

LAND COVER DATA BASE DATA SOURCES AND ASSEMBLY PROCESS:

The land cover GIS has been created and is managed in ERDAS Imagine, and is distributed as an ARC/INFO grid. The current data are preliminary. The assembly method and classification are the result of the CALFED Public and Conservation Lands Technical Work Group meetings.

DATA STRUCTURE:

Land Cover Classification Scheme

The following land cover classification scheme was adopted:

Land cover class names:

Open Water (OW)
Saline Emergent Wetland (SEW)
Permanent Freshwater Wetland (PFW)
Seasonal Wetland (SW)
Grassland (G)
Vernal Pools (VP)
Flooded Agricultural Field (FA)
Other Agricultural Field (OA)
Upland Scrub (S)
Orchard/Vineyard (OV)
Woody Riparian Habitat (WR)
Upland Woodland and Forest (WF)
Flats (FL)
Urban (U)
Other Developed and Disturbed Lands (ODD)
Fallow Field (FF)

The definitions of these class names are:

Land Cover Class Definitions

Land Cover Type	Description
Natural Plant Communities	
Open Water	Permanent bodies of water including tidal perennial aquatic, and unvegetated intertidal (i.e., tideflats) zones of estuarine bays, channels, and sloughs; and non-tidal permanent bodies of water that do not support emergent vegetation and are not subject to tidal exchange, including lakes, ponds, oxbows, gravel pits, and flooded islands..

Land Cover Type	Description
Flats	Tidal flats, mud banks, and sand bars visible above the water level during summer
Saline Emergent Wetland	Saline emergent habitat is defined to include portions of San Francisco, San Pablo, and Suisun Bays and the Delta that support saline tolerant emergent wetland plant species within the intertidal zone or on lands that historically were subject to tidal exchange (i.e., diked wetlands).
Permanent Freshwater Emergent Wetland	Freshwater permanent emergent habitat includes permanent (natural and managed) wetlands dominated by emergent wetland plant species that are not tolerant of saline or brackish conditions.
Seasonal Wetland	Natural and managed seasonal wetlands dominated by native or non-native herbaceous plants and annually pond surface water or maintain saturated soils at the ground surface for a portion of the year of sufficient duration to support facultative or obligate plant species, excluding vernal pools and croplands farmed for profit (e.g., corn and rice),.
Woody Riparian Habitat	Riparian habitat is defined to include all successional stages of woody vegetation generally dominated by willow, Fremont cottonwood, valley oak, sycamore, black cottonwood, white alder, birch, and dogwood within the active and historical floodplains of streams and rivers.
Grassland (without vernal pools)	Vegetation communities dominated by introduced and native annual and perennial grasses that do not support vernal pools.
Grassland (with vernal pools)	Vegetation communities dominated by introduced and native annual and perennial grasses that support inclusions of vernal pools.
Upland Scrub	Habitat areas that are dominated by shrubs characteristic of coastal and valley scrub and chaparral communities.
Upland Woodland and Forest	Upland woodland and forest includes vegetation communities with an overstory canopy layer dominated by valley oak, blue oak, interior live oak, coast live oak, pine, fir, cedar, and/or black oak.
Agricultural Lands	
Flooded Agricultural Field	Agricultural lands that typically maintain standing water for extended periods during winter, or winter and summer. This cover type includes agricultural lands that are flooded for extended periods during winter to provide waterfowl habitat or to control weeds.
Fallow Field	Exposed soil below approximately 300 foot elevation with little or no vegetation present, including fallow or recently plowed fields.
Orchards and Vineyards	Includes lands managed for d tree-borne fruit and nut, and grape production.
Other Non-flooded Agricultural Lands	Agricultural lands, exclusive of orchards, and vineyards, that typically are not flooded for extended periods during winter or summer.
Developed Lands	
Urban	High density residential, commercial, and industrial lands and associated infrastructure, including rural residential
Other Developed and Disturbed Lands	Includes residential, commercial, industrial, mined, barren, and other developed lands (e.g., freeway corridors) located outside of urban and rural residential lands.

Data Base Assembly Process

Urban Boundaries

1. The California Department of Conservation (CDOC) Important Farmland GIS was the primary layer for the urban category.

2. In counties where CDOC Important Farmland was not mapped, California Department of Forestry=s (CDF) CalVeg 2000 was used for urban designations (primarily in the uplands).

3. In counties where no CDOC Important Farmland was available and no CDF CalVeg 2000 was available, California Department of Water Resources (CDWR) Land Use GIS urban designations were used.

4. In counties where no CDOC, CDF, or CDWR urban categories were available, the California Gap Analysis urban category was used.

5. In all cases, CDWR land use code of UR, UC, UV, UL, and UI will be classified as urban.

Natural Plant Communities and Agricultural Lands

Valley Floor (< 300 feet elevation)

1. CDFG=s California Central Valley Wetland and Riparian GIS was the primary data source. The urban layer superceded the CDFG Wetland and Riparian GIS.

2. The CDFG Vernal Pool GIS was used to map grasslands with vernal pools, and superceded the CDFG Wetlands and Riparian GIS only in location mapped as grassland.

Other Areas

1. CDF=s CalVeg 2000 was be used as the primary data source outside the area that was occupied by the CDFG Wetland and Riparian GIS.

2. Where the two overlap, the CDFG data superceded the CDF data. The CDFG Vernal Pool layer superceded the CDF layer where CDF mapped grassland. The Urban layer superceded the CDF layer.

3. In areas where no CDF data nor CDFG data were mapped, California Gap Analysis data were used for the land cover data layer. The urban layer superceded any California Gap land cover data.

Format:

ARC/INFO grid, with 30 m pixels,

Projection information:

Projection: Albers Conical Equal Area,
Spheroid: Clark 1866,
Datum: NAD 27,
Units: meters,
latitude of first standard parallel is 34° 0’ 0”
latitude of second standard parallel 40° 30’ 0”
longitude of central meridian –120°,
latitude of origin of projection 0°,
false easting of central meridian 0 m,
false northing at origin –4,000,000 m,

CDFG Classification Crosswalk Table (Values 1-16 in output image)

CDFG LAND COVER	CALFED	CLASS CODE
Open Water	OW	1
Seasonally Flooded Estuarine Emergent	SEW	2
Permanently Flooded Estuarine Emergent	SEW	2
Tidal Estuarine Emergent	SEW	2
Seasonally Flooded Palustrine Emergent	SW	4
Permanently Flooded Palustrine Emergent	PFW	3
Tidal Flats	FL	13
Non-Tidal Flats	FL	13
Flooded Agriculture	FA	7
Seasonally Flooded Agriculture	FA	7
Non-Flooded Agriculture	OA	8
Orchard/Vineyard	OV	10
Riparian Woody	WR	11
Non-riparian Woody	WF	12
Grassland	G	5
Barren	FF	16
Other	ODD	15

CDF CalVeg 2000 Classification Crosswalk Table (Values 21-36 in output image)

VEGTYPE	DESCRIPTION	COVER TYPE	CALFED	CLASS CODE
	NON-FOREST TYPES			
BA	Barren/Rock	BAR	ODD	35
HJ	Wet Meadows	HEB	PFW	23
HG	Annual Grass/Forbs	HEB	G	25
WA	Water	WAT	OW	21
SN	Snow/Ice	BAR	ODD	35
AG	Agriculture	AGR	OA	28
UB	Urban/Developed	URB	U	34
DU	Dune	BAR	ODD	35
	CONIFER FOREST/WOODLAND			
AB	Santa Lucia Fir	CON	WF	32
BP	Bristlecone Pine	CON	WF	32
BT	Big Tree	CON	WF	32
DF	Pacific Douglas-Fir	CON	WF	32
DG	Douglas-Fir - Grand Fir	CON	WF	32
DM	Bigcone Douglas-Fir	CON	WF	32
DP	Douglas-Fir - Pine	CON	WF	32
DW	Douglas-Fir - White Fir	CON	WF	32
EA	Engelmann Spruce	CON	WF	32
EP	Eastside Pine	CON	WF	32
FP	Foxtail Pine	CON	WF	32
GF	Grand Fir	CON	WF	32
JP	Jeffrey Pine	CON	WF	32
KP	Knobcone Pine	CON	WF	32
LP	Lodgepole Pine	CON	WF	32
MB	Mixed Conifer - Giant Sequoia	CON	WF	32
MC	Cuyamaca Cypress	CON	WF	32
MF	Mixed Conifer - Fir	CON	WF	32
MG	Gowen Cypress	CON	WF	32
MH	Mountain Hemlock	CON	WF	32
MI	Piute Cypress	CON	WF	32
MK	Klamath Mixed Conifer	CON	WF	32
MM	Monterey Cypress	CON	WF	32
MN	McNab Cypress	CON	WF	32
MO	Baker Cypress	CON	WF	32
MP	Mixed Conifer - Pine	CON	WF	32
MS	Sargent Cypress	CON	WF	32
MT	Tecate Cypress	CON	WF	32
MU	Ultramafic Mixed Conifer	CON	WF	32
MY	Pygmy Cypress	CON	WF	32
MZ	Santa Cruz Cypress	CON	WF	32
PB	Brewer Spruce	CON	WF	32
PC	Coulter Pine	CON	WF	32

PD	Gray Pine	CON	WF	32
PJ	Singleleaf Pinyon Pine	CON	WF	32
PL	Limber Pine	CON	WF	32
PM	Bishop Pine	CON	WF	32
PO	Port Orford Cedar	CON	WF	32
PP	Ponderosa Pine	CON	WF	32
PQ	Fourneedle Pinyon Pine	CON	WF	32
PR	Monterey Pine	CON	WF	32
PS	Shore Pine	CON	WF	32
PT	Torrey Pine	CON	WF	32
PW	Ponderosa Pine - White Fir	CON	WF	32
RD	Redwood - Douglas-Fir	CON	WF	32
RF	Red Fir	CON	WF	32
RW	Redwood	CON	WF	32
SA	Subalpine Conifers	CON	WF	32
SG	Sitka Spruce - Grand Fir	CON	WF	32
SK	Sitka Spruce	CON	WF	32
SR	Sitka Spruce - Redwood	CON	WF	32
WB	Whitebark Pine	CON	WF	32
WF	Whte Fir	CON	WF	32
WJ	Western Juniper	CON	WF	32
WP	Washoe Pine	CON	WF	32
WW	Western White Pine	CON	WF	32
	HARDWOOD FOREST/WOODLAND			
IH	Non-native Hardwood	HDW	WF	32
NR	Mixed Riparian Hardwoods	HDW	WR	31
NX	Mixed Hardwoods	HDW	WF	32
Q1	Live Oak - Madrone	HDW	WF	32
QA	Coast Live Oak	HDW	WF	32
QB	California Bay	HDW	WF	32
QC	Canyon Live Oak	HDW	WF	32
QD	Blue Oak	HDW	WF	32
QE	White Alder	HDW	WR	31
QF	Fremont Cottonwood	HDW	WR	31
QG	Oregon White Oak	HDW	WF	32
QH	Madrone (Black Oak)	HDW	WF	32
QI	California Buckeye	HDW	WF	32
QJ	Cottonwood - Alder	HDW	WR	31
QK	California Black Oak	HDW	WF	32
QL	Valley Oak	HDW	WF	32
QM	Bigleaf Maple (Dogwood)	HDW	WR	31
QN	Engelmann Oak	HDW	WF	32
QO	Willow	HDW	WR	31
QP	California Sycamore	HDW	WR	31
QQ	Quaking Aspen	HDW	WR	31
QR	Red Alder	HDW	WR	31

QS	Willow - Aspen	HDW	WR	31
QT	Tanoak (Madrone)	HDW	WF	32
QV	Black Walnut	HDW	WR	31
QW	Interior Live Oak	HDW	WF	32
QX	Black Cottonwood	HDW	WR	31
QY	Willow - Alder	HDW	WR	31
QZ	Eucalyptus	HDW	WF	32
TA	Mountain Alder	HDW	WR	31
TC	Tree Chinquapin	HDW	WF	32
UI	Desert Ironwood	HDW	WF	32
UJ	Joshua Tree	HDW	WF	32
UL	Catclaw Acacia	HDW	WF	32
UM	Mesquite	HDW	WF	32
UP	Palo Verde	HDW	WF	32
UT	Tamarisk	HDW	WR	31
UW	Fan Palm	HDW	WR	31
UX	Smoke Tree - Desert Willow	HDW	WR	31
	SHRUB TYPES			
AC	Cushion Plant	SHB	S	29
AX	Mixed Alpine Scrub	SHB	S	29
AN	Mendocino Manzanita	SHB	S	29
BB	Bitterbrush	SHB	S	29
BC	Saltbush	SHB	S	29
BG	Black Greasewood	SHB	S	29
BL	Low Sagebrush	SHB	S	29
BM	Curlleaf Mountain Mahogany	SHB	S	29
BR	Rabbitbrush	SHB	S	29
BS	Basin Sagebrush	SHB	S	29
C1	Ultramafic Mixed Shrub	SHB	S	29
CA	Chamise	SHB	S	29
CB	Salal - California Huckleberry Shrub	SHB	S	29
CC	Foothill Mixed Chaparral	SHB	S	29
CD	Southern Mixed Chaparral	SHB	S	29
CG	Greenleaf Manzanita	SHB	S	29
CH	Huckleberry Oak	SHB	S	29
CI	Deerbrush	SHB	S	29
CJ	Brewer Oak	SHB	S	29
CK	Coyote Brush	SHB	S	29
CL	Wedgeleaf Ceanothus	SHB	S	29
CM	Upper Montane Mixed Shrub	SHB	S	29
CN	Pinemat Manzanita	SHB	S	29
CQ	Northern Mixed Chaparral	SHB	S	29
CR	Red Shanks Charparral	SHB	S	29
CS	Scrub Oak	SHB	S	29
CT	Tucker Scrub Oak	SHB	S	29
CV	Snowbrush	SHB	S	29

CW	Whiteleaf Manzanita	SHB	S	29
CX	Montane Mixed Chaparral	SHB	S	29
CZ	Semi Desert Chaparral	SHB	S	29
DA	Blackbush	SHB	S	29
DB	Desert Buckwheat	SHB	S	29
DC	Cholla	SHB	S	29
DD	Croton	SHB	S	29
DO	Ocotillo	SHB	S	29
DL	Creosote	SHB	S	29
DS	Shadscale	SHB	S	29
DX	Mixed Desert Shrub	SHB	S	29
IS	Non-native Shrub	SHB	S	29
NC	North Coastal Mixed Shrub	SHB	S	29
SB	Buckwheat (White Sage)	SHB	S	29
SC	Blueblossom Ceanothus	SHB	S	29
SD	Manzanita Chaparral	SHB	S	29
SP	Sage	SHB	S	29
SS	California Sagebrush	SHB	S	29
	HERBACEOUS TYPES			
DE	Arrowweed	HEB	PFW	23
GR	Unknown Grass	HEB	G	25
HC	Pickleweed - Cord Grass	HEB	SEW	22
HG	Annual Grass/Forbs	HEB	G	25
HJ	Wet Meadows (Grass/Sedge/Rush)	HEB	PFW	23
HM	Perennial Grass	HEB	G	25
HT	Tule - Cattail - Sedge	HEB	PFW	23

GAP Analysis Classification Crosswalk Table (Values 41-56 in output image)

WHR1	WHR Habitat Type	CALFED	CLASS CODE
ADS	Alpine-Dwarf Shrub	S	49
AGS	Annual Grassland	G	45
ASC	Alkali Desert Scrub	S	49
ASP	Aspen	WR	51
BAR	Barren	ODD	55
BBR	Bitterbrush	S	49
BOP	Blue Oak-Foothill Pine	WF	52
BOW	Blue Oak Woodland	WF	52
COW	Coastal Oak Woodland	WF	52
CPC	Closed-Cone Pine-Cypress	WF	52
CRC	Chamise-Redshank Chaparral	S	49
CRP	Cropland	OA	48
CSC	Coastal Scrub	S	49
DFR	Douglas-Fir	WF	52
DGR	Dryland Grain Crops	OA	48
DOR	Deciduous Orchard	OV	50
DRI	Desert Riparian	WR	51
DSC	Desert Scrub	S	48
DSS	Desert Succulent Shrub	S	48
DSW	Desert Wash	S	48
EOR	Evergreen Orchard	OV	50
EPN	Eastside Pine	WF	52
EST	Estuarine	SEW	42
EUC	Eucalyptus	WF	52
FEW	Freshwater Emergent Wetland	PFW	43
IGR	Irrigated Grain Crops	OA	48
IRF	Irrigated Row and Field Crops	OA	48
IRH	Irrigated Hayfield	OA	48
JPN	Jeffrey Pine	WF	52
JST	Joshua Tree	WF	52
JUN	Juniper	WF	52
KMC	Klamath Mixed Conifer	WF	52
LAC	Lacustrine	OW	41
LPN	Lodgepole Pine	WF	52
LSG	Low Sage	S	48
MCH	Mixed Chaparral	S	48
MCP	Montane Chaparral	S	48
MHC	Montane Hardwood-Conifer	WF	52
MHW	Montane Hardwood	WF	52
MRI	Montane Riparian	WR	51
OVN	Orchard and Vineyard	OV	50
PAS	Pasture	G	45
PGS	Perennial Grassland	G	45

PJN	Pinyon-Juniper	WF	52
POS	Palm Oasis	WR	51
PPN	Ponderosa Pine	WF	52
RDW	Redwood	WF	52
RFR	Red Fir	WF	52
RIC	Rice	FA	47
RIV	Riverine	OW	41
SCN	Subalpine Conifer	WF	52
SEW	Saline Emergent Wetland	SEW	42
SGB	Sagebrush	S	48
SMC	Sierran Mixed Conifer	WF	52
URB	Urban	U	54
VIN	Vineyard	OV	50
VOW	Valley Oak Woodland	WF	52
VRI	Valley-Foothill Riparian	WR	51
WFR	White Fir	WF	52
WTM	Wet Meadow	PFW	43

Vernal Pool Classification Crosswalk Table (Values 400-417 in output image)

Cover Type	CALFED TYPE	CLASS CODE
Cut Out	NA	0
Low Density	Vernal Pool	66
Medium Density	Vernal Pool	66
High Density	Vernal Pool	66
Developed	Vernal Pool	66
Mitigated	NA	0
Extirpated	NA	0
Disturbed 1	Vernal Pool	66
Disturbed 2	Vernal Pool	66

DOC Urban contains all "Developed" land from the original data sets. These urban areas were recoded to value 94 in the output image.

DWR Urban contains all areas that contain the values UR-Urban Residential (including ranchettes, etc.), UC-Urban Commercial, UV-Urban Vacant, UL-Urban Landscape (golf courses, etc.), and UI-Urban Industrial. These urban areas were recoded to value 114 in the output image.

Land Cover GIS Metadata

Background and Purpose

The following information provides metadata for the ARC/INFO coverage of land cover produced to aid development of the conservation strategy. This coverage provided regional-scale data for assessment of the effects on covered species. This assessment resulted in preliminary estimates and land status and covered species habitat.

Data Sources

Overview

The land cover map represents the best available data appropriate for a regional assessment of the San Joaquin Valley. This data was from the Department of Conservation's (DOC's) Important Farmland Mapping Program (Department of Conservation 2001); the California Department of Water Resources' (DWR's) Urban Boundaries (California Department of Water Resources 2001); DFG's Wetland Riparian and Vernal Pool GIS Mapping Layers (Ducks Unlimited 1997); and California GAP (GAP) (California GAP Davis et al. 1998). The California GAP was updated with the California Department of Forestry and Fire Protection's (CDF's) Hardwood Rangeland forest types (California Department of Forestry and Fire Protection 1994). Descriptions of these data sources are below, and links to the on-line metadata for each source are provided in the references cited section of this appendix.

Important Farmland

For areas with modern soil surveys this coverage maps farm, grazing and urban land (Department of Conservation 2001). It is based on aerial photographs of various scales and field reconnaissance, and is updated biennially. Only the urban categories were used from this data set. The urban category has a minimum mapping unit of 10 acres, and urban is defined as a building density of at least 1 unit to 1.5 acres, or approximately 6 structures to a 10 acre parcel.

Urban Boundaries

Only the urban land use types were used from this data set. The data cover a range of years (1994–1999), since individual counties are responsible for maintaining land use. These data were derived from air photo interpretation (scale not available) and extensive field visits (California Department of Water Resources 2001).

California Wetland and Riparian GIS

This coverage maps land cover within the Central Valley up to 300 feet in elevation (Ducks Unlimited 1997). It was produced from satellite imagery (primarily from 1993) using image classification techniques. Both summer and winter images were used to improve the classification's accuracy. Classification was performed through a combination of supervised and unsupervised classification techniques, and field data, aerial photography and other ancillary data sources were used in the labeling of spectral clusters.

California GAP

This coverage maps land cover within each of ten major regions of the state (Davis et al. 1998). It was produced from 1990 Landsat Thematic Mapper satellite imagery guided by high altitude aerial photography (1990), vector overlays of existing vegetation and land use maps, and forest inventory data. Upland types were mapped with a minimum mapping unit of 100 hectares, major wetlands were mapped with a 40-hectare-minimum mapping unit, and smaller wetlands were encoded as attributes of upland polygons.

California Hardwood Rangeland Vegetation

This coverage maps vegetation below 5,000 feet in elevation (California Department of Forestry and Fire Protection 1994). It was originally mapped in 1981 from 1:24,000 scale aerial photographs, and then updated using 1990 LANDSAT TM imagery. It consists of 25 meter pixels coded with a cover type, and for woodland and forest cover types, each pixel also is coded with a canopy closure class.

California Vernal Pool GIS

This coverage maps areas of vernal pools throughout the Central Valley. It was produced from aerial photographs (approximately 1:10,400 scale, dates unavailable) and had a minimum mapping unit of approximately 40 acres (Holland 1996). Each polygon was coded vernal pool density and disturbance

attributes. This land cover coverage was not incorporated into the PG&E land cover layer, but was later used to estimate the acreage of vernal pools that may be affected by P&E activities.

Assembly of Data Sources into Land Cover Layer

Overview

Integrating the data sources into one coverage involved selecting the best available data source for each location within our coverage boundary, combining these sources into a single image, and then processing this image to produce a vector-based ARC/INFO coverage in the Albers Equal Area Projection, datum NAD27, Spheroid Clark 1866 (units meters).

For urban and other developed land cover types, the Important Farmland coverage was the primary layer. For areas not included in the Important Farmland coverage, the California Hardwood Rangeland Vegetation coverage was used. For areas not covered by the previous two sources, the Urban Boundaries coverage was used. In areas not mapped by any of these three sources, the California GAP coverage was used. The mapping of urban areas superceded the mapping of natural vegetation and agricultural lands because urban areas were primarily based on the Important Farmland coverage, which is the most recent coverage.

For natural vegetation and agricultural lands, different data sources were used below 300 feet in elevation than above 300 feet in elevation. Below 300 feet in elevation, the California Wetland and Riparian GIS coverage was the primary data source (for 40% of total area containing 44% of PG&E facilities). Above 300 feet in elevation, the California Hardwood Rangeland Vegetation coverage was the primary data source (For 44% of total area containing 18% of PG&E facilities). For areas not included in the California Hardwood Rangeland Vegetation Coverage 8% of total area containing 11% of PG&E facilities), the California GAP coverage was used. The Upland Woodland and Forest category from GAP was recoded into Blue Oak/Foothill Pine in the northwest, Valley Oak Woodland in the southwest, and Conifer in the east to more accurately reflect these woodland types. Each of these types comprises a small portion (<2%) the overall plan area.

To produce a vector-based ARC/INFO coverage, the selected data was combined into a single image and recoded to the PG&E land cover classes using the Spatial Modeler in ERDAS Imagine 8.5; this image was then processed and converted into a vector-based format using an ARC/INFO raster-to-vector conversion routine. The steps in this process were designed to preserve the integrity of the original data sources. The Important Farmland and the Urban Boundaries coverages were converted to images at the same resolution (25 meter pixels) as the image-based layers. A raster-to-vector function was used in ArcInfo to convert the vector data to image data.

The full resolution vector-based land cover data was used for analyses involving the electric and gas transmission. As a result of the electric distribution data and full resolution land cover data covering such a large area and large quantity of spatial data, the land cover data set needed to be simplified. To accomplish this an elimination routine was applied to the full resolution image-based land cover data set. Areas that were less than or equal to 4 contiguous pixels of the same land cover type (2500 square meters or 0.61 acres) were eliminated and filled in with its majority neighboring land cover type.

After all data sets were converted into an image format, the Spatial Modeler in Imagine was used to assemble the data. The specific process was as described in the following sections.

Inaccuracy in analyses based on this coverage potentially could result from mismatching boundaries between multiple data sets, data conversion, variance in source scale of spatial information, elimination of very small land cover units (as described above), and differences in the time period when data sets were completed and published. Although these kinds of inaccuracies may exist, they are unlikely to invalidate the basic conclusions drawn from regional-scale analyses.

Assembly of Urban Boundaries

The specific assembly process in Spatial Modeler was:

1. The California Department of Conservation (CDOC) Important Farmland GIS was the primary layer for the urban category.

2. In counties where CDOC Important Farmland was not mapped, CDF Hardwood Rangelands was used for urban designations (primarily in the uplands).

3. In counties where no CDOC Important Farmland was available and no CDF Hardwood Rangelands was available, DWR Land Use GIS urban designations were used.

4. In counties where no CDOC, CDF, or DWR urban categories were available, the California Gap Analysis urban category was used.

In all cases, DWR land use code of urban residential (UR), urban commercial (UC), urban vacant (UV), urban landscape (UL), and urban industrial (UI) was classified as urban.

Natural Plant Communities and Agricultural Lands

Valley Floor (<300 feet elevation)

DFG California Central Valley Wetland and Riparian GIS was the primary data source. The urban layer superceded the CDFG Wetland and Riparian GIS.

Other Areas

The specific assembly process in Spatial Modeler was:

1. The CDF Hardwood Rangelands was be used as the primary data source outside the area that was occupied by the DFG Wetland and Riparian GIS.

2. Where the two overlap, the CDF data superceded the DFG data.

3. In areas where no CDF data nor DFG data were mapped, California Gap Analysis data was used for the land cover data layer. The Upland Woodland and Forest category from GAP was recoded into Blue Oak/Foothill Pine in the northwest, Valley Oak Woodland in the southwest, and Conifer in the east. Each of these types was relatively small compared to the overall project area.

Land Cover Classification

A classification system for land-cover types was developed for the plan area based on WHR, Holland (1986), Sawyer and Keeler-Wolf (1995), Mayer and Laudenslayer (1988), and recommendations by Jones & Stokes senior wildlife biologists and botanists. It contains 15 land cover types, which are described below, and whose correspondence to the land cover types used by data sources is shown in Table B-3. Plant species nomenclature follows *The Jepson Manual* (Hickman 1993).

Agricultural Fields (AG)

The agriculture land-cover type encompasses all areas where the native vegetation has been cleared for agriculture. This land cover type may include orchards, vineyards, row crops, irrigated pasture crops, and fallow fields.

Blue Oak Woodland (BOW)

The blue oak woodland land-cover type includes woodland dominated by blue oak (*Quercus douglasii*), with included patches of coast live oak (*Quercus*

agrifolia), interior live oak (*Quercus wislizenii*), and valley oak (*Quercus lobata*). At higher elevations, foothill pine (*Pinus sabiniana*) becomes frequent. Shrub species found within blue oak woodland include poison-oak (*Toxicodendron diversilobum*), California coffeeberry (*Rhamnus californica*), California buckeye (*Aesculus californica*), holly-leaf cherry (*Prunus ilicifolia*) and manzanitas (*Arctostaphylos* spp.). The herb layer is mainly annual grasses and forbs.

Blue Oak/Foothill Pine (BOFP)

Blue oak and foothill pine form a mixed, open canopy in blue-oak/foothill pine type. Associated tree species include blue oak, interior live oak, California buckeye, and elderberry (*Sambucus mexicana*), with chaparral species such as manzanitas, chamise (*Adenostoma fasciculatum*), and buckbrush (*Ceanothus cuneatus*) in the understory.

Coastal Oak Woodland (COW)

The coastal oak woodland land cover-type includes vegetation such as coast live oak, Pacific madrone (*Arbutus menziesii*), interior live oak, foothill pine, and California blackberry (*Rubus ursinus*).

Conifer (CON)

This land cover-type includes the WHR habitat types Sierran mixed conifer, closed-cone pine-cypress, and Ponderosa pine.

Sierran mixed conifer forest has a multi-layered canopy that includes five conifers: white fir (*Abies concolor*), Douglas-fir (*Pseudotsuga menziesii*), Ponderosa pine (*Pinus ponderosa*), sugar pine, and incense cedar (*Calocedrus decurrens*); and one hardwood, black oak (*Quercus kelloggii*). Shrubs such as deerbrush (*Ceanothus integerrimus*), manzanitas, bitter cherry (*Prunus emarginata*), gooseberries and currants (*Ribes* spp.), and mountain misery (*Chamaebatia foliolosa*) occur in openings.

Closed-cone pine-cypress generally occur on low-nutrient or serpentine substrates, the species in the plan area are Gowan cypress (*Cupressus goveniana*) and knobcone pine. The shrub layer is generally well-developed and includes manzanitas, ceanothus, shrubby oaks, buckthorn, and poison-oak.

Ponderosa pine woodland varies from pure stands of Ponderosa to mixed stands with oaks, Pacific madrone (*Arbutus menziesii*) and other conifers. Associated shrubs include manzanitas, mountain-misery, ceanothus, yerba-santa (*Eriodictyon californicum*), bitter cherry, poison-oak, and Sierra gooseberry (*Ribes roezlii*).

Grassland (G)

Grassland consists of herbaceous vegetation dominated by grasses and forbs. This land-cover type includes a variety of habitat types: annual grassland, perennial grassland, pasture, valley sacaton grassland, alkali meadow, and vernal pools.

Annual grasslands are dominated by introduced annuals, including wild oats (*Avena* spp.), brome grasses (*Bromus* spp.), barleys (*Hordeum* spp.), and annual fescues (*Vulpia* spp.). Common herbs are also introduced annuals such as filarees (*Erodium* spp.) and clovers (*Trifolium* spp.), and native species such as fiddleneck (*Amsinkia* spp.), lupines (*Lupinus* spp.), and owl's-clover (*Castilleja* spp.). These annuals germinate after late fall and winter rains and grow, flower and set seed through spring. Most of these plants die by summer.

Perennial grasslands are dominated by California oatgrass (*Danthonia californica*), sweet vernal grass (*Anthoxanthum odoratum*), brome grasses, and fescues (*Festuca* spp.). The associated herb cover includes native and non-native forbs and native wildflowers.

Pasture is cultivated for grazing, and may be irrigated.

Vernal pools include northern claypan and northern hardpan vernal pools. These communities are dominated by native annual species that germinate, grow, and flower as the pools dry up in the spring. Characteristic species include goldfields (*Lasthenia* spp), downingia (*Downingia* spp), meadowfoam (*Limnanthes alba*), navarettia (*Navarettia* spp.), and popcorn flower (*Plagiobothrys* spp.).

Valley sacaton grassland occurs in the San Joaquin Valley, especially on the fine-textured, usually alkaline soils of the Tulare Lake Basin area, where it used to be extensive. Alkali sacaton (*Sporobolus airoides*), a tussock-forming, native, perennial grass, is the dominant species, and saltgrass and low barley (*Hordeum depressum*) are common.

Alkali meadow is characterized by open to dense perennial grasses and sedges, and occurs on fine-textured, alkaline soils that are usually permanently moist. Typical plants include yerba mansa, sedges, saltgrass, rushes, alkali mallow (*Malvella leprosa*), alkali cord grass (*Spartina gracilis*), and alkali sacaton.

Montane Hardwood (MHW)

This land cover-type includes the WHR habitats montane hardwood, montane hardwood conifer, and montane riparian.

Montane hardwood has a clear hardwood layer with a sparse shrub layer, and may include occasional coniferous trees. The dominant tree in the plan area canyon live oak is (*Quercus chrysoplepis*), with a small component of foothill pine, knobcone pine *(Pinus attenuata*), and Pacific madrone. This habitat type

borders mixed conifer, montane hardwood-conifer, and mixed chaparral habitat types.

Montane hardwood conifer consists of a diverse mixture of hardwood and conifer trees, comprising at least one-third conifers and one-third broadleaved trees. The tree canopy is typically dense and multi-layered; characteristic trees in the plan area include black oak, black cottonwood (*Populus balsamifera*), canyon live oak, ponderosa pine, sugar pine, and incense cedar.

Montane riparian habitat as a narrow band of deciduous broadleaved trees along seeps, streams and rivers. In the plan area characteristic trees include (*Populus tremuloides*), willows, and white alder (*Alnus rhombifolia*).

Open Water (OW)

Open water land-cover types are natural and man-made aquatic habitats that support submerged or floating vegetation, such as lakes, reservoirs, flood control basins, ponds (including stock ponds), sloughs, canals, and rivers. Many of the large water bodies include permanent and seasonal wetland and riparian communities along their edge.

Other Developed and Disturbed Lands (ODD)

This land cover-type includes the barren WHR habitat type include other developed and disturbed lands consisting of perennial weeds, non-native species, and land with urban infrastructure.

Permanent Freshwater Wetland (PFW)

This land cover-type includes freshwater emergent wetland and wet meadow. Dominant vegetation in freshwater wetlands includes cattails (*Typha* spp.), tules and bulrushes (*Scirpus* spp.), sedges (*Carex* spp.), nutsedges (*Cyperus* spp.), arrowhead (*Sagittaria* spp.), baltic rush (*Juncus balticus*), and common reed (*Phragmites australis*), and on more alkali sites, saltgrass (*Distichlis spicata*).

Seasonal Wetland (SW)

Seasonal wetlands support ponded or saturated soil conditions, but generally only during winter and spring. The vegetation is composed of wetland generalists, such as hyssop loosestrife (*Lythrum hyssopifolia*), cocklebur (*Xanthium* spp.), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*) and Italian ryegrass (*Lolium multiflorum*), that typically occur in frequently disturbed sites, such as along streams.

Cismontane alkali marsh – yerba mansa (*Anemopsis californica*), saltgrass, rushes, pickleweed (*Salicornia virginica*), cattails, alkali heath (*Frankenia salina*).

Upland Scrub (US)

This land cover type includes a wide variety of shrub types, including but not limited to alkali desert scrub (including valley/Coast Range Saltbush scrub and Valley sink scrub) and three types of chaparral: mixed, chamise-redshank, and montane.

Alkali desert scrub is similar to the WHR type "Valley/Coast Range Saltbush Scrub and Valley Sink Scrub", and includes both xerophytic and halophytic shrub-dominated communities such as valley/Coast Range Saltbush scrub and Valley sink scrub. These habitat types are dominated by shrubs in the chenopod family, especially all-scale (*Atriplex polycarpa*), and other Atriplex species. Characteristic shrubs of Valley and Coast Range Saltbush scrub include all-scale, arrowscale (*Atriplex phyllostegia*), goldenbush (*Isocoma acradenia* var. *bracteosa*), bladderpod (*Isomeris arborea*), and alkali heath.

Valley sink scrub is an open shrub-dominated community on highly alkaline soils, usually heavy, sticky clay. Alkali playas (or balds) are common. The groundwater table is usually high, and the soil surface is often covered with a salty crust. Characteristic shrubs include iodine bush (*Allenrolfea occidentalis*), bush seepweed (*Suaeda moquinii*), and typical forbs are saltgrass, nitrophila (*Nitrophila occidentalis*), pickleweed (*Salicornia subterminalis*), and alkali sacaton.

Three types of chaparral are distinguished in the plan area, and are characterized by dense stands of evergreen shrubs whose species composition varies greatly with elevation, location, aspect, climate, and substrate. Fire is regular in these communities, and influences structure and species composition. Herbaceous plants include annual and perennial grasses and forbs in small openings in the shrub canopy.

Mixed chaparral is typically dense and diverse. Dominant species include shrubby oaks (*Quercus* spp.), manzanitas, and several species of ceanothus, in mixed or patchy stands. Commonly associated shrubs include chamise, toyon, yerba-santa, birchleaf mountain-mahogany (*Cercocarpa betuloides*), buckeye, silk-tassel (*Garrya* spp.), fremontia (*Fremontia californicum*), and chaparral-pea (*Pickeringia montana*).

Chamise-redshank chaparral is characterized by a dense monolayer dominated by chamise and redshank. Associated shrubs are similar to those in mixed chaparral.

Montane chaparral is characterized by evergreeen shrubs with small amounts of broadleaved species. Typical shrubs include mountain whitethorn (*Ceanothus*

cordulatus), manzanitas, bitter cherry, huckleberry oak, mountain-mahogany, and toyon.

Urban (U)

Developed areas include all types of urban development for residential, commercial, industrial, and recreational uses. Developed areas also include sites that have structures, paved surfaces, horticultural plantings, and lawns.

Valley Oak Woodland (VOW)

Valley oak woodland is strongly dominated by valley oak, but may also contain blue oak, California sycamore, black walnut, and boxelder. The canopy layer is typically open, forming a savanna structure rather than woodland. Associated understory shrubs include elderberry, poison oak, toyon, and California blackberry. The herb layer is often dominated by leymus grass (*Leymus triticoides*), and includes a variety of annual and perennial grasses and forbs.

Woody Riparian Habitat (WR)

The woody riparian land-cover type includes valley-foothill riparian and desert riparian habitat types (as defined by WHR). Woody riparian types include Great Valley Cottonwood Riparian Forest and Great Valley Mixed Riparian Forest, and are dominated by trees and shrubs such as Fremont's cottonwood (*Populus fremontii* ssp. *fremontii*), valley oak, sycamore (*Platanus racemosa*), box elder (*Acer negundo*), willows, blackberries (*Rubus* spp.), buttonbush (*Cephalanthus occidentalis*), and California grape (*Vitis californica*).

References Cited

DOC [California Department of Conservation]. 2001. Farmland Mapping and Monitoring Program metadata. Farmland Mapping and Monitoring Program, California Department of Conservation, Sacramento, CA. Available: <ftp://ftp.consrv.ca.gov/pub/dlrp/FMMP/fmmp_meta.txt>

DWR [California Department of Water Resources]. 2001. California Department of Water Resources, Division of Planning and Local Assistance, land use data. Last Revised: December 27, 2001. Available: <http://www.waterplan.water.ca.gov/landwateruse/landuse/ludataindex.htm>. Accessed: November 20, 2002.

Davis, F. W., D. M. Stoms, A. D. Hollander, K. A. Thomas, P. A. Stine, D. Odion, M. I. Borchert, J. H. Thorne, M. V. Gray, R. E. Walker, K. Warner,

and J. Graae. 1998. The California Gap Analysis Project--Final Report. University of California, Santa Barbara, CA. Available: <http://www.biogeog.ucsb.edu/projects/gap/gap_home.html>

CDF [California Department of Forestry and Fire Protection]. 1994. California hardwood rangeland vegetation. California Department of Forestry and Fire Protection, Sacramento, CA. Available: <http://frap.cdf.ca.gov/data/frapgisdata/select.asp>.

Ducks Unlimited. 1997. California Wetland and Riparian Geographic Information System Project: final report January 17, 1997. Ducks Unlimited, Sacramento, CA. Available: < http://maphost.dfg.ca.gov/wetlands/metadata/wet_ph1.pdf>

Holland, R. F. 1996. Great Valley vernal pool distribution, photorevisited 1996. Pages 71-76 in C. Witham (ed.) Ecology, conservation, and management of vernal pool ecosystems: proceedings from a 1996 conference. California Native Plant Society, Sacramento, CA.

Table B-3. Crosswalk between Land Cover Types in Land Cover Classification and in Data Source Coverages

Land Cover Type	DFG Land Cover Type(s)[1]	CDF Land Cover Type(s)[2]	GAP Land Cover Type(s)[3]
Natural Vegetation Cover Types			
Blue oak woodland	–	Blue oak woodland	Blue oak woodland
Blue oak/foothill pine	–	Blue oak/foothill pine	Blue oak-foothill pine Jeffery pine
Coastal oak woodland	–	Coastal oak woodland	Coastal oak woodland
Conifer	–	Conifer	Closed-cone pine-cypress Douglas-fir Lodgepole pine Ponderosa pine Red fir Sierran mixed conifer White fir
Grassland	Grassland	Grass	Annual grassland Pasture Perennial grassland
Montane hardwood	–	Montane hardwood	Montane hardwood-conifer Montane hardwood Montane riparian
Open water	Open Water	Open water	Lacustrine Riverine
Permanent freshwater wetland	Permanently flooded palustrine emergent	–	Freshwater emergent wetland Wet meadow

Table B-3. Continued

Land Cover Type	DFG Land Cover Type(s)[1]	CDF Land Cover Type(s)[2]	GAP Land Cover Type(s)[3]
Seasonal wetland	Seasonally flooded estuarine emergent	–	–
Upland scrub	–	–	Alpine-dwarf shrub
			Alkali desert scrub
			Bitterbrush
			Chamise-redshank chaparral
			Coastal scrub
			Desert scrub
			Desert succulent scrub
			Desert wash
			Low sage
			Mixed chaparral
			Montane chaparral
			Sage brush
Valley oak woodland	–	Valley oak woodland	Valley oak woodland
Woody riparian habitat	Riparian woody	–	Aspen
			Desert riparian
			Valley foothill riparian

Table B-3. Continued

Land Cover Type	DFG Land Cover Type(s)[1]	CDF Land Cover Type(s)[2]	GAP Land Cover Type(s)[3]
Developed & Agricultural Cover Types			
Agricultural fields	Flooded agriculture	–	Cropland
	Seasonally flooded agriculture		Dryland grain crops
	Non-flooded agriculture		Deciduous orchard
	Orchard/vineyard		Evergreen orchard
			Irrigated grain crops
			Irrigated row and field crops
			Irrigated hayfield
			Orchard and vineyard
			Rice
			Vineyard
Other developed and disturbed land	Other	–	Barren
Urban	Other	Urban	Urban

Notes:

[1] The California Wetland and Riparian GIS coverage used this classification.

[2] The California Hardwood Rangeland Vegetation coverage used this classification.

[3] The California GAP coverage used this classification.

Appendix C

Analysis of Species' Distributions with Respect to Geologic Units

Appendix C

Analysis of Species' Distributions with Respect to Geologic Units

Geologic units differ in parent material and the duration of their exposure. Consequently, they differ in the distributional density of vernal pools and clay playas; in soil attributes; and to some degree in the area, depth, and hydrology of the pools they support. Several researchers have documented or suggested differences in species distributions across geologic units (Platenkamp 1998; Helm and Vollmar 2002). Accordingly, the physical differences in these surfaces are likely to be reflected in the vernal pool ecosystems upon them—including the special-status species associated with vernal pool habitats.

This appendix summarizes the analysis of the distribution of vernal pool–associated species with respect to the geologic units in the project region described by Marchand and Allwardt (1981). This analysis was based on geographic information system (GIS) data layers of the geologic formations (unpublished data file, California Department of Fish and Game) and vernal wetlands (EIP 2002b) of the project region, and of the results of surveys for conservancy fairy shrimp (*Branchinecta conservatio*), vernal pool fairy shrimp (*B. lynchi*), midvalley fairy shrimp (*B. mesovallensis*), vernal pool tadpole shrimp (*Lepidurus packardi*), succulent owl's-clover (*Castilleja campestris* ssp. *succulentus*), Colusa grass (*Neostapfia colusana*) and San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*) (EIP 1999a and 1999b; URS 2001a, Dittes and Guardino 2002; Helm and Vollmar 2002). These surveys were based on either samples or censuses of vernal wetlands (i.e., vernal pools and swales). For each species survey based on a sample, the number of searched and occupied vernal wetlands on each geologic unit was tabulated. For each species survey based on a census, the number of occupied wetlands and the acreage of surveyed vernal wetlands on each geologic unit were tabulated. These tabulations were the basis for the statistical evaluation of species' distributions.

The statistical evaluation tested the hypothesis that species were distributed in vernal wetlands independently of geologic unit. In other words, if the underlying geologic unit has no influence on the likelihood of a species occupying a vernal wetland, then the species should occupy the same proportion of wetlands, or wetland area, on all geologic units. Therefore, for sample-based surveys, the correlation of species' frequency to the geologic units on which they occur was evaluated using a test for independence (Zar 1999). For census-based surveys, the species' distribution among geologic units was evaluated through a goodness

of fit test (Zar 1999), in which the distribution of occupied sites was expected to be proportional to the area of vernal wetlands on each geologic unit.

The sample- and census-based surveys were treated differently to address the limitations of the available data. Because only the boundary of the surveyed area was recorded for the censuses, and not the number of surveyed locations, the GIS map of eastern Merced County's vernal wetlands was the only source of information regarding the number or area of surveyed wetlands. In this wetlands map, vernal pools and swales were frequently mapped as interconnected complexes, particularly when they were present at high density; consequently, determining their number in a consistent manner was somewhat problematic. Accordingly, for the censuses, the analysis as based on the area of wetlands on each geologic unit. In contrast, the samples recorded the number of locations surveyed and their location. Unfortunately, because the recorded locations of samples did not always correspond to wetland locations on the wetland map, determining the area of wetlands sampled was problematic. Accordingly, for the samples, the analysis was based on the frequency of species in the wetlands surveyed on each geologic unit.

San Joaquin Valley Orcutt grass, Colusa grass, and Conservancy fairy shrimp were too rare to support statistical analysis of their distribution across geologic surfaces. Despite their rarity, however, they did occur on more than one geologic surface.

The distribution of vernal pool fairy shrimp, midvalley fairy shrimp, vernal pool tadpole shrimp, and succulent owl's-clover was not independent of geologic unit (Tables C-1, C-2, C-3, and C-4). The results of samples contained significant ($P < 0.05$) or suggestive ($P < 0.10$) differences among geologic units in the frequency of occupied wetlands. Similarly, the census results indicated that the percentage of occupied wetlands on each geologic unit had significant or suggestive differences from the proportion of the censused area on each geologic unit. For example, in the vernal pool tadpole shrimp surveys by Vollmar Consulting (Vollmar and Helm 2001), just 23% of the wetlands sampled were on the Riverbank Formation, yet 69% of wetlands that supported the species were on this formation (Table C-3). Similarly, in the URS census of wetlands for vernal pool tadpole shrimp, 57% of the area surveyed was on the Riverbank Formation, while 74% of the occupied sites were on this formation (Table C-3).

In general, the Riverbank Formation supported more sites occupied by these four species than was expected (Tables C-1, C-2, C-3 and C-4). Because a substantial portion of vernal wetlands occurs on this substrate, and these wetlands contain a disproportionate share of the occupied habitat, lands on the Riverbank Formation have a high value for conservation.

However, with the exception of vernal pool tadpole shrimp, these species were not strongly associated with a particular geologic unit. Each of these species was found on most of the geologic units, and the observed frequencies on most units did not differ dramatically from those expected if species were distributed independently of geologic unit.

Furthermore, associations with particular geologic units were not consistent across all surveys. For example, in the areas sampled by Jones & Stokes, succulent owl's-clover was much more frequent on North Merced Gravels than expected, while in the areas surveyed for the Vollmar Consulting regional study (Dittes and Guardino 2002), it occupied far fewer sites on North Merced Gravels than expected (Table C-4).

In conclusion, although underlying geologic units either affect species' distributions or are correlated with a variable (or variables) that affects distributions, these relationships are not strong enough to serve as the basis for models of species' distributions. Rather, the observed differences in distribution among units suggest that geologic units could be considered indicators of different physical habitats for these species, but that vernal pools on any unit represent potential habitat.

Table C-1. Distribution of Vernal Pool Fairy Shrimp among Geologic Units

Survey Name	EIP VST and Campus Lands 1998–1999		EIP Community Plan		URS Parkway Project		Vollmar Consulting Regional Study	
Basis	Sample (N = 720 wetlands)		Census (82 acres of wetlands)		Census (81 acres of wetlands)		Sample (N = 1,275)	
Unit	Sites Observed No. (%)	Sites Expected No. (%)	Sites Observed No. (%)	Sites Expected No. (%)	Sites Observed No. (%)	Sites Expected No. (%)	Sites Observed No. (%)	Sites Surveyed No. (%)
Ione	–	–	–	–	–	–	34 (7%)	67 (5%)
Laguna	64 (13%)	71 (15%)	4 (6%)	3 (5%)	9 (3%)	37 (13%)	53 (11%)	145 (11%)
Mehrten	12 (3%)	9 (2%)	0 (0%)	< 1 (<1%)	4 (1%)	15 (5%)	121 (24%)	282 (22%)
Modesto	–	–	1 (1%)	6 (8%)	0 (0%)	28 (10%)	5 (1%)	14 (1%)
North Merced Gravel	236 (49%)	217 (45%)	0 (0%)	< 1 (1%)	17 (6%)	29 (10%)	86 (17%)	296 (23%)
Other	1 (<1%)	1 (<1%)	0 (0%)	< 1 (< 1%)	1 (< 1%)	< 1 (< 1%)	1 (< 1%)	31 (2%)
Recent Alluvium	15 (3%)	22 (5%)	17 (24%)	25 (35%)	59 (20%)	18 (6%)	18 (4%)	44 (3%)
Riverbank	153 (32%)	161 (33%)	48 (68%)	36 (50%)	207 (70%)	170 (57%)	137 (28%)	292 (23%)
Turlock Lake	1 (<1%)	1 (<1%)	1 (1%)	1 (2%)	0 (0%)	<1 (<1%)	12 (2%)	35 (3%)
Valley Springs	–	–	–	–	–	–	28 (6%)	69 (5%)
Total	**482 (100%)**	**720 (100%)**	**71 (100%)**	**71 (100%)**	**297 (100%)**	**297 (100%)**	**495 (100%)**	**1,275 (100%)**

Table C-2. Distribution of Midvalley Fairy Shrimp among Geologic Units

Survey Name	EIP VST and Campus Lands 1998–1999		EIP Community Plan		URS Parkway Project		Vollmar Consulting Regional Study	
Basis	Sample (N = 720 wetlands)		Census (82 acres of wetlands)		Census (81 acres of wetlands)		Sample (N = 1,275)	
Unit	Sites Observed No. (%)	Sites Surveyed No. (%)	Sites Observed No. (%)	Percent of Wetland Area	Sites Observed No. (%)	Percent of Wetland Area	Sites Observed No. (%)	Sites Surveyed No. (%)
Ione	–	–	–	–	–	–	1 (1%)	67 (5%)
Laguna	1 (2%)	105 (15%)	1 (10%)	5%	0 (0%)	13%	3 (4%)	145 (11%)
Mehrten	1 (2%)	14 (2%)	0 (0%)	< 1%	0 (0%)	5%	10 (15%)	282 (22%)
Modesto	–	–	0 (0%)	8%	0 (0%)	10%	0 (0%)	14 (1%)
North Merced Gravel	29 (54%)	323 (45%)	0 (0%)	1%	0 (0%)	10%	13 (19%)	296 (23%)
Other	0 (0%)	2 (< 1%)	0 (0%)	< 1%	0 (0%)	< 1%	0 (0%)	31 (2%)
Recent Alluvium	0 (0%)	34 (5%)	0 (0%)	35%	1 (8%)	6%	0 (0%)	44 (3%)
Riverbank	22 (41%)	240 (33%)	9 (90%)	50%	11 (92%)	57%	35 (51%)	292 (23%)
Turlock Lake	1 (2%)	1 (< 1%)	0 (0%)	2%	0 (0%)	< 1%	0 (0%)	35 (3%)
Valley Springs	–	–	–	–	–	–	6 (9%)	69 (5%)
Total	**54 (100%)**	**720 (100%)**	**10 (100%)**		**12 (100%)**		**68 (100%)**	**1,275 (100%)**

Table C-3. Distribution of Vernal Pool Tadpole Shrimp among Geologic Units

Survey Name	EIP VST and Campus Lands 1998–1999		EIP Community Plan		URS Parkway Project		Vollmar Consulting Regional Study	
Basis	Sample (N = 720 wetlands)		Census (82 acres of wetlands)		Census (81 acres of wetlands)		Sample (N = 1,275)	
Unit	Sites Observed No. (%)	Sites Surveyed No. (%)	Sites Observed No. (%)	Percent of Wetland Area	Sites Observed No. (%)	Percent of Wetland Area	Sites Observed No. (%)	Sites Surveyed No. (%)
Ione	–	–	–	–	–	–	0 (0%)	67 (5%)
Laguna	0 (0%)	(15%)	0 (0%)	5%	2 (1%)	13%	1 (1%)	145 (11%)
Mehrten	0 (0%)	(2%)	0 (0%)	< 1%	8 (3%)	5%	6 (8%)	282 (22%)
Modesto	–	–	0 (0%)	8%	2 (1%)	10%	1 (1%)	14 (1%)
North Merced Gravel	0 (0%)	(45%)	0 (0%)	1%	28 (12%)	10%	4 (6%)	296 (23%)
Other	0 (0%)	(< 1%)	0 (0%)	< 1%	0 (0%)	< 1%	0 (0%)	31 (2%)
Recent Alluvium	0 (0%)	(5%)	0 (0%)	35%	19 (8%)	6%	4 (6%)	44 (3%)
Riverbank	4 (100%)	(33%)	0 (0%)	50%	170 (74%)	57%	49 (69%)	292 (23%)
Turlock Lake	0 (0%)	(< 1%)	0 (0%)	2%	0 (0%)	< 1%	5 (7%)	35 (3%)
Valley Springs	–	–	–	–	–	–	1 (1%)	69 (5%)
Total	**482 (100%)**	**100**	**0**		**229 (100%)**		**71 (100%)**	**1,275 (100%)**

Table C-4. Distribution of Succulent Owl's-Clover among Geologic Units

Survey Name	EIP VST and Campus Lands 1998–1999		Jones & Stokes Survey 2003		URS Parkway Project		Vollmar Consulting Regional Study	
Basis	Census (199 acres of wetlands)		Sample (N = 992 wetlands)		Census (81 acres of wetlands)		Census (1,040 acres of wetlands)	
Unit	Sites Observed No. (%)	Percent of Wetland Area	Sites Observed No. (%)	Sites Surveyed No. (%)	Sites Observed No. (%)	Percent of Wetland Area	Sites Observed No. (%)	Percent of Wetland Area
Ione	–	–	1 (2%)	9 (1%)	–	–	16 (3%)	11%
Laguna	7 (3%)	12%	0 (0%)	112 (11%)	0 (0%)	13%	204 (32%)	21%
Mehrten	0 (0%)	11%	1 (2%)	179 (18%)	0 (0%)	5%	14 (2%)	16%
Modesto	–	–	0 (0%)	6 (1%)	0 (0%)	10%	0 (0%)	1%
North Merced Gravel	187 (83%)	48%	14 (32%)	257 (26%)	0 (0%)	10%	65 (10%)	16%
Other	–	–	1 (2%)	1 (< 1%)	0 (0%)	< 1%	1 (< 1%)	< 1%
Recent Alluvium	–	–	8 (18%)	41 (4%)	2 (4%)	6%	12 (2%)	1%
Riverbank	32 (14%)	28%	15 (34%)	358 (36%)	52 (96%)	57%	304 (48%)	31%
Turlock Lake	0 (0%)	1%	0 (0%)	2 (< 1%)	0 (0%)	< 1%	0 (0%)	1%
Valley Springs	–	–	4 (9%)	27 (3%)	–	–	15 (2%)	1%
Total	**226 (100%)**	**100%**	**44 (100%)**	**992 (100%)**	**54 (100%)**	**100%**	**631 (100%)**	**100%**

Appendix D

Summary of Results of Succulent Owl's-Clover Survey

Appendix D

Summary of Results of Succulent Owl's-Clover Survey on Selected Properties under Consideration as Mitigation for University of California, Merced

Introduction

This appendix summarizes the methods and results of the survey for succulent owl's-clover (*Castilleja campestris* ssp. *succulentus*) (SOC) conducted in April 2003. The survey was conducted to document the presence and estimate the percentage of vernal pools occupied by this plant at proposed UC Merced mitigation lands. Information obtained through these surveys will be incorporated into the Conservation Strategy required by the UC Merced biological opinion. The data collected contribute to the understanding of the relative value of the campus site to the species, the value of mitigation sites in offsetting campus impacts, and the overall status of the species in the project region.

Methods

Surveys were conducted at five sites.

1. The Virginia Smith Trust (VST).
2. The Cyril Smith Trust (CST).
3. The portion of the Flying M Ranch under TNC easement.
4. The portion of the Flying M Ranch under WCB consideration for a conservation easement.
5. The proposed UC Merced campus.

At the first four sites, surveys were restricted to portions of the site that had not been previously surveyed by EIP Associates or Vollmar Consulting. Although a sample of pools from throughout the campus site had already been surveyed, this site was included to aid comparisons of habitat and populations on the proposed campus and with those on compensation sites.

At each site, areas of potential habitat for SOC were identified; within these areas, a random sample of vernal pools and swales was searched for SOC. Potential habitat was broadly defined as areas containing moderate to high densities of vernal pools and swales (more than about 5% of the area comprising vernal pools and swales). All areas with vernal pools were considered potential habitat except for steeper terrain with a low density of vernal pools and swales (less than about 5% of area supporting pools and swales, where these features consisted primarily of swales).

Within areas of potential habitat, random points were generated at a density of 100 points per square mile for the VST and 50 points per square mile for the CST and Flying M Ranch sites. Samples consisted of the nearest vernal pool or swale to each random point. At the campus site, the sample consisted of those vernal pools surveyed by UC consultants for the U.S. Army Corps of Engineers functional assessment of the campus site. The functional assessment sample is a random sample stratified by soil type.

Greater sampling effort was expended on the VST because of its proximity to the campus site, the high likelihood of SOC being present, and the easement being held by UC. The functional assessment's sample was used for the campus site because environmental data collected at these pools by the functional assessment team might provide insight into the factors determining SOC's distribution and how development of the campus site might affect nearby populations of SOC.

Surveys were conducted from April 7 to 18, 2003. During that time observed populations of SOC at the surveyed sites contained more flowering than fruiting plants.

On the first day of surveys, SOC was located in a pool, and the distinguishing features were described to all of the biologists. Nine individuals participated in the surveys: four professionally trained botanists experienced in vernal pool surveys and five other biologists. All non-botanists were paired with botanists for the first 1–3 days of work on the survey.

From each random point, the nearest vernal pool or swale was identified, its geographic coordinates recorded (using Garmin eTrex GPS devices), and searched for SOC. The plant's abundance was recorded in one of five categories.

1. Not present.
2. Low abundance (1–10 plants).
3. Medium abundance (10–100 plants).
4. High abundance (100–1000 plants).
5. Very high abundance (> 1000 plants).

Also, if SOC was present in a pool, the four nearest pools (one in each quadrant of the compass) were searched.

At each site, the frequency of SOC was calculated and the area of vernal pool habitat occupied by SOC was estimated by multiplying the estimated frequency of SOC by the acreage of vernal pools and swales on the site. Confidence intervals were calculated for both the frequency of SOC and the estimate of occupied habitat. Because the sample at the proposed campus site was stratified by soil type, the frequency and confidence intervals were generated through a weighted averaging procedure. For all confidence intervals, a correction was incorporated for sampling from a finite population without replacement. For this correction, an estimate of the total number of vernal pools and swales within the sampled area was derived from the draft wetlands GIS layer for eastern Merced County produced by EIP Associates. Because estimating confidence intervals for small frequencies is problematic, confidence intervals were estimated both through a parametric and a bootstrapping approach, and the larger of the two intervals was used.

Table D-1. Sites Included in Study

Site	Total Area of Site (acres)[1]	Potential Habitat for SOC Surveyed in this Study (acres)[2]
Cyril Smith Trust	3,000	1,000[3]
Flying M Ranch—TNC	4,900	2,550[4]
Flying M Ranch—WCB	5,150	3,250
Virginia Smith Trust	5,250	2,250[3]
Campus Lands[5]	2,100	—[6]

[1] Land area of site to nearest 50 acres.

[2] Area of land with vernal pools that had not been previously surveyed for SOC, excluding relatively steep terrain with a low density of vernal pools.

[3] May include some land previously surveyed by EIP because exact boundaries of EIP surveyed land are not documented and available.

[4] Previously surveyed by different and undocumented methods.

[5] Campus lands include the proposed campus site, Campus Land Reserve, and Campus Natural Reserve.

[6] Vernal pools from throughout the entire site have been included in a sample by EIP in 1999.

Results and Discussion

The properties addressed in this study encompass nearly 28 square miles of land and include more than 15 square miles of potential habitat for SOC that had either not been surveyed at all or for which existing surveys were insufficient to estimate the species' abundance. As part of the random survey, 1,000 vernal pools and swales were searched within this previously unsurveyed habitat, representing 1–10 % of the vernal pools and swales within the areas sampled. (Because many vernal pools and swales were mapped as part of a "pool/swale

complex," the total number of these wetlands, and hence the percentage searched, is not known.) An additional 144 vernal pools and swales were opportunistically surveyed in the vicinity of occupied habitat.

Succulent owl's-clover was present in a small number (3–6 %) of the vernal pools and swales surveyed at all sites (Table 2). Typically, 10–100 SOC plants were present in those vernal pools or swales in which the species was observed during this survey. The data indicate that the frequency of SOC in wetlands is comparable among these sites. However, based on the size of the confidence intervals, searching a larger number of pools may have revealed differences in occupancy rates of several percentage points among sites.

SOC was observed in an additional 40 vernal pools and swales out of 146 surveyed near the occupied pools included in the sample.

The results of the random sample indicate that the campus lands (proposed campus, land reserve, and natural reserve combined) contain less occupied habitat than the other surveyed lands combined (Table 3). The proposed campus site accounts for approximately 1 acre of occupied habitat. (The 90 % confidence interval is 0– acres.) Thus, the results indicate that the other surveyed properties contain at least three times more occupied habitat than does the campus site. (This calculation does not include occupied habitat documented on the other previously surveyed portions of the CST and VST.)

In this study, the frequency of SOC in vernal pools on the campus lands and the VST (3% and 6 %, respectively) differed substantially from those reported in the biological assessment and the supplement to the biological assessment (EIP 2002a; Jones & Stokes 2002). Much of this difference is due to misinterpretation in those documents of EIP's survey results. Table 2-6 presents the frequency of SOC observed by EIP calculated on the basis of the wetlands GIS data layer, data files provided by EIP with the results of their succulent owl's-clover survey, and the survey methodology as described in the survey report (EIP 1999b). In this table, relatively small differences still exist between the results of the two surveys. Differences in observers, sample design, and rainfall patterns could all have contributed to these differences.

The small number of pools at which SOC was observed (41 across five sites) through the random sample does not allow for a detailed analysis of the species' habitat relationships based entirely on this study. However, the data from this study will be incorporated into an analysis of SOC habitat requirements and distribution based on all available survey results (i.e., Vollmar, Jones & Stokes, and EIP surveys).

Table D-2. Results From Searching Random Sample of Vernal Pools and Swales at Sites

Site	Vernal Pools Searched[1]	Vernal Pools with SOC[1]	Percent of Vernal Pools with SOC[1, 2]
Cyril Smith Trust	79	2	3 ± 3 %
Flying M Ranch—TNC	201	8	4 ± 2 %
Flying M Ranch—WCB	254	8	3 ± 2 %
Virginia Smith Trust	348	20	6 ± 2 %
Campus Lands[3]	118	3	3 ± 5 %

[1] Includes both vernal pools and swales.

[2] Observed frequency as the best estimate of actual frequency ± a 90 % confidence interval.

[3] Campus lands include the proposed campus site, campus land reserve and campus natural reserve.

Table D-3. Estimated Area of Vernal Pools Occupied by SOC in 2003[1]

Site	Vernal Pool Area (acres)[2]	SOC Frequency (%)	Area Occupied by SOC (acres)[2, 3]
Cyril Smith Trust	90	3 ± 3 %	2 ± 2
Flying M Ranch—TNC	200	4 ± 2 %	8 ± 5
Flying M Ranch—WCB	100	3 ± 2 %	3 ± 2
Virginia Smith Trust	180	6 ± 2 %	10 ± 4
Campus lands[4]	70	3 ± 9 %	2 ± 4

[1] Unlike estimates in Chapter 4 of the Conservation Strategy, these areas do not include the uplands in the watersheds of vernal pools.

[2] This area is only for vernal pools and swales within the portion of the site surveyed in this study, not the entire property. Acreages and frequencies were rounded off after calculations were performed.

[3] Estimated area of occupied habitat (the product of vernal pool area and SOC frequency) ± a 90 % confidence interval.

[4] Campus lands include the proposed campus site, Campus Land Reserve, and Campus Natural Reserve.