DEVELOPMENT OF THE SANTA ROSA VERNAL RESERVE SYSTEM.

I. PROPERTY INVENTORY, DATABASE CONSTRUCTION AND SHORT-TERM MANAGEMENT REGIMES FOR ECOLOGICAL RESTORATION

Bruce M. Pavlik, Abigail Smith and Alice Miller
Department of Biology
Mills College
Oakland, California 94613

Prepared for

Region 3
California Department of Fish and Game
P.O. Box 47 Yountville, CA 94599

and

Plant Conservation Program
California Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

Funded by

U.S. Fish and Wildlife Service Section 6 Funds
Contract No. FG 7452 NH

December 1998

ABSTRACT

The vernal swales and pools of the Santa Rosa Plain (Sonoma County, CA) were once part of an interconnected network of creeks, floodplains, and wetlands that drained west-southwest towards the Laguna de Santa Rosa, a tributary to the Russian River. Over the last 140 years, the hydrologic network of the plain has been fragmented by roads and property lines, altered by drainage channels, levees and irrigation, and degraded by runoff from farms and dairies. Cultivation brought thousands of acres of orchards, vineyards and row crops, and introduced more than 100 species of competitive weeds that invaded the remnants of wetland and upland communities, especially affecting the abundance and distribution of native species that occupy vernal pool and swale habitats.

Acquisition of properties containing vernal pools and swales and their rare inhabitants has resulted in more than 18 separate properties, ranging in size from 1 to 174 acres, being placed under the regulatory auspices of the California Department of Fish and Game (CDFG). The purposes of this project (phase I) were to 1) integrate the CDFG owned or controlled properties on the Santa Rosa Plain into a single, scientifically-based planning, management and public education system (the Santa Rosa Vernal Reserve System, SRVRS) by inventorying the biological, logistical and security characteristics of the properties and synthesizing the information into a database, 2) suggest a system of short-term management regimes that would help organize and prioritize restoration activities, and 3) design an initial set of management experiments that could provide practical prescriptions for maintaining plant species richness and ecosystem integrity with respect to vernal pools and swales.

The SRVRS Database was thus produced as an electronic summary of property-based information entered into Microsoft Access and displayed as nine tables: Properties, AdjacentPropEast, North, South, or West (the adjacent properties),

BioResources, Hydrology, Soils, and Security. The 2.13 Mb database became the basis for narratives that describe property attributes from the standpoint of potential for supporting management experiments and restoration activities. The analysis of these attributes led to recommendations for short-term management regimes and goals for the SRVRS. Each property was placed in one of four categories (experimental, ecosystem enhancement, intensive care or quiescent) that will guide management decisions over the next 5 to 10 years.

The first goal of the Santa Rosa Vernal Reserve System is to develop management prescriptions for improving the habitat quality of native plant populations, especially those of conservation interest. The goal will be met through four objectives: 1) conduct initial experiments at a single site that test ecologically sound and practical manipulations for shifting plant cover from exotic to native and from sparse to abundant, 2) conduct a second set of experiments at multiple sites that differ in their soils, hydrology, and initial plant cover, 3) perform non-experimental manipulations that favor native cover, 4) repeat the experimental and non-experimental manipulations in years with different temperature and precipitation regimes. Portions of several objectives will be addressed over the next two years (November 1998 to November 2000). The design of a primary experiment on the effects of early summer mowing is presented (objective #1) using the Cramer property with its extensive, relatively unaltered swale and pool system and large *Limnanthes vinculans* (Sebastopol meadowfoam) subpopulations. A secondary experiment, on a smaller scale, will be conducted at Alton Lane in order to expose *Blennosperma bakeri* (Sonoma Sunshine) to mowing and to include a different soil type in the treatment (objective # 2). Finally, some non-experimental "spot treatments" with foliar herbicide (to control *Mentha pulegium)* and fire (using burn box technology, Pavlik *et al.* 1993, Pavlik 1995) will be initiated for purposes of developing some intensive care procedures (objective #3).

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

ACKNOWLEDGMENTS

The authors appreciate the contributions and expertise of Robert Becker (Sonoma County Airport), Allan Buckmann (CDFG), Debbie Eakins, Betty Guggolz (CNPS), Jack Guggolz (CNPS), Ann Howald (Santa Rosa Junior College), Theresa LeBlanc (CDFG), Jeff Monk (Monk and Associates), Dr. Philip Northen (Sonoma State University), Lorraine Parsons (Sonoma County Water District), Charles Patterson, Marco Waaland (Golden Bear Associates), and Carl Wilcox (CDFG). The project was launched with the help of Jan Knight (USFWS), Peter Baye (USFWS) and Sandy Morey (CDFG). Support, helpful suggestions, and careful review were provided by Diane Ikeda (CDFG) and Diane Elam (USFWS) from beginning to end. Reviews by Ann Howald and Carl Wilcox improved earlier versions of this report.

DEVELOPMENT OF THE SANTA ROSA VERNAL RESERVE SYSTEM. I. PROPERTY INVENTORY, DATABASE CONSTRUCTION AND SHORT-TERM MANAGEMENT REGIMES FOR ECOLOGICAL RESTORATION

Bruce M. Pavlik, Abigail Smith and Alice Miller

INTRODUCTION

The vernal swales and pools of the Santa Rosa Plain were once part of an interconnected network of creeks, floodplains, and wetlands that drained west-southwest towards the Laguna de Santa Rosa, a tributary to the Russian River. This extensive network permeated more that 55,000 acres of grassland and oak woodlands in the basin, creating an ecologically-rich mosaic of lowland communities. Those communities supported native populations of large grazing animals, such as elk and deer, roaming predators such as mountain lion and grizzly bear, and vast numbers of migratory waterfowl. Seasonal flooding, especially in high rainfall years, must have driven the large-bodied fauna into adjacent uplands while facilitating dispersal of aquatic and wetland species across otherwise impassable terrain. In years of low rainfall, pools were isolated from each other in their shallow basins and fires swept across the dry summer grasslands. Pomo Indians collected acorns and other seed crops, acting as stewards of the native plants and animals upon which they relied. In this wild, uncontrolled state, boundaries were few and interactions among all species had a long and complex history. These essential properties of intact ecosystems, interconnectivity, faunal exchange, disturbance-driven dynamism, and historical integration, were forever disrupted by the advent of European settlement, agricultural development and urbanization.

Over the last 140 years, the hydrologic network of the plain has been fragmented by roads and property lines, altered by drainage channels, levees and irrigation, and degraded by runoff from farms and dairies. The roving, native grazers were replaced by paddocked cattle and sheep and large predators have been almost eliminated. Natural

disturbance processes that once propagated like waves from one end of the plain to the other have been so confined in space and time that they have become ecologically irrelevant. The stewardship of native people, based on an ancient and intimate knowledge of the land, was replaced by intensive cultivation developed in other places. Cultivation brought thousands of acres of orchards, vineyards and row crops, and introduced more than 100 species of competitive weeds that invaded the remnants of wetland and upland communities. Such rapid and significant changes, described in greater detail by Patterson *et al.* (1994a) and CH2M Hill (1995), now determine the biological character of the Santa Rosa Plain, especially affecting the abundance and distribution of native species that occupy vernal pool and swale habitats.

Acquisition of properties supporting vernal pools and swales and their rare inhabitants has continued since the establishment of the Laguna de Santa Rosa Ecological Reserve on Todd Road in 1980. More than 18 separate properties, ranging in size from 1 acre to 174 acres, have been placed under the regulatory auspices of the California Department of Fish and Game (CDFG), either by purchase, mitigation agreements, or the establishment of conservation easements with private landowners. The presence of three plant taxa that are federally- and state-listed as endangered (*Blennosperma bakeri* Hieser (Baker's blennosperma), *Lasthenia burkei* (E. Greene) E. Greene (Sonoma sunshine) and *Limnanthes vinculans* Ornd. (Sebastopol meadowfoam) has provided additional incentive for preserving vernal wetland habitat in this region. The collection of CDFG properties, extending from Windsor to Cotati, could be referred to as the Santa Rosa Vernal Reserve System (SRVRS) if biological, logistical and security information were integrated into a single database that supported a single planning, management, and public education unit.

But current efforts to preserve the vernal wetlands of the Santa Rosa Plain must also take into account the effects of fragmentation, degradation, and invasion on biological diversity, even where habitat destruction has been stopped. For example,

populations of *Lasthenia burkei* have steadily declined at the Todd Road reserve after removal of domestic livestock and may be effectively extirpated (B. Guggolz, pers. comm. 5/98). Invasive Mediterranean grasses and other weedy plants could be responsible (Patterson *et al.* 1994a), especially when they develop dense, competitive swards in the absence of grazing or periodic fire. Light- to moderate-levels of grazing and low-intensity burns are generally thought to favor the maintenance of high native species richness in grasslands around the globe (Meurk *et al.* 1989, Parker 1989, Rosentreter 1994, Schlising 1996, Fensham 1998, Muller *et al.* 1998). Mowing has also been shown to favor native perennial grasses over exotic annuals in California (Danielsen 1996) and to increase species diversity in the chalk grasslands of France (Fensham 1998). Reducing excessive inputs of nutrients, especially nitrogen from crops and pastures, would also favor native perennial grasses over non-native annual grasses (Claassen and Marler 1998) and possibly shift the "competitive balance" back towards a higher diversity of less aggressive plant species (Wedin and Tilman 1996). There is, therefore, a clear need for site-specific management prescriptions that lessen the effects of fragmentation, disruption, degradation, and invasion, and thus conserve native plant species richness and ecosystem integrity within the SRVRS.

The purposes of this project (phase I) were to: 1) Integrate the CDFG owned or controlled properties on the Santa Rosa Plain into a single, scientifically-based planning, management and public service system. Biological, logistical and security information was collated from CDFG file records, property acquistion documents, California Natural Diversity Database (CNDDB) records, and all available "gray literature". The properties were visited to fill gaps with direct field observations and with the assistance of local experts. The inventory information was then synthesized into a standard format (database) to 2) suggest a system of short-term management regimes that would help organize and prioritize restoration activities. Each property was placed in one of four categories (experimental, ecosystem enhancement, intensive care or quiescent) that will

guide management decisions over the next 5 to 10 years. The biological and logistical attributes of two properties, Alton Lane and Cramer, permitted 3) design of an initial set of management experiments to provide practical prescriptions for maintaining plant species richness and ecosystem integrity with respect to vernal pools and swales. Such experiments can also identify significant gaps in our understanding of the properties, their habitats, and the rare species they support.

THE SANTA ROSA VERNAL RESERVE SYSTEM (SRVRS)

Location and Nomenclature of the Properties

The eighteen properties owned or otherwise controlled by the Department of Fish and Game (Figure 1) are scattered across the Santa Rosa Plain, from Wikiup in the north (Mark Springs exit off 101) to Haroutunian in the south (Todd Road exit). All but Wikiup lie to the west of Highway 101. (Appendix 1 gives directions and addresses). Some are clustered together or contiguous (e.g. Lagomarsino and Carinalli), others are isolated from other SRVRS properties (e.g. Bennett). Each has been assigned a map number that corresponds to the Laguna Wetland Ownership Map A, currently being developed at the CDFG Regional Headquarters at Yountville (A. Buckmann, pers. comm. 3/98).

The names of the properties have been problematic, each with an obscure history that could reflect general location (e.g. Airport, FEMA), street address (Alton Lane, Todd Road), previous owner (Jinks, Carinalli, Gobbi), mitigation project (Bennett, SW Santa Rosa Bank), nearby development (Broadmoor), or more formal designation (Laguna de Santa Rosa Ecological Reserve (= Todd Road)). Such inconsistencies, combined with a host of popular synonyms, result in considerable confusion when reading documents or talking to local experts. Table 1 is an attempt to summarize and synonymize the property nomenclature. It is desirable to begin thinking in terms of "management units" instead of

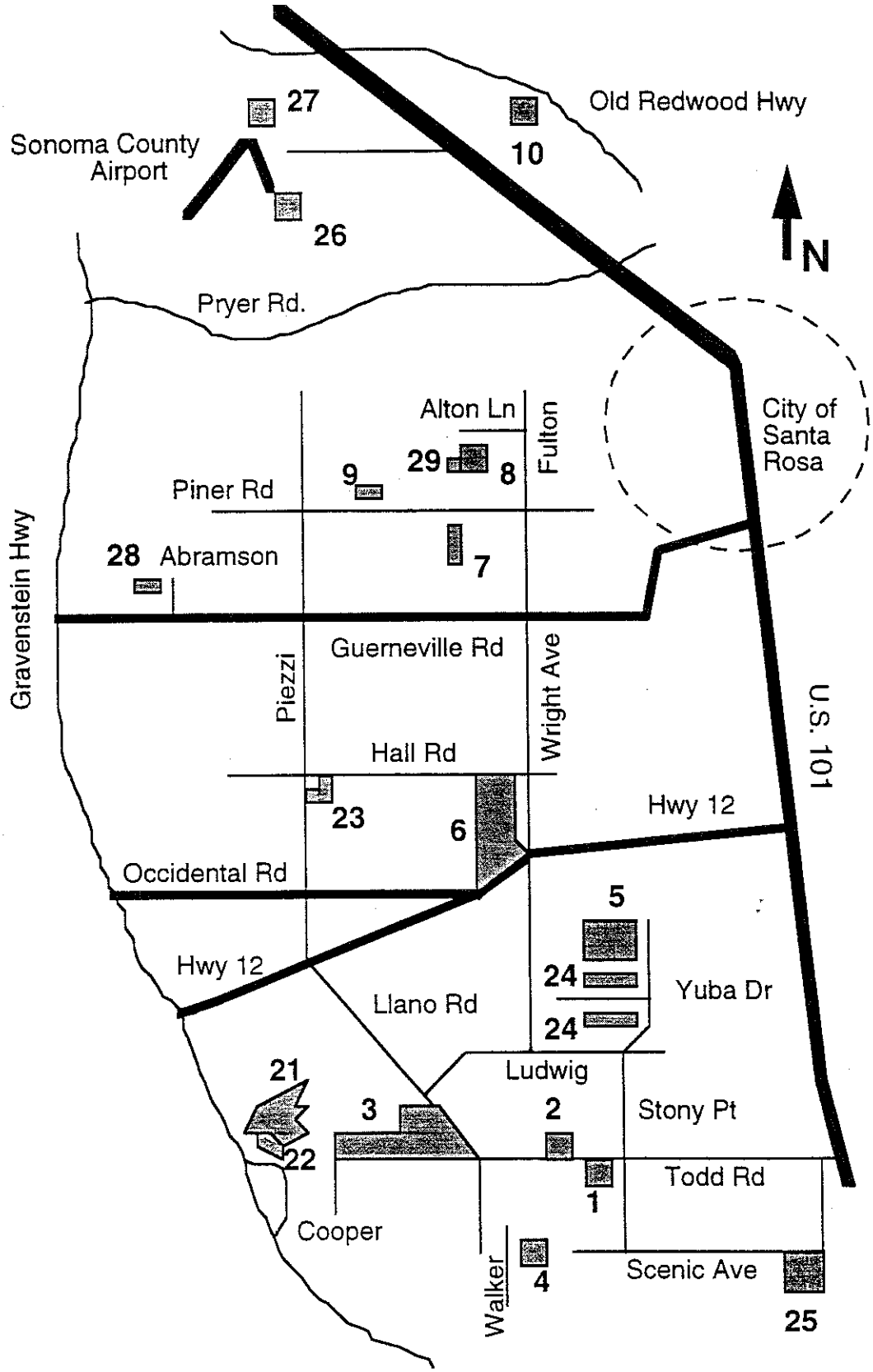

Figure 1. Locations of the SRVRS properties. Numbers correspond to Laguna Wetland Ownership Map A, Table 1 and Appendix 1. Not to scale.

Table 1. Properties of the Santa Rosa Vernal Reserve System (SRVRS), listed from north to south. Map numbers () are used in Figure 1 and adopted from the Laguna Wetland Ownership Map A (CDFG). Some have synonyms and multiple parcels. A "management unit" is a planning and prescription unit.

property	synonym	parcel(s)/acreage	management unit
Wikiup (10)		12 acres	Wickiup
Airport (26/27)	Sonoma County Airport	mitigation sites - 3 acres wildflower reserve - 12+ ac	Airport
Alton Lane (8)		35 acres	Alton Lane
Simi (9)	Comalli	1.50 acres	Piner Rd Complex
Jinks (7)	Piner Road	1.47 acres	
San Miguel (29)	Rancho San Miguel	2.07 acres	Alton Lane
Abramson Rd (28)	Bainbridge West	7.5 acres	Abramson Road
Crinella (23)	Hall Rd, Piezzi	4 acres	Crinella
Cramer (6)	Wright	174 acres	Cramer
FEMA (5)	High Frequency	69 acres	FEMA
Broadmoor (24)		North - 14 acres South- 13 acres	Broadmoor
Carinalli (21)		152 acres	Cooper Road
Lagomarsino (22)	Cooper Rd	76 acres	Cooper Road
Todd Road (3)	Laguna de Santa Rosa Eco Reserve	77 acres	Todd Road
SW Santa Rosa Bank (2)	Engle	39.4 acres	SW Santa Rosa Bank
Gobbi (1)	Courtside	31 acres	Gobbi
Bennett (4)		16 acres	Bennett
Haroutunian (25)	Sonoma Ag + Open Space	30 acres	Haroutunian

properties, and assigning standardized names to those units. This requires consensus between the Department of Fish and Game and all associated parties, and hence, is beyond the scope of the present project. The management units circumscribed and named in Table 1 are only an initial suggestion: the exact circumscription will ultimately depend on how we learn to manage. For example, it may make sense to combine FEMA and Broadmoor North into a single management unit for application of treatments, fence repair or other actions because they share a common border. In some cases adjacent properties have already been grouped together because there is no institutional obstruction to doing so (e.g. Lagomarsino + Carinalli = Cooper). Purely as a matter of convenience, some non-adjacent properties have been grouped because they share a common, muddled history or geography (e.g. Simi + Jinks + San Miguel = Piner Road Complex).

DATA COLLECTION AND COLLATION INTO A DATABASE

Data on the SRVRS properties were collected from three sources: 1) the CDFG files and library, 2) field trips and 3) local experts. Site-specific information from these sources was transcribed onto standard forms (Appendix 2) prior to construction of the database. These original, handscribed forms are contained in a series of four looseleaf binders that will be stored at the Yountville CDFG office.

CDFG Files and Library

Lands Files

We first examined the Region 3 lands files (Yountville) to gather initial site information. Site-specific information was contained in the following lands files: ecological reserve documents, land evaluation, conservation easements, and mitigation lands. A variety of general information and site characteristics, such as county assessor parcel maps, land acquisition agreements, MOUs, and general

correspondence, were found in these files. A majority of the site information is disseminated among all of the files but a few sites have additional parcel-specific files. These sites include Todd Road, Cramer, FEMA, Lagomarsino, and Broadmoor.

Plant Ecologist Files

These files contained species-specific information about vernal pool RTE species of concern occurring on the Santa Rosa Plain. The majority of the files consist of species-specific information on CNDDB print outs and CNPS field survey forms. In addition, these files contained specific subject and environmental review documents which contained a limited amount of general information about the properties.

Files of Allan Buckmann, CDFG Biologist

These files contain a broad range of regulatory documents relating to current specific CDFG mitigation sites. Environmental Assessments, monitoring reports, wetland delineation reports, maps, and site-specific documents, such as newspaper articles, experimental proposals and protocols are included.

CDFG Library

The CDFG library (Yountville) contained regulatory documents, a majority of which were mitigation, and monitoring reports, Environmental Impact Reports, biological assessments, and MOUs. The library contained information about sites including Bennett, Cramer, Crinella, FEMA, San Miguel, as well as a general vernal pools file. Summary documents containing the work of the Santa Rosa Vernal Pool Task Force (CH2M Hill 1995) and summarizing information on vernal species and properties (Patterson *et al.* 1994a,b) were also available from this library.

Field Trips

Site visits to most of the SRVRS properties were made on April 1, 13, 20, 22, 29, May 6, 13, and 30, 1998. These visits were often guided by local experts who knew the locations of plants and projects and could give a historical perspective for understanding the dynamics of the vernal swale and pool ecosystems.

Local Experts

Many people have been involved in rare plant and wetland conservation issues on the Santa Rosa Plain. Some were consulted in person (pers), by phone (ph), by questionairre (q - see Appendix 3), or on field trips (f). These included; Robert Becker, Sonoma County Airport (f), Allan Buckmann, CDFG (pers, ph, f), Debbie Eakins (pers), Betty Guggolz, CNPS (pers, ph, q, f), Jack Guggolz, CNPS (f), Ann Howald, Santa Rosa Junior College, (pers, ph, f), Teresa LeBlanc, Lands Coordinator CDFG Region 3 (pers), Jeff Monk (ph), Dr. Philip Northen, Sonoma State University (ph, q), Lorraine Parsons, Sonoma County Water District (pers, ph, f), Charles Patterson, private consultant (q), Dr. Charles Quibell, Sonoma State University (q), Marco Waaland, Golden Bear Associates (pers., q, f), and Carl Wilcox, Environmental Specialist Supervisor CDFG Region 3 (pers, ph, f).

The SRVRS Database

The SRVRS Database is an electronic summary of information gathered on properties that have been placed under the regulatory auspices of CDFG, either by purchase, mitigation agreements, or the establishment of conservation easements with private landowners. The information (2.13 Mb) has been collated into three major sections: **property attributes**, **biological resources**, and **security** and entered into Microsoft Access (1997). These are displayed as nine tables: **Properties, AdjacentPropEast, North, South, or West** (the adjacent properties),

BioResources, Hydrology, Soils, and Security. Appendix 4 is an abbreviated introduction to opening, querying, reporting from, and entering data into the Access database. There is also a detailed set of guidelines and abbreviations that can be used for data entry in the future. New information and periodic updates are essential for keeping this database useful as a planning and management tool.

NARRATIVE DESCRIPTIONS OF THE PROPERTIES: POTENTIAL FOR RESTORATION EXPERIMENTS AND MANAGEMENT

The properties of the SRVRS are presented below in alphabetical order. The descriptions include information on land-use history, plant community composition, recent trends in rare plant populations, introduced species, previous conservation or restoration activities, access, and the potential for conducting experiments to manipulate habitat quality.

Abramson Road (7.5 acres)

A small complex of vernal swales and pools, the Abramson Road property was known for its stands of native grasses and forbs and its seasonal habitat for waterfowl, shorebirds and fairy shrimp. A small population of *Lasthenia burkei* is present (2,200 plants in 1991, 1000-5000 in 1992), along with *Ranunculus lobbii* and an unusual subpopulation of *Quercus kelloggii* (Patterson 1994a). The site was grazed by horses as part of the original 20 acre Bainbridge parcel, and some minor alterations to the hydrology have been made by damming a small basin on the eastern side. The uplands are dominated by exotic annual grasses. Access to this isolated property is by a permanent easement from Guerneville Road north, but there is no driveway or internal tracks. It is unlikely that management experiments could be conducted here

in the near future because of the small population size of *Lasthenia burkei* and the generally poor access.

Airport (15+ acres)

A large number of created pools and swales are found around the complex of runways, tarmacs, and access roads of the Sonoma County Airport. Many slow-draining channels were unintentionally created by the military during airstrip construction for World War II . These tend to be linear depressions that run parallel to the runways and taxiways. All of these linear swales were seeded with *Lasthenia burkei* by Charlie Patterson in the late 1980s and have not been re-seeded since 1993. Swale patches, typically 25 to 40 m long and 1-2 m wide, each contained roughly 5000-8000 robust, flowering plants. There were also a number of linear swales in which seeding failed entirely, but these were not subsequently monitored to allow determination of how microsite variation affected *Lasthenia burkei* demography. There is also evidence that subpopulations have become self-established across the airport in sites with suitable habitat conditions. Owing to their juxtaposition to the runways, the artificial swales and their subpopulations are mowed and mulched in late spring (May to June) as part of regular airport groundskeeping (R. Becker pers. comm 4/98).

Towards the northwest is the Wildflower Preserve which contains three recently created pools and one, apparently natural, swale. Of the three pools, the WF-2 (or center pool) supports a very large (10^4 - 10^5), self-sustaining population of *Lasthenia burkei*, as well as a few other native pool species (e.g. *Downingia*). *Mentha pulegium* is present in the pool bottom but contributes less than 1% cover. Other common pool/swale plants are absent (e.g. *Pleuropogon*), leading to the conclusion that created pools can be good reserves for rare plants such as *Lasthenia burkei* but poor reproductions of the swale communities of the Santa Rosa Plain. The surrounding

grasslands were largely dominated by typical weedy species and sparse populations of *Nassella* and *Danthonia*. A natural swale, to the south of WF-2, once supported a small natural population of *Limnanthes vinculans* (B. Guggolz pers. comm. 4/98), but is now dominated by freshwater marsh perennials (e.g. *Eleocharis, Scirpus*). Adjacent irrigation by the Sonoma County Water District may have altered the hydrology sufficiently to convert the swale into a persistent wetland. Detailed descriptions of the pool creation project and subsequent monitoring are given in Patterson (1990) and WESCO (1993).

Given the large number of robust, separate, and introduced subpopulations of *Lasthenia burkei*, the Sonoma County Airport would be a favorable site for experimental, small-scale manipulations. The effects of fire, weeding, herbicides, and mowing (timing, techniques) on the demography of *Lasthenia burkei* could be done without disrupting airport operations or putting natural populations at risk. There would be access and public relations issues related to obtaining cooperation from airport administrators.

Alton Lane (35 acres)

Prior to the planting of a historic vineyard, this property was the site of a complex natural swale, pool, and upland system with a rich native flora and significant populations of native grasses (e.g. *Danthonia, Nasella, Sitanion, Elymus* and *Hordeum brachyantherum*)(Patterson 1993). By the late 1980s, motorcycles had worn roads and trails throughout the site, and grapevines, cotoneasters, and annual barley were well established. An aerial photo shows two branching, natural swales and at least 11 separate, natural pools (total wetland area = 2.5 acres), supporting an estimated 248,000 individuals of *Blennosperma bakerii* and 8,000 of *Lasthenia burkei* in the spring of 1989 (Patterson 1990 Table C-3, Patterson 1993 Figure 3, Table 3). Over the next three years, the natural *Blennosperma* population at Alton Lane

declined to 63,000, while *Lasthenia* fluctuated between 10,400 (1990) and 3600 (1993). There was no record of *Limnanthes vinculans* in these natural pools prior to 1993 (Patterson 1993, Table 3), although many other native vernal pool plants were present (e.g. *Limnanthes alba, L. douglasii* , *Downingia concolor, Lasthenia glaberrima, Pleuropogon californicus, Ranunculus lobbii*) (Patterson 1993, Table 4). There was also a small population of *Blennosperma nanum* on a small part of the western parcel (= San Miguel, see below), one of only two on the Santa Rosa Plain that co-occurred with the rare species (D. Eakins via A. Howald, pers. comm. 11/98).

Beginning in 1988, Alton Lane became a site for mitigating the loss of wetlands and rare plant populations elsewhere on the plain (Patterson 1990, 1991, 1992c, 1993). Created or excavated pools were scraped from broad depressions by removing 10-20 inches of topsoil in upland areas on the western half of the property. Swales on the eastern side of the property were enlarged by the construction of earth dams. By 1993, there was a total of 26 excavated pools on the site, adding approximately 6 acres of wetland surface, and enlarged swales added another 2 acres (Patterson 1993, Table 1). Surface soil (plugs and shovel scrapings) and seeds (collected with a vacuum cleaner) were transferred from the San Miguel project sites (a mile to the east) and used to innoculate newly created pools or expanded swales. Portions of swales with natural subpopulations of *Blennosperma* were left untreated. Although a few plugs were transfered in 1988, the majority of the innoculation began in summer of 1988 and ended in fall of 1992. The amount of material moved was not given in the progress reports, although a presumably rough estimate was several hundred thousand *Blennosperma* seeds and 10,000 to 20,000 *Lasthenia* seeds (Patterson 1990). A total of 45,250 *Blennosperma* individuals supplemented the natural population (63,200) in 1993, with more than 210,000 added over the 1990-1993 period. More than 36,000 *Lasthenia burkei* plants supplemented the natural population (3600) in 1993, with more than 61,000 added over the four years (Patterson

1993, Table 3). Detailed distribution maps for these two taxa were last produced in 1993 (Patterson 1993, Figures 15 and 18). It also appears that several of the new pools were innoculated with *Limnanthes vinculans*, *Pogogyne douglasii* ssp. *parviflora*, and *Ranunculus lobbii* (Patterson 1993, Tables 2 and 4) but without CDFG authorization (A. Howald, pers. comm. 11/98).

An additional proposal was made to use the southern portion of Alton property as a mitigation site (see Harding Lawson and Associates 1994). The plan called for the construction of 2.6 acres of wetland, including habitat for *Blennosperma bakerii* *Lasthenia burkei*, and *Pogogyne douglasii* ssp. *parviflora*. Details of the design of the pools and expanded swales were included in the report. Vacuum-collection of seed was made from the TMD-Brown project site about 1 mile to the northeast. Unfortunately, construction and installation took place late in the year (1992) and it soon became apparent that the excavated pools were much too deep. Water retention was year-round and cattails soon invaded. In effect, high-quality uplands with minor vernal pool features had been traded for a very standard freshwater wetland with new, weedy margins (A. Howald, pers. comm. 11/98). Since that time cattails have been removed and populations of *Blennosperma bakerii* and *Lasthenia burkei* have become established. Five years of monitoring reports are available at CDFG, Yountville.

The Alton Lane site in 1998 reflects the complex history imposed by so many creation and innoculation projects. Natural pools still support subpopulations of *Blennosperma bakerii* and *Lasthenia burkei* in fairly high numbers (several thousand each, rough estimates 4/98). Numerous created pools and expanded swales fill the once open spaces between the natural pools, providing habitat for native plant and animal species. It is possible that the genetic integrity of the rare plant subpopulations has been compromised because seed innoculum originated from different portions of the Santa Rosa Plain, but electrophoretic data are lacking. *Mentha pulegium* and *Rumex crispus* have become well established in most natural, created pools and

expanded swales. Uplands still have native perennial grasses, but have been significantly degraded by intensive construction activities related to wetlands creation (A. Howald, pers. comm. 4/98).

The large number of natural and created wetlands, combined with reasonably large populations of *Blennosperma bakerii, Lasthenia burkei* , and *Limnanthes vinculans* would allow the installation of replicated, management experiments. The irregular topography and high density of pools and swales might complicate the use of mowers, but other variables (e.g. grazing, fire) could readily be investigated.

Bennett (16 acres)

This small preserve contains a population of *Limnanthes vinculans* (5,000-10,000 individuals in 1994, Monk and Associates 1994) in a matrix of annual grassland. A wetland creation project was also proposed for the site (as mitigation) and construction is scheduled to begin in 1999. Access to the site is inconvenient, given the surrounding private land and the distance from roads.

Broadmoor North (14 acres)

The Broadmoor property consists of two parcels ("North" and "South") that are isolated from each other by two streets and several blocks of houses. Broadmoor North (14 acres) is contiguous with the southern boundary of the FEMA property, with which it shares a swale and pool complex. It is considered "part of a larger vernal pool management area.....envisioned to total about 150 acres, which includes the FEMA parcel ..... and land from the adjacent U.S. Naval Reserve" (Cochrane 1990). A plan to build a trail system between Broadmoor North and Roseland Creek to the west has been discussed but not implemented. The site was acquired by the Santa Rosa High School District as mitigation for the Elsyie Romer High School construction project. A management plan was to be prepared that provided for wetland and endangered plant

enhancement (C. Wilcox pers. comm 11/98). The district now uses the land to graze several horses and conduct a few class field trips. Runoff from storms seems to accumulate here, producing floods that allows pools to coalesce and saturate the land for many weeks.

Half of the north property is occupied by pools or shallow pool fringe, supporting a small-to-medium size population of *Limnanthes vinculans* (10 to 5,000 individuals, 1988-1993, Patterson 1994a). Approximately 80% of the plants are found in the shallow pool fringe which is heavily pock-marked by horses' hooves. *Pogogyne douglasii* and *Ranunculus lobbii* are also found in its wetlands, along with large numbers of aquatic invertebrates and amphibians (e.g. half a million toads in 1989, California tiger salamander - Land Evaluation Proposal 1990, Broadmoor file). *Mentha pulegium, Dipsacus fullonum,* and *Rumex crispus* are common weeds throughout. The uplands are dominated by valley oaks of several size classes, along with sparse annual grassland. Footpaths, fecal material from horses, and dilapidated fencing give the site a well-worn look. Buckmann and Dixon (1989) provide lists of flora and fauna, with a discussion of soils, habitat relations and on-site resources. A detailed habitat map by A. Buckmann and data on wetland delination (with the distribution of *Limnanthes vinculans*) are presented in Charles and Associates (1990).

Under the present circumstances, the northern parcel is not an appropriate site for conducting management experiments. Horse pasturing, easy access and high visibility would jeopardize plots and markers, even if the cooperation of the school district could be obtained. Short-term improvements in the timing of horse pasturing should be negotiated in order to minimize impacts to the pool fringe habitat. An intensive care regime focused on weed removal could also be established with the help of high school students interest in ecological restoration.

Broadmoor South (13 acres)

The swales of Broadmoor South are truncated by the housing development along the northern border and, therefore, carry much less water than those on the north property. The shallow fringe is narrow and has been encroached by upland grasses that form an adjacent, tall canopy. The population of *Limnanthes vinculans* is small (500 - 2400 individuals 1991-1993, C. Patterson pers. comm. 7/98) and confined to the bottoms of swales that rarely flood. Valley oak savanna and grasslands dominate the uplands, which were ungrazed, tall and lush compared to those on the north. A detailed habitat map by A. Buckmann and data on wetland delination (with the distribution of *Limnanthes vinculans*) are presented in Charles and Associates (1990).

Under the present circumstances, the southern parcel is not an appropriate site for conducting management experiments. Easy access and high visibility would jeopardize plots and markers. An ecosystem enhancement regime, focused on improving the cover of native upland grasses and forbs, could benefit *Limnanthes vinculans* in the confined and poorly watered swales. Minimizing cover by introduced grasses and broadleaf weeds could expand the effective habitat adjacent to the shallow pools. Controlled burns would be difficult to conduct, given the proximity of adjacent houses. If mowing is found to favor perennial grasses, it could be applied here when access through the Picchi parcel (south end of Ash Drive) is arranged.

Carinalli (152 acres)

Most of this large property is dominated by a large open water/freshwater marsh wetland complex, partly natural and partly created by dams (the "duck pond" in many reports and field notes). Extensive stands of *Scirpus* and *Typha* provide habitat for waterfowl and wading birds. Along the northern edge of this complex were large populations of *Blennosperma bakeri* and *Limnanthes vinculans* , last observed 5 or 6 years ago (Linda Huntington, NDDB data, 5/90; B. Guggholz, A. Buckmann pers.

comm. 5/98). It now appears that in the absence of livestock grazing, this edge has been overwhelmed by non-native forbs and grasses and tall wetland natives. *Rumex, Raphanus* and *Scirpus* form a dense sward that lodges in late spring, smothering low growing native herbs. In some places the only native annual was a species of *Plagiobothrys*; otherwise, the lush weedy uplands extend to the edge of standing deep water, obliterating potential habitat for rare swale plants. We found no evidence of *Blennosperma bakeri* or *Limnanthes vinculans* in areas where it had last been seen in 1993 along the shores and shallows of this pond.

In contrast, the grassy uplands and vernal swales of the northwest portion of the property have more native plant cover than observed along the edge of the wetland complex. Robust stands of *Pleuropogon, Juncus*, and *Scirpus* occur in several swales and broad depressions. However, even here the swale edge habitat was dominated by weedy herbs and *Limnanthes vinculans* was found in only five patches on the extreme northwestern corner. Swales that had formally supported populations of *Limnanthes vinculans* (A. Buckmann pers. comm. 5/98) did not appear to have any plants this year.

Given the difficult access and small population sizes of rare plants, it is unlikely that any management experiments could be conducted on this property for purposes of rare plant recovery. It may be possible to better manage the uplands with grazing animals in order to reduce grass biomass and thatch build-up, but there is no scientific evidence that such a regime would provide a significant benefit for the rare species (see discussion of Todd Road property, below). A plant list for the site has been compiled by Dr. Philip Northen (Sonoma State University) .

Cramer (174 acres)

This large, topographically-complex parcel is regarded as the most pristine and, therefore, the best reference site for restoration in the central Santa Rosa Plain (C. Wilcox, C. Patterson, pers. comm. 5/98). Numerous swales and shallow pools with

Limnanthes vinculans are rather evenly distributed across the northern, eastern and southern portions, with extensive, interconnecting stands of *Pleuropogon.* Cover by native vernal pool and wetland species is moderate to high, but *Mentha pulegium* can be locally dominant and probably restricts the abundance of *Limnanthes vinculans* and *Lasthenia burkei.* Estimates of population sizes of *Limnanthes vinculans* range between 3,000 and 100,000 individuals (1988-1994), while those of *Lasthenia burkei* tend to vary between 100 and 1,000 individuals (1988-1993) (Patterson 1994a). The property apparently supports the largest single concentration of *Limnanthes vinculans* in the county (CH2M Hill 1995). Uplands that separate the pools have pockets of *Danthonia californica, Hordeum brachyantherum* and, to a lesser extent, *Nassella pulchra.* There is much cover by *Erodium botrys, Avena,* non-native *Hordeum* and *Lolium* (sometimes greater than 5 feet tall), especially in the west-central portion of the property where dairy corrals may have held animals for long periods of time. Two large stream channels trisect the property and could serve as fire breaks for low intensity fires on windless days. A wetland delineation report (Patterson 1992b) provides detailed descriptions of soils, vegetation, and hydrology, including a map and inventory of all pools and swales, and a comprehensive flora.

The size and complexity of this parcel, combined with the presence of many subpopulations of *Limnanthes vinculans,* would allow replicated experimentation with mowing, grazing and fire. Plots could be large and include both upland and swale habitats in areas with relatively high native cover (e.g. the north and central portions) and areas with no native cover (west). The buildings on adjacent parcels (to the east and south) are a good distance away from many swales and could easily be protected from controlled burns. Access from the north and west is good, although the large stream channels will restrict mower movements. In the future it may be expedient to build at least one bridge across the northern channel to allow the mower easy access to more interior portions of the property.

Crinella (4 acres)

Crinella contains a small, isolated group of swales amidst heavily disturbed valley oak savannah and annual grassland. The swales contain small subpopulations of *Lasthenia burkei* and scattered individuals of *Limnanthes vinculans*, but support good pockets of *Pleuropogon/Juncus* wetland. Detailed maps and transect data are available for 1991, 1992, and 1994 (Patterson 1994b) and they indicate a rapid decline in *Lasthenia burkei* (21,000 to 1,135 individuals) and a small but fairly steady population of *Limnanthes vinculans* (30 to 90 individuals). *Mentha pulegium* is aggressively invading *Limnanthes* habitat. The savannah has very little valley oak regeneration and a few clumps of *Nassella pulchra*, but otherwise the uplands are dominated by *Erodium botrys*, *Avena*, *Lolium,* and *Bromus diandrus*. There is an "Endangered Species Management Plan" that describes in detail the background, use restrictions, and management requirements for the Crinella property (Anon. 1996).

In the late summer of 1993, a landowner's poorly-executed attempt to reduce fire hazard by discing undoubtedly disturbed upland and wetland soils and seed banks. C. Patterson concluded that the subpopulations of rare plants on the site were already trending downward prior to the discing, perhaps due to drought, exotic weeds, or other conditions. The effects on native species, therefore, were small or ambiguous given the complex history of the site (Patterson 1994b). CDFG staff, however, concluded that "of the eight locations were *Lasthenia burkei* were observed in 1991 and 1992, ... six ... showed significant reductions in [*Lasthenia burkei*] numbers, and several [had no plants at all] in 1994...." and that " discing, and possibly other changes in land management practices at the Crinella property, have resulted in degradation of the vernal pool habitat and significant reductions in numbers of the endangered plant, Burke's goldfields" (Hunter 1994).

Small, declining population sizes of rare plants make it unlikely that any management experiments could be conducted on this property for purposes of

recovery. Given the low, overall cover of natives, burning or other ecosystem enhancement techniques would do little to improve the quality of the uplands and adjacent residential development would make fire used at any scale logistically difficult. This is a site that requires intensive management of rare plant subpopulations before implementing other, general strategies for improving the overall quality of the vegetation.

FEMA (69 acres)

Located along the southeast quarter of the Santa Rosa Air Center (SRAC), the FEMA parcel is largely comprised of annual grassland with scattered valley oaks (78%) and semi-permanent marsh (12 %) (see "Map of Biological Resources...." in the FEMA file) . The vernal swales and pools support a modest, occasionally large, population of *Limnanthes vinculans* (range of 1,000 to 10,000 individuals, 1990-1993, Patterson 1994a) in a well-developed matrix of *Pleuropogon, Eleocharis* and *Juncus.* Other rare species include *Pogogyne douglasii, Ranunculus lobbii,* and California tiger salamander. *Mentha pulegium* is abundant within the wetlands. The uplands are dominated by exotic annual grasses, with dense infestations of *Dipsacus fullonum* where discing was done for fire control. The southern boundary is shared with the Broadmoor North parcel (see below) and is transected by water flowing from northeast to southwest. A plant and wildlife list is available in the Final Environmental Assessment Report (1995). Patterson (1992a) provides detailed maps and discussion of the biological resources on the adjacent SRAC and Madera parcels.

The property is currently owned by the U.S. Army but will eventually be transferred to CDFG (C. Wilcox, pers. comm. 11/98). Access to the center of the site is good because of a circular road that services a number of storage bunkers used by FEMA and the Sonoma County Sheriff's Department. The road would allow mowers and fire control vehicles to be used with minimal damage to wetland soils and

vegetation. Security is also better than on most other parcels, although there are several places along the southern and eastern borders where fence repairs need to be made. Overall, given the number of rare plants, the moderate population sizes, good access and security, and the general restoration potential, management experiments could readily be conducted on this parcel. Mowing, small scale controlled burns (depending on the contents of the bunkers), and selective herbicide application are recommended as variables to test here.

Gobbi (31 acres)

This property is the site of a wetlands restoration project in which the original topography has been re-established (1996-1997) by excavating swales that were graded for agriculture (Stromberg 1996, L. Stromberg pers. comm. via G. DeNevers 5/98). This kind of restoration, where pre-existing features are uncovered and enhanced, is in contrast to projects that create new features (e.g. Alton Lane, Airport, San Miguel, Wikiup). At present the newly excavated swales do not support populations of endangered plants (although one individual of what appeared to be *Blennosperma bakeri* was found this spring), and cover by native species is very low in general. The adjacent uplands, still impacted by excavation, are dominated by *Erodium botrys*, *Avena*, *Lolium,* and *Bromus diandrus*. Away from the excavation, near the southern boundary of the property, a small *Limnanthes vinculans* populations was censused in 1994 and 1995 (20-90 individuals, Stromberg 1996). The population appeared extensive in 1998 and might be used as a seed source for innoculation of the restored pools. But wholesale reconstruction of the ecosystem and reintroduction of its native populations is beyond the scope of this management project. It is unlikely, therefore, that any manipulation aimed at population enhancement will take place on this parcel in the near future. Suggestions for site management using livestock grazing have been outlined by Stromberg (1996).

Haroutunian (30 acres)

This property is owned and administered by Sonoma County Agricultural and Open Space District. Although its northern third has been heavily impacted by horses (removed in 1997), the southern two-thirds supports remnant perennial grasslands (*Danthonia, Nassella, Hordeum brachyantherum* and native forbs) and excellent swales (with *Pleuropogon californicus, Blennosperma bakeri, Limnanthes vinculans*, and *Juncus*). The swale system is extensive, relatively undisturbed and supports a very large population of *Blennosperma bakeri* (10^4 - 10^5 individuals). Close examination of 10 random samples revealed that the *Blennosperma bakeri* at this site lacks the red stigmas that are diagnostic for the species. Small colonies of *Limnanthes vinculans* are found near the southern boundary, with a total of 100 to 200 plants. *Mentha pulegium* and *Rumex* are common throughout. The uplands are largely annual grassland and an old prune orchard, but growth of the non-natives (e.g. *Erodium, Brassica*) is not overwhelming. A plant list is available (Jack and Betty Guggolz) based on surveys begun in 1994 (B. Guggolz, pers. comm. 4/98). Doug Eakins began a survey of the aquatic fauna in 1994 and produced a list (see CDFG files, Yountville).

The Haroutunian property has high restoration potential because of the presence, if not local dominance, of native plants. It may be desirable to manage the grasslands with fire on an experimental basis. There are no structures adjacent to the south end of the property and fire trucks could be brought in along the railroad tracks on the eastern edge of the parcel. Mowing and grazing treatments might also be appropriate, and the large *Blennosperma bakeri* population would even allow some replicated experiments (although access across the swales would require some temporary bridges to be built). Coordination with the Sonoma County Agricultural and Open Space District would be essential for conducting any management action.

Lagomarsino (76 acres)

This property is unique because it contains a large number of discreet depressions that form vernal pools, rather than the continuous, sinuous swales that occur elsewhere. The pools support extensive stands of wetland plants such as *Pleuropogon*, *Juncus*, and *Eleocharis*. *Downingia* and *Plagiobothrys* are also present, but no rare plant species were observed at the time of our field visit (late May 1998). Historically, significant subpopulations of *Limnanthes vinculans* have been observed here (B. Guggolz, pers. comm. 4/98). *Mentha pulegium* was found in most depressions but wasn't as robust as observed on other parcels. In general, uplands had relatively low densities of non-native plants, such as *Brassica, Avena*, and *Erodium*, and native grasses were present but sparsely distributed. The *Eucalyptus* grove in the northeast corner provides nesting habitat for many species of birds, including raptors (A. Buckmann, pers. comm. 5/98).

This parcel has fairly good access from Cooper Road on the west that would allow for some experimentation on *Limnanthes vinculans*. The effects of livestock grazing may be investigated here if a circulating paddock design could be installed and linked to an adjacent ranching operation. Dr. Philip Northen has done monitoring on the site for the past three years and has designed a management plan that includes experiments with grazing and controlled burns (P. Northen pers. comm. 3/98). These efforts should be supported and coordinated with restoration experiments to be conducted at other parcels in the SRVRS.

Piner Road Complex

Jinks (1.47 acres)

This conservation easement is on a small portion of the landowner's property along the southeast side. It has a subpopulation of *Blennosperma bakeri* that is contiguous with other subpopulations on adjacent properties. In addition to intensive

grazing, the land has been disced and graded in the past (C. Patterson pers. comm. 7/98). Landowner disposition was not favorable for gaining access for this survey, and would probably obstruct any attempts to construct experiments or carry out management related actions.

Simi (1.50 acre)

Surrounded on three sides by intensive agricultural use (vineyards), the character of this site (in permanent conservation easement) has changed radically over the last five years (B. Guggolz, pers. comm. 5/98). Portions of three swales and one small pool (along the northern border) once provided habitat for small populations of *Blennosperma bakeri* and *Lasthenia burkei* (Patterson 1989). Disruption of drainage patterns and run-off from the vineyards have converted the property into a weed-infested wetland and annual grassland. Cursory searches in 1998 did not reveal any rare plant populations or native vernal swale plants in general. A few *Blennosperma bakeri* individuals have been present each year in the westernmost swale, but *Lasthenia burkei* has apparently been recently extirpated (C. Wilcox pers. comm. 11/98). It is unlikely that reasonable management or restoration efforts could improve habitat quality and native plant cover at this site unless the influences of the surrounding vineyards and road could be minimized.

San Miguel (2.07 acres)

This parcel is a conservation easement (as mitigation) that is contiguous with the western edge of the Alton Lane property, approximately 1 mile east of Simi and half a mile north of Jinks. It has a large natural swale that covers a significant portion of the property. A wetlands creation project proposes to construct three large pools (approximately 1.5 acres) by conversion of old vineyards. No rare plants are currently found here (although *Blennosperma bakeri* was once resident and *B. nanum* has been

observed, see Alton Lane) and access is difficult. There are plans to expand the property to 6.4 acres. Management experiments could not be conducted at this site until construction activities are completed and the property is fully integrated into Alton Lane.

Southwest Santa Rosa Bank (39.4 acres)

The majority of this parcel contains intact, physiographically complex swales with nearly continuous subpopulations of *Limnanthes vinculans* in a matrix of *Pleuropogon Juncus,* and *Eleocharis.* The population size of *Limnanthes vinculans* is in the range of 10^4 - 10^5 individuals, while a single patch (<20 individuals) of *Blennosperma bakeri* is found near the northern boundary of the property (Waaland 1996a). Other rare species on the site include *Ranunculus lobbii* and California tiger salamander. *Mentha pulegeum* grows along the edges of the swales and was observed invading areas probably once dominated by *Limnanthes vinculans.* Upland hummocks support annual grassland (*Lolium perenne, Hordeum hystrix*) with scattered individuals of native perennials (e.g. *Danthonia californica, Hordeum brachyantheum*). A site map showing rare plant distributions and permanent transects, along with a plant list, are available (Waaland 1996a). Soils, hydrology and site history are discussed in Waaland (1996b and 1996d).

Grazing by cattle has been intensive in the past and is still occurring as animals from the Hale property to the west move freely across the property line. In general, the uplands remain in good shape with pockets of native grass and a few native forbes. Waaland (1996c) has devised a grazing management plan that is likely to be implemented in the near future. There is also discussion of related vegetation enhancement techniques and a monitoring component that will document changes in the vegetation during grazing treatment. Therefore, this parcel and its management prescription should be incorporated into the management plan for the Santa Rosa

Vernal Reserve System. Given the apparent momentum of these efforts, however, it would not be advisable to locate any new experimental designs on this site.

Todd Road (77 acres)

The Laguna de Santa Rosa Ecological Reserve (= Todd Road) was the first-established CDFG vernal pool conservation site on the plain, purchased in 1980 from the City of Santa Rosa. The city had acquired the property in 1977 as a native plant reserve because its wastewater irrigation program was impacting lands elsewhere. There is still a Sonoma County Water Agency easement and pumping station on the site that services irrigation fields to the north.

Long known for its beautiful floral displays and valley oak savanna, the Todd Road parcel has been the site of many collections, studies and small-scale management actions (see Jack and Betty (Lovell) Guggolz records in the Todd Road file). Observations in the late 1970's and 1980's indicated that rare plant populations could be large (*Blennosperma bakeri* w/ 75,000 individuals in 1976; *Lasthenia burkei* w/ 5,000-10,000 in 1988; *Limnanthes vinculans* w/ 5,000-10,000 in 1988) but fluctuated greatly in size and distribution (CH2M Hill 1995). *Lasthenia burkei*, for example, had very small populations in 1974 and 1987 (< 100 plants), disappeared entirely in 1985, peaked in 1988, and disappeared again in 1990, 1991, and 1994. No *Lasthenia* were observed in 1998, and the swale along the southern border of the property that once supported large and fairly frequent populations of *Blennosperma bakeri* and *Limnanthes vinculans*, was essentially devoid of rare taxa (fewer than 100 individuals of each). Pools on the southwest side of the parcel supported a sparse population of *Blennosperma bakeri* (<100 plants) and very few individuals of *Limnanthes vinculans* (but much *L. douglasii*). The vernal swale system supports a lush growth of *Juncus*, *Ranunculus*, and some *Pleuropogon*, but *Mentha pulegium* is aggressively invading. The uplands have significant populations of *Nassella* and

Danthonia but there is much cover by non-native grasses and forbs (especially along the buried wastewater irrigation pipes). Natural valley oak regeneration is occurring in addition to the planting project on the northern part of the property.

Scientific interest in the site has been high, but relatively little of the information generated has been written-up, critically synthesized or published. Species lists were compiled by Betty Lovell (Guggolz) and Nancy Harrison as early as 1974. Dr. Charles Quibell has supervised student projects in the 1970s and 1980s, including an ecological survey by Self and Taniguchi (1982). A flora was appended to the reserve's management plan that drew from this early work as well as a floristic survey by D. Broaderson (1985). More recent experiments on fire and grazing were conducted by Deborah Eakins (see below), but these have not been summarized in the form of a final report. Denise Cadman (a student of Dr. Philip Northen) has recently conducted thatch removal studies at Todd Road (A. Howald, pers. comm. 4/98).

There has been considerable conjecture that the removal of domestic grazers after the Todd Road property was acquired in 1980 led to the slow, steady decline in rare plant populations observed during the 1990s. Anecdotal evidence and some field counts indicate that populations of two rare plants (*Blennosperma bakeri* and *Limnanthes vinculans*) were at least capable of maintaining themselves, and occasionally flourishing, under the intensive grazing regime that typified the site until 1979 (CH2M Hill 1995, B. Guggolz notes in Todd Road file, 4/98). Cattle were excluded from some portions of the property at this time (B. Guggolz notes in Todd Road file, 4/98), although there is no record of how many animals remained in which other areas. The original management plan (January 1985) indicates that grazing was completely halted in August 1984 to promote valley oak regeneration and to lessen impacts to ground nesting birds. The plan recognized the potential benefits of light grazing on the rare plants and indicated that ongoing studies were needed (these were apparently not conducted). A comparison of field notes from 1985 and 1996

indicate a general improvement in cover by native grasses and forbs and a better showing of *Blennosperma bakeri* and *Limnanthes vinculans* during this 10 year rest period (Bittman 1997), but data are lacking. Others have maintained that the overall trend in rare plants has been downhill since cattle removal and that active management using controlled burns and/or domestic grazers is necessary (B. Guggolz, pers. comm. 4/98, Eakins 1993).

Attempts to experiment with controlled burns and grazing were made in 1992 and 1993 at the Todd Road property (Eakins 1993). Three replicate areas along the southern boundary contained three each plots (burned, grazed for 25 hours by tethered goats, and control). Unfortunately, there was great variability between replicate areas in the behaviour of the rare plants, probably due to stochastic climatic factors, such as drought. There was some indication that fire could benefit both *Blennosperma bakeri* and *Limnanthes vinculans* to some extent, and that grazing could benefit the latter, but the low number of replicates and the short duration of the treatments prevented more robust conclusions from emerging.

Although it is likely that seed banks of the three rare plants persist, it is unwise to conduct experiments at Todd Road while the above-ground populations appear to be so sparse and transient and while the effects of the available management treatments seem obscure or ambiguous. A fire too hot or hooves too heavy could further deplete the seed banks, and replicates would still be too few to provide a sound statistical design. Instead, while experiments are conducted at other sites and better prescriptions are developed, an interim program of intensive care should begin. The program would attempt to improve habitat quality in the vicinity of seed banks by assuming that any careful removal of non-native competitors will be generally beneficial. Techniques for such care need to be developed in cooperation with volunteers who are knowledgeble with respect to native plants and sensitive to the goals of ecological restoration.

Wikiup (12 acres)

The Wikiup property was established as a wetlands mitigation bank, lying between Highway 101 and the Old Redwood Highway, north of Mark West Creek, and surrounded by low density residential development. It was mostly an upland supporting a dense oak savanna bearing little resemblance to the other SRVRS properties. Five large, created vernal pools now occupy almost 50% of the total area, supporting a wide array of native wetland species (C. Wilcox pers. comm. 11/98). Although once home to a small population of *Lasthenia burkei*, and having been unsuccessfully seeded with *Pogogyne douglasii* ssp. *parviflora* , no rare plant populations are now known to occur on the site (Patterson 1996). There is a plant checklist, hydrological map and summaries of cover data (Patterson 1996), as well as a series of wetland monitoring reports (1996-1998) available at CDFG Yountville.

SHORT-TERM MANAGEMENT REGIMES AND GOALS FOR THE SRVRS

The properties that currently form the core of the Santa Rosa Vernal Reserve System differ in many ways. Some have relatively high cover by native grasses and forbs and relatively large, numerous subpopulations of endangered species (e.g. Cramer, Haroutunian). Others have high native cover but rapidly declining subpopulations of endangered species (e.g. Todd Road, Crinella). Logistical factors also would permit the construction of experimental plots on some properties (e.g. FEMA, Alton Lane), but be prohibitive elsewhere (e.g. Bennett, Broadmoor North).

Given the biological and logistical conditions associated with each property, it was possible to construct four short-term management regimes that could be applied to the SRVRS over the next five to ten years (Table 2). Properties under the experimental regime have relatively large, stable subpopulations of rare plants that are well-dispersed among swales or pools. This would allow the construction of replicate plots for testing the effects of mowing or controlled burning without impacting

a large proportion of the above-ground individuals. Native dominants are locally abundant, weeds are present, and basic hydrology and soil conditions have not be significantly altered (except on sites with created wetlands, e.g. Airport and Alton Lane). Access and overall security are generally good, with minimal administrative conflicts. The management goal for these properties is to provide a system for generating taxon-specific (rather than site-specific) scientifically robust information for increasing the abundance and distribution of native plants, especially the rare species. When possible, the demographic effects of habitat manipulations will be part of the monitoring program and incorporated into evaluations of alternative prescriptions (Pavlik 1994, 1996). In terms of the 5 to 10 year framework, experimental work would take place in the first five years to allow development of management prescriptions.

Table 2. Properties of the SRVRS categorized by short-term management regime. Rare plant occurrences (Bb =*Blennosperma bakeri,* Lb =*Lasthenia burkei,* and Lv =*Limnanthes vinculans*) are indicated. [] indicates possible disposition of a property in an alternative management regime.

experimental	**ecosystem enhancement**
Airport - Lb	Broadmoor South - Lv
Alton Lane - Bb, Lb, Lv	Carinelli - Lv
Cramer - Lb, Lv	Haroutunian - Bb, Lv
FEMA - Lv	SW Santa Rosa Bank - Lv
[Haroutunian - Bb, Lv]	Lagomarsino - Lv
[Lagomarsino - Lv]	
intensive care	**quiescent**
Broadmoor North - Lv	Abramson - Lb
Crinella - Lb, Lv	Bennett - Lv
Todd Road - Bb, Lb, Lv	Gobbi - Lv
	Piner Road Complex - Bb
	Wikiup

Properties under the ecosystem enhancement regime have small or moderate subpopulations of rare plants (except for Southwest Santa Rosa Bank) that are relatively stable, usually in a few clusters, and have significant cover by native dominants. Weeds are present but not overwhelming. Hydrology may have been significantly altered (e.g. Broadmoor South), resulting in a shift from wetlands to grasslands. These sites would receive treatments for improving overall quality of the uplands, swales and pools without specific actions directed at the rare plant populations. The judicious use of selective herbicides in dilute concentrations could be explored, with attention paid to minimizing non-target effects. Essentially, the goal is to maintain or improve the existing community matrix with a collateral potential for providing more habitat for the rare plants through the addition of periodic disturbance. Permanent, long-term trend plots should be established and rare plant populations surveyed, but replication of treatments and demographic monitoring would not be performed. Actions related to ecosystem enhancement would take place after experimental studies were completed and management prescriptions developed.

The intensive care regime allows some management actions to take place before our scientific understanding and justification are fully formed. Properties with rapidly declining rare plant populations that are already at a low level require careful, informed intervention to prevent extirpation of the seed banks. Removal of exotic species, especially grasses, in the vicinity of the rare plants is a reasonable first action that is justified by studies on other species or ecosystems (e.g. Pavlik *et al.* 1993, Rosentreter 1994). Working on the vernal pools of Miramar Naval Air Station, Bauder (1988, 1992, pers. comm. 3/98) has used student volunteers to reduce cover by *Polypogon, Lolium, Vulpia, Bromus mollis,* and *Cotula* and improve habitat for *Pogogyne abramsii* and other vernal pool natives. The response of individual pool plants has been "spectacular", although the shift from exotic-dominated to native-dominated at the community level has been slow. The goal of intensive care is to

increase the size of the seed banks of rare species by removing competitors one plant at a time. The judicious use of grass-specific herbicides in dilute concentrations could be explored (Pavlik *et al.* 1993), with attention paid to minimizing non-target effects. Care must be taken to minimize trampling damage and soil compaction by volunteers. A preliminary attempt to organize a program should take place within the next few years. Evaluation of these efforts must follow standard guidelines for monitoring rare plant restoration efforts (Sutter 1996).

Finally, properties in the quiescent regime are to be left alone in the near term. In general, they are small, have small native populations, have been significantly disturbed, or are logistically unsuitable for any management action at this time. In the case of Gobbi, a swale reconstruction project is underway and its progress should not be impeded. Some of the properties (e.g. Bennett or Jinks (Piner Road Complex)) might be moved to the intensive care or ecosystem enhancement categories if access or landowner relations improved.

DEVELOPING MANAGEMENT PRESCRIPTIONS FROM EXPERIMENTS. I. Increasing the Extent and Density of Native Plants by the Use of Summer Mowing

The development of management prescriptions that favor native plants, especially those whose populations have been severely reduced, requires the use of scientific approaches and statistical analyses of alternative outcomes. An experiment designed to uncover limitations on population growth by implementing practical manipulations of habitat quality can be a very effective tool for reintroducing a species or enhancing its abundance or distribution (Pavlik 1994, Sutter 1996, Guerrant and Pavlik 1998). Treatment variables (e.g. controlled fire, selective herbicides) are chosen according to the best available information for the taxa in question: field observations, greenhouse studies, or inference from related ecosystems, provide testable hypotheses

for the first round of trials. These initial choices may not be the most effective for restoring a population or community, but the experiments will provide new information for choosing other variables or treatments in subsequent rounds. Restoration is, therefore, an iterative process that benefits from "failure" as well as "success" (Pavlik 1996) and requires a long-term committment to do the science required for developing management prescriptitons.

The first goal of the Santa Rosa Vernal Reserve System is to develop management prescriptions for improving the habitat quality of native plant populations, especially those of conservation interest. The goal will be met through four objectives: 1) conduct initial experiments at a single site that test ecologically sound and practical manipulations for shifting plant cover from exotic to native and from sparse to abundant, 2) conduct a second round of experiments at multiple sites that differ in their soils, hydrology, and initial plant cover, 3) perform non-experiment manipulations that achieve the same ends, 4) repeat the experimental and non-experimental manipulations in years with different temperature and precipitation regimes. These objectives are structured to include the spatial and temporal environmental variations that have been shown to greatly affect the productivity and competitive strength of exotic annuals (Murphy 1970, Pitt and Heady 1978, Bartolome and Gemmil 1981), the establishment of native perennial grasses (Jackson and Roy 1986, Dyer *et al.* 1996), and the demography of rare grassland herbs (Pavlik 1991, Schlising 1996).

Portions of several objectives will be addressed over the next two years (November 1998 to November 2000). A primary experiment on the effects of early summer mowing will be set up in spring 1999 at the Cramer property (objective #1). Mowing was chosen as the first treatment to be tested because it is easiest to do logistically (compared to replicated, meso-scale controlled burns or grazing) and because others have reported benefits to native grasses (Danielsen 1996, Muller *et al.* 1998, J. Menke pers. comm. 9/98) and possibly to vernal pool plants (M. Waaland pers.

comm. 5/98). The Cramer property offers an extensive, relatively unaltered swale and pool system with a large number of *Limnanthes vinculans* subpopulations (see above) that can be the sites of replicated plots. A secondary experiment, on a smaller scale, will be conducted at Alton Lane in order to expose *Blennosperma bakeri* to mowing and to include a different soil type in the treatment (objective # 2). Finally, some non-experimental "spot treatments" with foliar herbicide (to control *Mentha pulegium)* and fire (using burn box technology, Pavlik *et al.* 1993, Pavlik 1995) will be initiated for purposes of developing some intensive care procedures (objective #3).

Primary Experiment

The primary experiment will examine the effects of early summer mowing on the cover of native and introduced plants at the Cramer property (on Wright loam soil). Mowing is easiest to do logistically, has purported benefits to native grasses and possibly to vernal pool plants, and could be readily implemented on other sites by private landowners. The Cramer property offers an extensive, relatively unaltered swale and pool system with a large number of *Limnanthes vinculans* subpopulations that can be the sites of replicated plots. The replicated plots will be arranged in blocks (Figure 2) among swales and pools on the north end of the Cramer property, thus avoiding pseudoreplication. Blocks will include a mowed plot (M), a mowed and mulched plot (Mm) and an untreated control. At present, each plot will be 20m X 10m, with its long axis perpendicular to the edge of the standing water. Smaller, but more numerous plots could be used if preliminary characterization of the site suggests high levels of spatial variability. Additional considerations related to construction, distribution, and number of blocks will be made in consultation with a biostatistian to avoid problems with data analysis related to spatial autocorrelations and assumptions of normality during ANOVA (Holmes 1998).

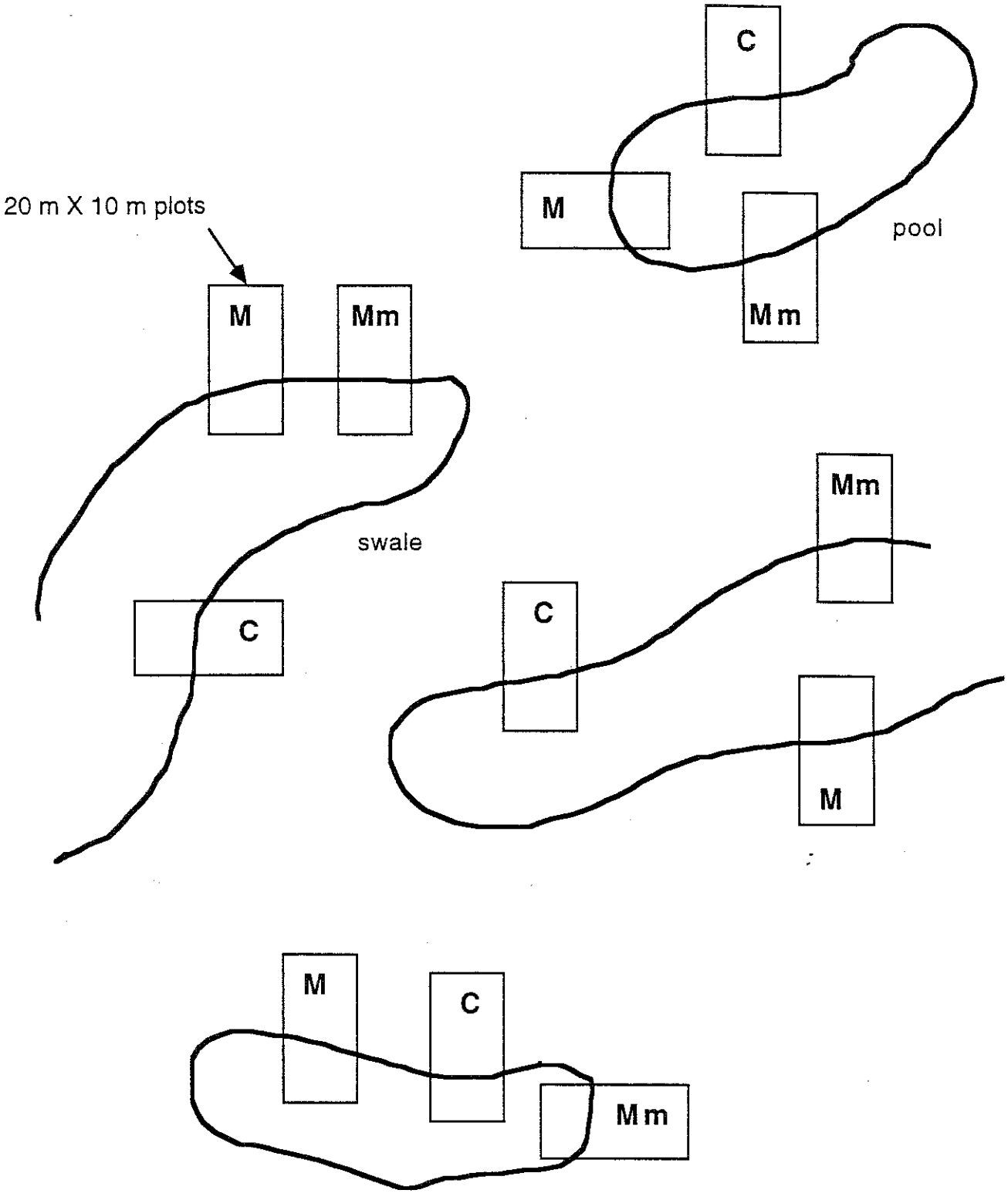

Figure 2 . Proposed design for mowing experiments at a single reserve property. Control (C), mowed (M) and mowed/mulched (Mm) treatments randomly assigned.

Approximately 25-30% of the plots will extend into the water of the swales and pools, with the water-margin edge marked by three permanent metal sleeves driven into the soil (Figure 3). This edge occurs at the "tension zone" (TZ) between open standing water and the shallow, vegetated transition that fluctuates seasonally depending on rainfall and evaporation during the winter and early spring. Above this edge is the portion of the plot called the margin, roughly designated as the *Pleuropogon-Juncus-Limnanthes* band. Above the margin is upland, with *Danthonia californica* and a wide array of native and non-native plants. The upland edge of the plot will also be permanently marked with metal sleeves that will support 2 m tall, removable sections of PVC pipe during treatment or sampling. It is the intention of these treatments to 1) increase the cover, density and vigor of *Limnanthes vinculans* and other vernal natives in the plot margins, 2) spread *Limnanthes vinculans* into the lowest portions of the plot upland (the "expansion zone" or EZ) where it is presumably limited by competition, and 3) increase the cover of native perennials in the plot uplands.

Detecting changes in the cover, density and vigor of the plants along the pool to upland transition will be done by sampling a series of contiguous 1 X 1 m (possibly 0.5 X 0.5 m) quadrats that extend from unvegetated, aquatic portions of the transect to the dense grasslands of the upland (Figure 3). The water and upland ends of the transect will also be marked with metal sleves, fixing the position of the transect regardless of year-to-year fluctuations in water level. Each year the transect is sampled the water levels could be different, but the extent and quality of the native vegetation will be "mapped", with expansions and contractions readily detectible. If needed, supplemental margin and upland plots, located laterally, could detect additional spatial variation in vegetation quality. A single quadrat from the margin and another from the upland will be randomly selected each year for biomass sampling (clip-plot, sorted by species, native vs. non-native). Pre-treatment characterization of all plots will take place during the spring of 1999, thus establishing baseline conditions.

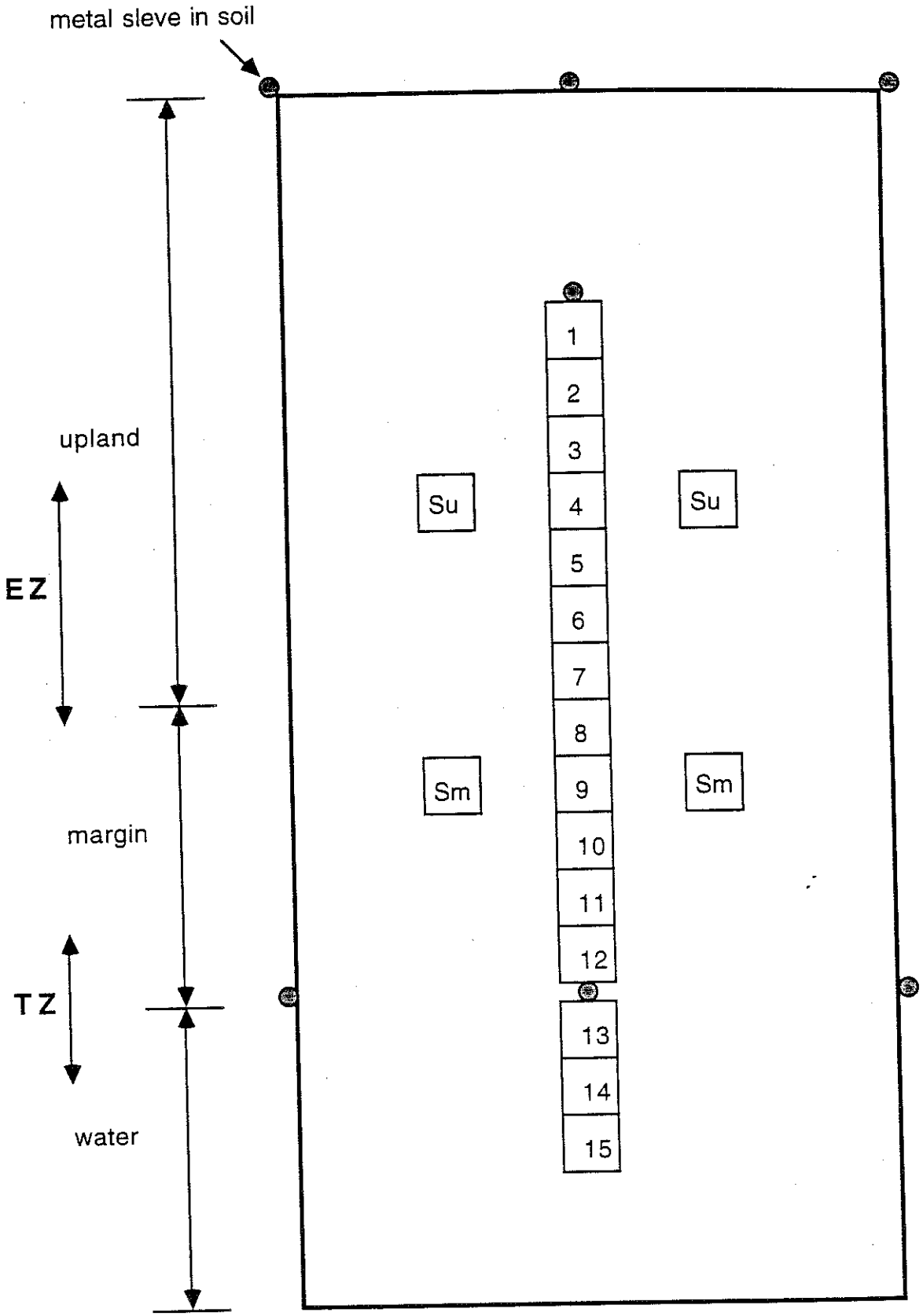

Figure 3 . Mowing treatment with forward tractor paths. "EZ" marks the expansion zone for RTE plants, "TZ" marks the tension zone caused by fluctuations in water levels. "Sm" and "Su" indicate supplemental plots.

Mowing treatments will take place in the late spring-early summer of 1999. A small 4-wheel drive utility tractor (similar to John Deere model 4100, 20 hp, manual transmission) fitted with a mid-mount, 60" wide grooming mower will be used to cut five foot wide strips parallel to the long edge of the M and Mm plots. The mowed strips will extend as far into the expansion zone between the upland and the margin as possible without rutting in wet soil. Two patterns could be run depending on traction and degree of soil damage. If soil is slick and readily torn or compacted, the tractor will simply go back and forth without turning and leaving all portions of the margin untreated (Figure 4). If the soil is strong, the tractor will be able to take the mower into the upper edge of the margin by turning around (Figure 5). Note that in either case the tractor will span the center of the plot were the sampling transect is located, thus avoiding direct mechanical disturbance. In M plots the cuttings will be instantly collected by a hydraulic dump material collection system fitted with a variable speed fan to provide strong vacuum (similar to John Deere 13 bushel hydraulic collection system). In the Mm plots this collection system will be disengaged, allowing clippings to fall in place.

How will mowing affect changes in vegetation quality? Mowing (without mulching) in late spring should subsequently favor perennial grasses in the upland and the expansion zone of the plots by collecting and removing a high proportion of this year's crop of annual grass and weed (e.g. *Erodium*) seed. Perennial grasses will also be cut and seed removed, but they should have improved growth and/or survivorship over the first summer (higher soil moisture) and next growing season (higher light, soil moisture). Removal of biomass could also lower available soil nitrogen, thus favoring perennial grasses over annuals (Claassen and Marler 1998). Lowering annual grass cover and competition in the upland could also allow the spread of native margin plants into the expansion zone because soils would be relatively moister and the canopy more open. To the extent that annual grasses are also mowed in the upper part of the margin, direct competition with annuals such as *Limnanthes vinculans* and perennials such as

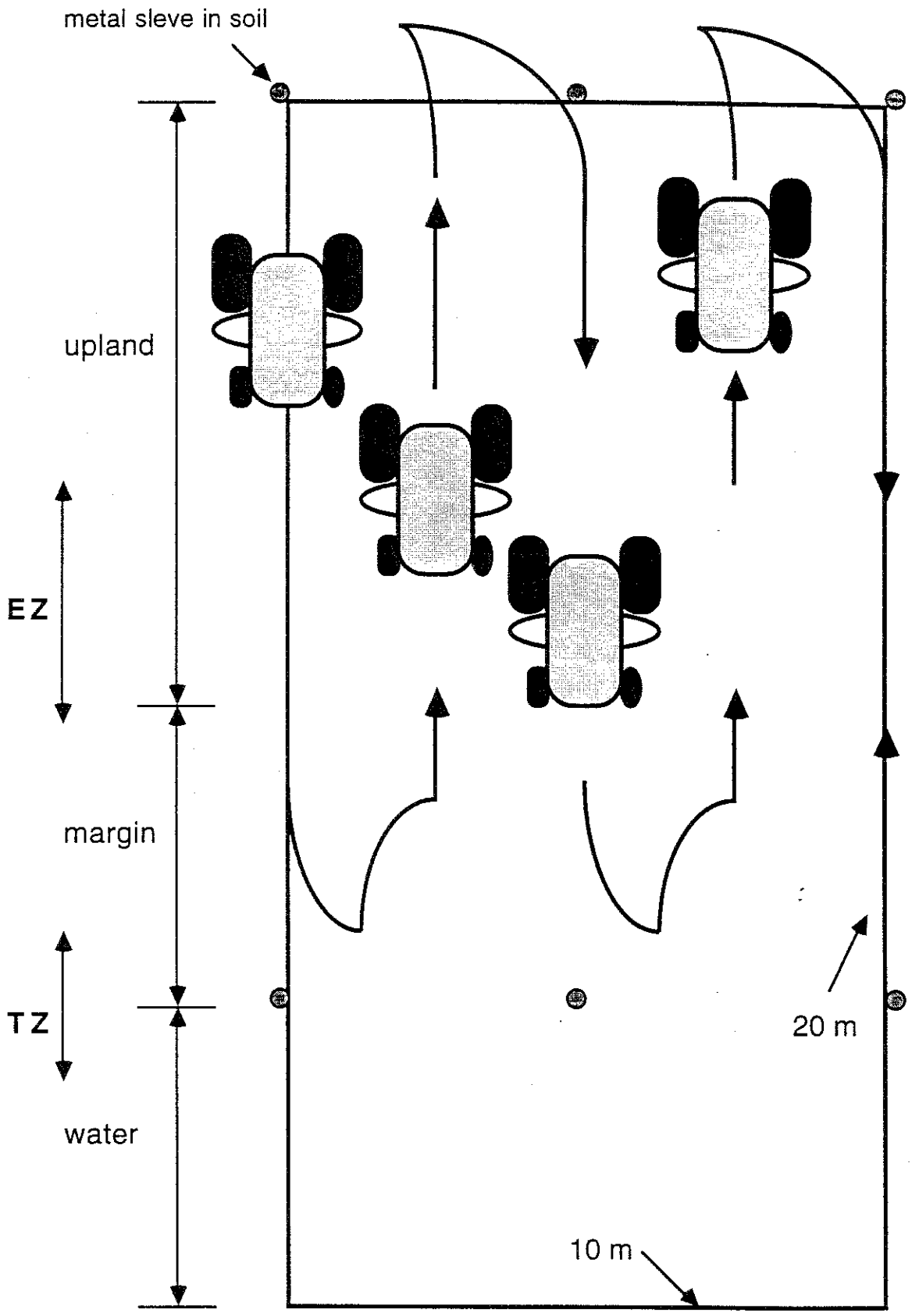

Figure 4. Mowing treatment with reverse tractor paths. "EZ" marks the expansion zone for RTE plants, "TZ" marks the tension zone caused by fluctuations in water levels.

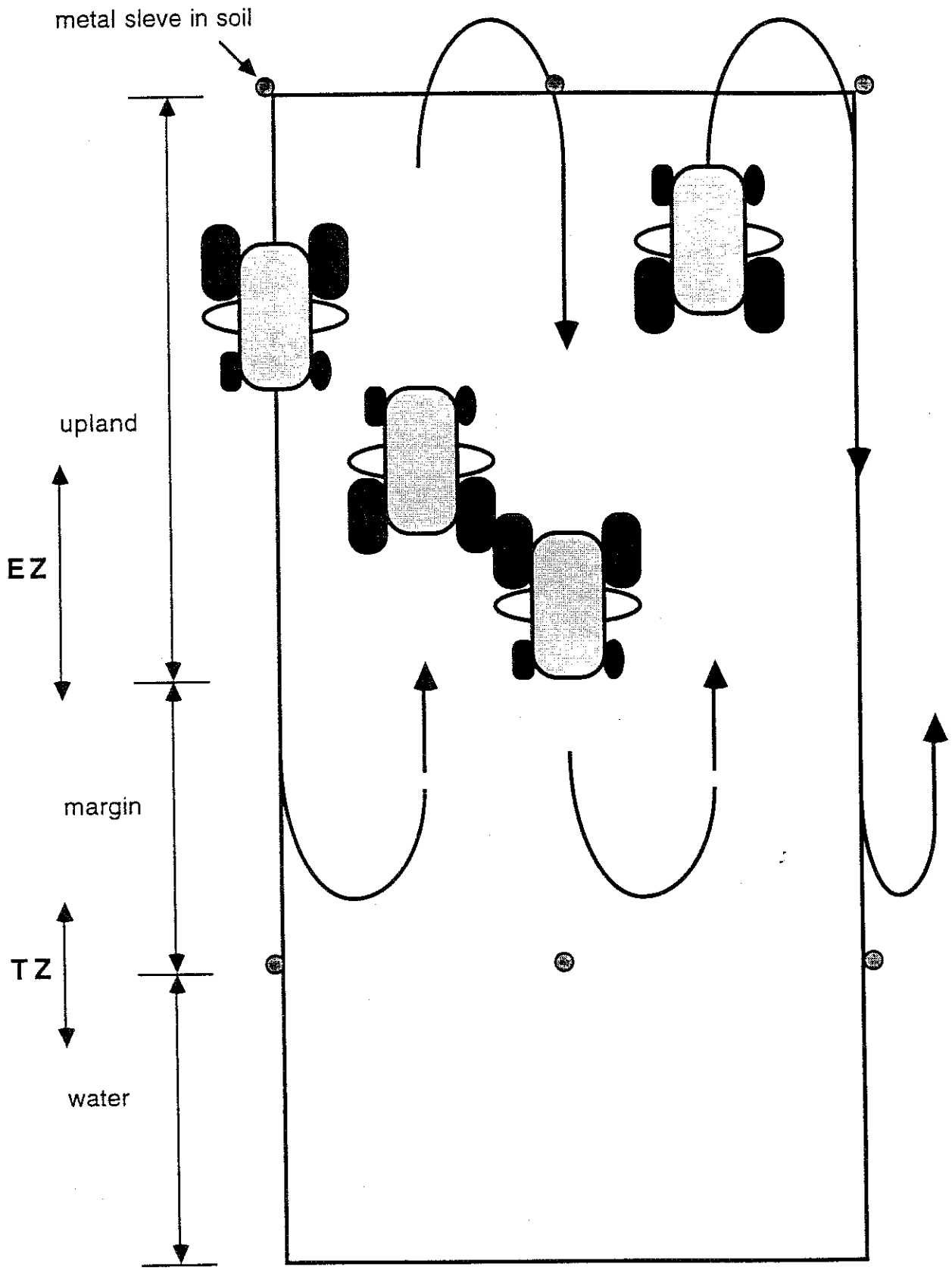

Figure 5. Mowing treatment with forward tractor paths. "EZ" marks the expansion zone for RTE plants, "TZ" marks the tension zone caused by fluctuations in water levels.

Pleuropogon will be reduced and plant growth could be improved. Removal of material that adds to the thatch and inhibits germination of annuals in the margins may also benefit the natives, but could possibly benefit annual weeds as well.

The mowing with mulching treatment is an attempt to manipulate soil nitrogen levels. During the first year after mulching the germination of all annuals, both native and exotic could be inhibited, leading to a short-term decrease in *Limnanthes vinculans*, as well as *Avena, Lolium* and other exotic grasses. If the native seed bank is any more long-lived than that of the non-natives, the native seeds should persist. However, mulching will provide a readily-decomposed carbon source for soil bacteria, including denitrifiers. The population of denitrifying bacteria should grow and effectively compete with the plants for available soil nitrogen and eventually release it to the atmosphere (Keller and Friese 1998). Thus, the soil should have reduced availability of nitrogen, putting annual plants in drier (e.g. upland) habitats at a disadvantage relative to perennials. This could eventually retard the growth of exotics, and open the canopy to native perennials. If RTE species, such as *Limnanthes vinculans* are adapted to more open, nitrogen-poorer soils, they should benefit from lower competition microsites that lack high nitrogen and extravagant annual grasses.

In order to follow soil nitrogen levels, 4 soil samples will be collected in each plot and analyzed by a testing lab for two forms of nitrogen (nitrate and ammonium), as well as the baseline levels of other essential nutrients. The samples will come from two depths (1-2 cm and 3-5 cm) in upland and margin portions of the plots, probably from the same quadrats as the biomass samples.

Secondary Experiment

A smaller scale experiment will be conducted at Alton Lane in order to expose *Blennosperma bakeri* to mowing and to include a different soil type (Huichica clay loam) in the treatment. It is unlikely that a tractor could negotiate the complex terrain of

this property, so a hand mower will be used. A similar block design with controls, M and Mm plots can be installed along natural, unaltered pools and swales (pool features 3,4,5,8, 25 on Patterson 1993, Figure 15) and along dammed swales (features 10,11,12,26,27, ibid) that support subpopulations of *Blennosperma bakeri*. The plots themselves will be much smaller (4 m X 2 m), reflecting the smaller scale of features on the property. Otherwise, the sampling protocol and statisical considerations will be the same as for the primary experiment at Cramer. If budget permits, soil samples will be collected and analyzed for baseline nutrient levels and ammonium and nitrate at two soil depths.

Intensive Care Trials

Some non-experimental "spot treatments" with a foliar herbicide (to control *Mentha pulegium)* and fire (using burn box technology, Pavlik *et al.* 1993, Pavlik 1995) will be initiated for purposes of developing some intensive care procedures. Hand applications of a non-restricted, non-selective herbicide suitable for wetland conditions will be used in at least five pools or swales at Cramer that are not part of the primary experiment. A 1% solution of glyphosate, labeled for aquatic weed control (similar to Rodeo) can be applied with hand sprayer or rope wick in early summer after senescence of the native broadleaves. Avoidance of the surrounding native grasses and rushes will be essential but not difficult. An operator identification number will be obtained from the County Agricultural Commissioner's office with whom a report will be filed.

Although the technical aspects of the burn box protocol are well established, the political environment for using experimental fire on the Santa Rosa Plain needs development. This includes making connections with local fire control officials (City of Santa Rosa, California Division of Forestry and Fire Protection), law enforcement, and immediate neighbors of the Cramer property. With politics and air pollution control

permitting, a late spring/early summer burn could occur in 1999. Five patches within upland and swale margin habitats will be burned using the box and the required safety and control crews. Each patch will be at least 2 m X 2 m and paired with an adjacent control patch. Baseline conditions of the vegetation, rare plants and thatch will be recorded prior to the burn and monitored afterwards.

SUMMARY

The Santa Rosa Vernal Reserve System Database was produced as an electronic summary of property-based information entered into Microsoft Access. The 2.13 Mb database became the basis for narratives that describe property attributes from the standpoint of potential for supporting management experiments and restoration activities.

The 18 properties that currently form the core of the Santa Rosa Vernal Reserve System differed in many ways. Some have relatively high cover by native grasses and forbs and relatively large, numerous subpopulations of endangered plant species. Others have high native cover but rapidly declining subpopulations of endangered species. Logistical factors permit the construction of experimental plots on some properties, but are prohibitive elsewhere. Given the biological and logistical conditions associated with each property, it was possible to construct four short-term management regimes (experimental, ecosystem enhancement, intensive care and quiescent) that could be applied to the SRVRS over the next five to ten years.

The first goal of the SRVRS is to develop management prescriptions for improving the habitat quality of native plant populations, especially those of conservation interest. The goal will be met through four objectives: 1) conduct initial experiments at a single site that test ecologically sound and practical manipulations for

shifting plant cover from exotic to native and from sparse to abundant, 2) conduct a second set of experiments at multiple sites that differ in their soils, hydrology, and initial plant cover, 3) perform non-experimental manipulations that favor native cover, 4) repeat the experimental and non-experimental manipulations in years with different temperature and precipitation regimes. Portions of several objectives will be addressed over the next two years (November 1998 to November 2000). The design of a primary experiment on the effects of early summer mowing is presented (objective #1) using the Cramer property with its extensive, relatively unaltered swale and pool system and large *Limnanthes vinculans* (Sebastopol meadowfoam) subpopulations. A secondary experiment, on a smaller scale, will be conducted at Alton Lane in order to expose *Blennosperma bakeri* (Sonoma Sunshine) to mowing and to include a different soil type in the treatment (objective # 2). Finally, some non-experimental "spot treatments" with foliar herbicide (to control *Mentha pulegium)* and fire (using burn box technology) will be initiated for purposes of developing some intensive care procedures (objective #3).

LITERATURE CITED

Anonymous. 1996. Endangered Species Management Plan for the 'Crinella' subdivision. Crinella file, Department of Fish and Game, Yountville.

Bartolome, J. W. and B. Gemmill. 1981. The ecological status of *Stipa pulchra* (Poaceae) in California. Madrono 28, 172-184.

Bauder, E. 1988. Vernal pool enhancement. Report to Department of Fish and Game, Sacramento.

Bauder, E. 1992. Vernal pool enhancement. Research project to assess various restoration techniques III. Report to Department of Fish and Game, Sacramento.

Bittman, R. 1997. Comparison of two field visits to Todd Road Preserve, 10 years apart. Memo to Teresa LeBlanc, Department of Fish and Game, Yountville. 3 pp.

Broaderson, D. 1985. A floristic survey of Todd Road Vernal Pools. Student paper, Sonoma State University. (B. Guggolz has a copy).

Buckmann, A. and C. Dixon. 1989. Broadmoor acres #4: A survey and analysis of vernal pool wetlands and valley oak grasslands for environmental review and regional planning. Special Report, Department of Fish and Game, Yountville.

CH2M Hill. 1995. Final Santa Rosa Plain vernal pool ecosystem preservation plan. Report to the Santa Rosa Plain Vernal Pool Task Force, Santa Rosa, California. City of Santa Rosa.

Charles, L. and Associates. 1990. Broadmoor acres no. 4 subdivision: Draft environmental impact report. Report to Department of Fish and Game, Yountville.

Claassen, V. P. and M. Marler. 1998. Annual and perennial grass growth on nitrogen-depleted decomposed granite. Restoration Ecology 6, 175-180.

Cochane, S. 1990. Memorandum to Department of Fish and Game Regional Manager, Yountville. [property file, Y}

Danielsen, C.A. 1996. Restoration of a native bunchgrass and wildflower grassland underway at Mount Diablo State Park (California). Restoration and Management Notes 14, 65.

Dyer, A.R., H.C. Fossum and J.W. Menke. 1996. Emergence and survival of *Nasella pulchra* in a California grassland. Madrono 43, 316-333.

Eakins, D. 1993. Interim report on the effects of burning and grazing on the federally endangered *Limnanthes vinculans* and *Blennosperma bakeri* at Todd Road Ecological Reserve. Interim report to Plant Conservation Program, Department of Fish and Game, Sacramento, CA 3 pp. [species file, Y]

Fensham, R.J. 1998. The grassy vegetation of the darling downs, south-eastern Queensland, Australia. Floristics and grazing effects. Biological Conservation 84, 301-310.

Guerrant, E.O. Jr. and B. M. Pavlik. 1998. Reintroduction of rare plants: Genetics, demography and the role of *ex situ* methods. In: P.L. Fiedler and S.K. Jain (eds.) Conservation Biology: The Theory and Practice of Nature Conservation, Preservation and Management. Second Edition, Chapman and Hall, London. pp 80-108.

Harding Lawson and Associates. 1994. Wetlands and rare plant mitigation plan. Report to Department of Fish and Game, Yountville.

Holmes, T. 1998. Smart blocking: Effective restoration experiments in complex environments. Abstract, Society for Ecological Restoration International Conference, Austin, Texas.

Hunter, B. 1994. Results of Crinella property site visit. Letter to Jeffrey Holtzman, Deputy District Attorney, Santa Rosa, CA. [plant ecologist files, DFG, Yountville].

Jackson, L.E. and J. Roy. 1986. Growth patterns of Meditteranean annual and perennial grasses under simulated rainfall regimes of southern France and California. Acta Oecologia/Oecologia Plantarum 7, 191-212.

Keller, S.M. and C.F. Fiese. 1998. Nitrogen dynamics as a functional indicator of wetland health and restoration. Abstract, Society for Ecological Restoration International Conference, Austin, Texas.

Meurk, C. D., D. A. Norton, and J. M Lord. 1989. The effect of grazing and its removal from grassland reserves in Canterbury. pp. 72-75 in: Norton, D.A. (ed.) Management of New Zealand's Natural Estate. New Zealand Ecological Society Occasional Publication No. 1.

Monk, J. and Associates. 1994. Wetlands and rare plant mitigation plan, wine country retail outlet mall, Cotati, California. Report to Department of Fish and Game, Yountville.

Muller, S., T. Dutoit, D. Alard and F. Grevilliot. 1998. Restoration and rehabilitation of species-rich grassland ecosystems in France: A review. Restoration Ecology 6, 94-101.

Murphy, A.H. 1970. Predicted forage yield based on fall precipitation in California annual grasslands. J. Range Management 23, 363-365.

Parker, T. 1989. Effect of prescribed burning on the establishment of native perennial grasses: Results after 3 years at Henry Coe State Park. Report to Department of Parks and Recreation, Central Coast Region.

Patterson, C.A. 1989. Distribution of swales, pools and rare plants for Simi. Report to Department of Fish and Game, Yountville. [A. Buckmann files, "Lands: Piner Rd., Simi"].

Patterson, C.A. 1990. Vernal pool creation and rare plant translocation in Sonoma County, California. Report to Department of Fish and Game, Yountville. (Includes data on the Airport and Alton Lane properties).

Patterson, C.A. 1991. Vernal wetland and sensitive plant monitoring report. Year 2 - 1991, Alton Road mitigation site, Sonoma County, California. Report to Cobblestone Development, Santa Rosa, CA. Copy at Department of Fish and Game, Yountville.

Patterson, C.A. 1992a. Mitigation plan for Sebastopol Meadowfoam (*Limnanthes vinculans*) at the Santa Rosa Air Center and Madera parcels, Sonoma County, California. Report to Department of Fish and Game, Yountville.

Patterson, C.A. 1992b. Wetland delineation report, Cramer property, Sonoma County, California. Report to Department of Fish and Game, Yountville. [environmental review file, Y]

Patterson, C.A. 1992c. Vernal wetland and sensitive plant monitoring report. Year 3 - 1992, Alton Lane mitigation site, Sonoma County, California. Report to Cobblestone Development, Santa Rosa, CA. Copy at Department of Fish and Game, Yountville.

Patterson, C.A. 1993. Vernal wetland and sensitive plant monitoring report. Year 4 - 1993, Alton Road mitigation site, Sonoma County, California. Report to Cobblestone Development, Santa Rosa, CA. Copy at Department of Fish and Game, Yountville.

Patterson, C.A. 1994a. Inventory of rare plant locations and sites surveyed for wetland resources on the Santa Rosa plains, Sonoma County, California. Report to Department of Fish and Game, Yountville.

Patterson, C.A. 1994b. Monitoring report on the discing incident at the Crinella property (Hall Road at Piezzi). Memorandum to James Hummer. [property file, Y]

Patterson, C.A. 1996. Annual monitoring report: Wikiup mitigation bank, year 1, 1996. Report to Wikiup Builders, Santa Rosa, CA. [CESCO files, Y]

Patterson, C.A., Guggolz, B. and M. Waaland. 1994a. Seasonal wetland baseline report for the Santa Rosa Plain, Sonoma County. Report to Department of Fish and Game, Yountville. 65 pp. + appendices.

Patterson, C.A., Guggolz, B. and M. Waaland. 1994b. Inventory of rare plant locations and sites surveyed for wetland resources on the Santa Rosa Plain, Sonoma County. Report to Department of Fish and Game, Yountville. 58 pp.

Pavlik, B.M. 1991. Management of reintroduced and natural populations of *Amsinckia grandiflora.* Endangered Plant Program, California Department of Fish and Game, Sacramento, CA

Pavlik, B.M. 1994. Demographic monitoring and the recovery of endangered plants. In: Bowles, M. and C.Whalen (eds.) Restoration of Endangered Species. Blackwell Scientific, London. pp. 322-350.

Pavlik, B.M. 1995. The recovery of an endangered plant. II. A three-phased approach to restoring populations. In: Urbanska, K.M. and K. Grodzinska (eds.) Restoration Ecology in Europe. Geobotanical Institute SFIT, Zurich, Switzerland. pp. 49-69.

Pavlik, B.M. 1996. A framework for defining and measuring success during reintroductions of endangered plants. In: Falk, D., C. Millar and P. Olwell (eds.) Restoring Diversity. Strategies for Reintroduction of Endangered Plants. Island Press, Washington, D.C. pp. 127-156.

Pavlik, B.M., D.Nickrent and A. Howald 1993. The recovery of an endangered plant. I. Creating a new population of *Amsinckia grandiflora* . Conservation Biology 7, 510-526.

Pitt, M.D. and H.F. Heady. 1978. Responses of annual vegetation to temperature and rainfall patterns in northern California. Ecology 59, 336-350.

Rosentreter, R. 1994. Displacement of rare plants by exotic grasses. pp. 170-175 in: Monsen, S. B. and S. G. Kitchen (comps.) Proceedings - ecology and management of annual rangelands. U.S. Department of Agriculture, Forest Service, Intermountain Research Station. Gen. Tech. Rep. INT-GTR-313, Ogden, Utah. 416 pp.

Schlising, R. 1996. First-year response to fire by the California grassland perennial, *Dodecatheon clevelandii* ssp. *patulum* (Primulaceae). Madrono 43, 93-96.

Self, D.W. and D.M. Taniguchi. 1982. Todd Road Preserve Ecological Study. Student paper for independent project. Sonoma State University. (B. Guggolz has a copy).

Stromberg, L. P. 1996. Endangered species management plan for Sebastopol Meadowfoam, Courtside Village project, Santa Rosa, California. Report to Department of Fish and Game, Yountville. 36 pp.

Sutter, R. 1996. Monitoring. In: Falk, D., C. Millar and P. Olwell (eds.) Restoring Diversity. Strategies for Reintroduction of Endangered Plants. Island Press, Washington, D.C. pp. 235-264.

Waaland, M. 1996a. Sensitive species survey for the proposed Southwest Santa Rosa Vernal Pool Preservation Bank (Engel site), Santa Rosa. Report to Department of Fish and Game, Yountville.

Waaland, M. 1996b. Biological assessment and banking plan Southwest Santa Rosa Vernal Pool Preservation Bank for the Southwest Santa Rosa Vernal Pool Preservation Bank Site. Report to Department of Fish and Game, Yountville.

Waaland, M. 1996c. Management plan for the Southwest Santa Rosa Vernal Pool Preservation Bank Site. Report to Department of Fish and Game, Yountville.

Waaland, M. 1996d. Wetland delineation for the proposed Southwest Santa Rosa Vernal Pool Preservation Bank (Engel site), Santa Rosa. Report to Department of Fish and Game, Yountville.

Wedin, D.A. and D. Tilman. 1996. Influence of nitrogen loading and species composition on the carbon balance of grasslands. Science 274, 1720-1723.

WESCO (Western Ecological Services Company, Inc.) 1993. Fourth year monitoring report, county service area 31, airport wastewater storage pond, wetlands mitigation project. Report to County of Sonoma, Department of Public Works, Santa Rosa.

Appendix 1

PROPERTY LOCATIONS

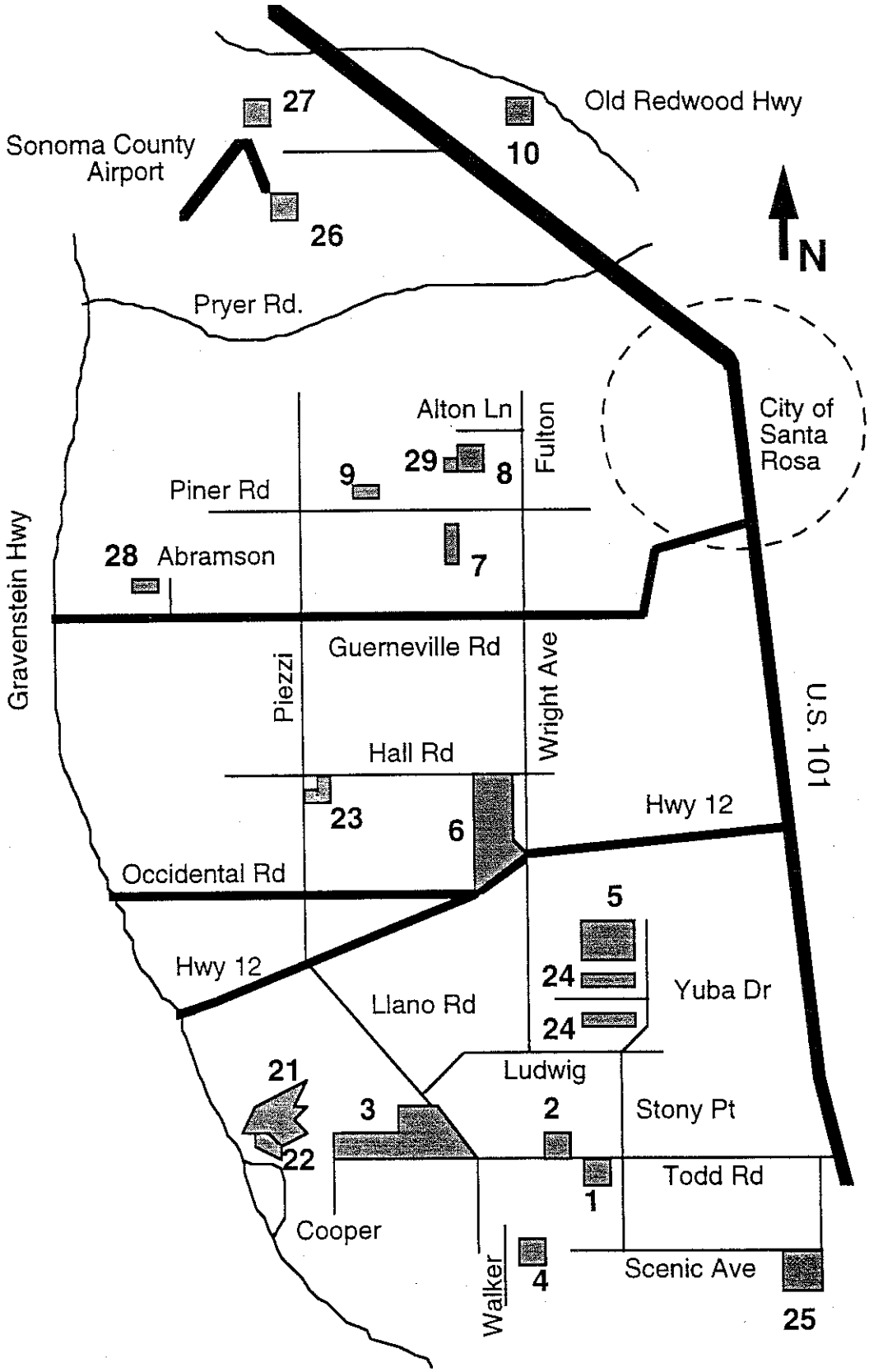

Figure 1. Locations of the SRVRS properties. Numbers correspond to Laguna Wetland Ownership Map A, Table 1 and Appendix 1. Not to scale.

SANTA ROSA VERNAL RESERVE SYSTEM
Property Locations

Map Reference numbers 1-22 (Figure 1) correspond to Laguna Wetland Ownership Map A, Allen Buchman, CDFG (1998). See Table 1 for more information.

1. **Gobbi**
   South side of Todd Rd, between Llano Rd and Stony Point Rd (0.5 mi west of Stony Point Rd)

2. **SW Santa Rosa Bank**
   1187 Todd Road
   North side of Todd Rd, between Llano Rd and Stony Point Rd

3. **Todd Road**
   Along Todd Rd, entrance is 0.6 mi west of Llano Rd

4. **Bennett**
   3912 Walker Road
   South side of Todd Rd and east of Walker Rd on the Colgan Creek channel

5. **FEMA**
   On Finley Ave, north of Ludwig and west of Stony Pt Rd

6. **Cramer**
   Along Occidental Rd, bounded on the north by Hall Rd and Wright Rd on the east

7. **Jinks** (Piner Rd Complex)
   2788 Piner Road.
   South of Piner Rd, west of Fulton Rd

8. **Alton Lane**
   West of Fulton Rd, south of Alton Lane

9. **Simi** (Piner Rd Complex)
   2.5 mi west of Hwy 101 on Piner Rd

10. **Wikiup**
    Between Hwy 101 and Redwood Hwy off of Mark Springs Rd, nestled between two trailer parks.

21. **Carinalli**
    North of Cooper Rd, east of Gravenstein Hwy, access from Llano Rd

22. **Lagomarsino**
    North of Cooper Rd, east of Gravenstein Hwy, access from Cooper Rd

Property Locations (cont.)

23. **Crinella**
Near the corner of Hall Rd and Piezzi

24. **Broadmoor** (North and South)
North and South of Yuba Drive (offStony Point Rd)

25. **Haroutunian**
On Scenic Ave, west of Hwy 101, east of Stony Point Rd, off South Moreland Ave

26. **Airport** (Vernal Pool Reserve)
Located at the southwest corner of Sonoma County Airport, and south of Lone Redwood Rd.

27. **Airport** (Wildflower Reserve)
Located in the northern portion of Sonoma County Airport, and north of Lone Redwood Rd.

28. **Abramson Rd**
North of Guernville Rd on Abramson Rd

29. **San Miguel** (Piner Rd Complex)
Contiguous with the western edge of the Alton Lane property

Appendix 2

PROPERTY INFORMATION DATASHEET

Property Name: _____ Date:_____
revised:_____

Critical Resources: _____
_____
_____

by: _____

I. Property Attributes

A. Property Description

1. Size

   Area

   Perimeter

   Max Dimensions

2. Shape

3. Relief

   Central Elevation

   Slope/Drainage/Exposure

   Microtopography

4. Physical Features

   Vernal Pools/Wetlands

   Permanent Streams

   Intermittent Streams

   Channels

   Hillocks

   Vegetation

5. Property # (APN): Property Index # (PNI):

B. Parcel Location

1. Address
2. Maps (topo, county, CH2M)
3. Access
    - Directions
    - Internal Roads
    - Parking
        - (# cars)
    - Large Vehicles
4. Lot Lines and Number
5. Next Nearest Reserve

C. Parcel History/Economics

1. Former uses/development
2. Proposed uses/development
3. Parcel appraisels/land values

D. Comments/Photos/Other Descriptions

E. Boundaries

1. Fencing

   Type (barbed, post, gated, lockable)

   Height/# Strands

   Cattle/Horse/Deer Exclusion

   State of Repair

2. Transposable Impacts

   Weeds

   Domestic Animals

   Pollutants

   Irrigation Water

   Garbage/Debris

   Other

C. Boundaries (cont.)

3. Adjacent Properties - **North**

Current Use(s)

On-Site Owners/Tenants	Off-Site Owners/Tenants
Name(s) Address	Name(s) Address
Phone #	Phone #
Disposition	Disposition
Contacted By:	Contacted By:
Known By:	Known By:

Development

Buildings

Type and Number of

Distance to Parcel Boundary

Occupation

State of Repair

Utilities

Overhead Power/Phone or Underground Cable/Pipes

Roads

Paved/Gravel/Dirt

State of Repair

Fire Prevention

Clearing or Fire Breaks (width, state)

Plantings

On Site Water/Hydrants

C. Boundaries (cont.)

3. Adjacent Properties - **East**

Current Use(s)

On-Site Owners/Tenants	Off-Site Owners/Tenants
Name(s) Address	Name(s) Address
Phone #	Phone #
Disposition	Disposition
Contacted By:	Contacted By:
Known By:	Known By:

Development

Buildings

Type and Number of

Distance to Parcel Boundary

Occupation

State of Repair

Utilities

Overhead Power/Phone or Underground Cable/Pipes

Roads

Paved/Gravel/Dirt

State of Repair

Fire Prevention

Clearing or Fire Breaks (width, state)

Plantings

On Site Water/Hydrants

C. Boundaries (cont.)

3. Adjacent Properties - **South**

Current Use(s)

On-Site Owners/Tenants

Name(s)
Address

Phone #

Disposition

Contacted By:

Known By:

Off-Site Owners/Tenants

Name(s)
Address

Phone #

Disposition

Contacted By:

Known By:

Development

Buildings

Type and Number of

Distance to Parcel Boundary

Occupation

State of Repair

Utilities

Overhead Power/Phone or Underground Cable/Pipes

Roads

Paved/Gravel/Dirt

State of Repair

Fire Prevention

Clearing or Fire Breaks (width, state)

Plantings

On Site Water/Hydrants

C. Boundaries (cont.)

3. Adjacent Properties - **West**

Current Use(s)

On-Site Owners/Tenants	Off-Site Owners/Tenants
Name(s) Address	Name(s) Address
Phone #	Phone #
Disposition	Disposition
Contacted By:	Contacted By:
Known By:	Known By:

Development

Buildings

Type and Number of

Distance to Parcel Boundary

Occupation

State of Repair

Utilities

Overhead Power/Phone or Underground Cable/Pipes

Roads

Paved/Gravel/Dirt

State of Repair

Fire Prevention

Clearing or Fire Breaks (width, state)

Plantings

On Site Water/Hydrants

C. Boundaries (cont.)

4. Adjacent Resources/Environment (NESW)

RTE Species

Taxa

Populations

Size

Condition

Non-native Species

Woody

Herbaceous

Animal

Natural Communities

Vernal Pools

Other Wetlands

Native Grassland

Riparian Forest

Misc.

C. Boundaries (cont.)

4. Adjacent Resources/Environment (NESW) (cont.)

Hydrology

Vernal Pools

Size

Duration

Drainage

From Adj. Property to Parcel

From Parcel to Adj. Property

Dams, Wells, Flow Regulation

Water Quality

Evidence for Pollution (Fecal/Pesticide/Sediment/HC)

Soils

Type

Plowed

6. Management

Amount of Commercial Activity

Currently Plowed

C. Boundaries (cont.)

6. Management (cont.)

Grazing

Type/Number of Animals

Operation

Paddocks

Range

Feedlot

Apparent Impacts

Controlled Burns

Chemical Applications

7. Prospects for Further Commercial Development

8. Prospects for Enhancement of Biological Resources

Property Name: _____ Date:_____
revised:_____

II. Biological Characteristics

A. RTE Species

1. Plants

Taxa

Description: Hickman _____ Munz _____ CNPS _____ Other _____
Hickman _____ Munz _____ CNPS _____ Other _____
Hickman _____ Munz _____ CNPS _____ Other _____
Hickman _____ Munz _____ CNPS _____ Other _____

Status: Fed _____ State _____ CNPS _____
Fed _____ State _____ CNPS _____
Fed _____ State _____ CNPS _____
Fed _____ State _____ CNPS _____

Population Size/Year _____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____ _____

Census Data Found in: _____
_____
_____
_____

A. RTE Species (cont)

1. Plants (cont)

General Distribution on Property Date: _____

Phenology

seedlings seen by: peak fruiting by:
peak flowering by: dormancy/senescence by:

Local Expertise:

Photographs/Records

A. RTE Species (cont).

2. Animals

Taxa

Descriptions:

Status: Fed _____ State _____
Fed _____ State _____
Fed _____ State _____
Fed _____ State _____

Population Size/Year _____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____ _____

Census Data Found in: _____
_____
_____
_____

General Distribution on Property

Local Expertise:

Photographs/Records

B. Other Noteworthy Native Species

1. Taxa of Conservation Concern

2. Taxa at Distributional Limits

3. Unusual or Distinctive Taxa/Wildlife Values

C. Vegetation (Natural Communities)

1. Major Units/% of Property Area

CNPS System

Holland System

C. Vegetation (Natural Communities) (cont)

2. Distribution of Major Units

3. Dominant Species/Cover within each unit

unit	species	canopy ht	relative cover

C. Vegetation (Natural Communities) (cont.)

4. RTE/Unusual Species Distributions by Vegetation Unit

species	unit	% of species distrib

5. Other photos/descriptions/data sets

D. Hydrology

1. Natural Vernal Pools

ID	Size	Duration	Water Depth

2. Streams and Channels

Forms

Drainage

Pool to Pool Flow

Off-Site Flow

3. Distribution

D. Hydrology (cont.)

1. Created Vernal Pools

ID	Size	Duration	Water Depth

2. Streams and Channels

Forms

Drainage

Pool to Pool Flow

Off-Site Flow

3. Distribution

4. Project Reference

E. Soils

1. Mapped Units

Unit Name	Description	Reference

2. Distribution

3. Impacts from Previous Uses

Plowed	Graded
Grazed	Excavation/Deposition
Burned	

4. Other Sources

Property Name: _____

Date:_____
revised:_____

III. Security

A. Visibility

1. From Roads

2. From Adjacent Properties

3. Attractiveness

Attractive Natural Features

Access

B. Barriers/Warnings

1. Fencing

2. Gates/Locks

3. Signing

C. Evidence of Incursion

1. Trespassing

2. Vandalism

3. Longevity of Signs, Stakes

4. Local Hositility?

D. Enforcement

1. Local Authorities

2. Cooperative Neighbors

3. Neighborhood Watch Program?

Appendix 3

PROPERTY QUESTIONAIRE

Summary of Observations on the Santa Rosa Vernal Reserve System (SRVRS)

I. Personal

your name: _____ number of years of observation of (SRVRS) _____

phone: _____ fax: _____ email: _____

II. History of Observations: **What <u>kind</u> of records do you have?**

parcel	list all years of observation in spring	for those years of observation, check(√)if you have: field notes	plot data	specimens	maps	photos
Lagomarsino + Carinalli						
Cramer						
Todd Road						
FEMA						
SW Santa Rosa Bank						
Gobbi						
Broadmoor						
Haroutunian						
Alton Lane						
Airport						
Bennett						
Wikiup						
Abrams						
Calton Homes						
Piner Road Complex						
Crinella						

III. Observations of RTE Populations: **What years were "good" or "bad" for vernal pool plants?**

parcel	taxa observed	years of large, dense populations[2]	years of sparse populations[2]	years with numerical pop size estimates[3]
Lagomarsino + Carinalli				
Cramer				
Todd Road				
FEMA				
SW Santa Rosa Bank				
Gobbi				
Broadmoor				
Haroutunian				
Alton Lane				
Airport				
Bennett				
Wickiup				
Abrams				
Calton Homes				
Piner Road Complex				
Crinella				

1 Bb = *Blenosperma bakeri*, Lb = *Lasthenia burkei*, Lv = *Limnanthus vinculans*, Nlp = *Navarrettia leucocephala* ssp. *plieantha*

2 General impressions from field notes, photos, non-numerical assessments

3 List the years and indicate if replicate plots (rp), permanent plots (pp), and/or areal estimates (ae) were used

III. Observations of RTE Populations: **What factors affect the vernal pool plants?**

parcel	taxa observed	livestock grazing[1]	past tillage	altered hydrology	non-native grasses or forbs[2]	other[3]
Lagomarsino + Carinalli						
Cramer						
Todd Road						
FEMA						
SW Santa Rosa Bank						
Gobbi						
Broadmoor						
Haroutunian						
Alton Lane						
Airport						
Bennet						
Wikiup						
Abrams						
Calton Homes						
Piner Road Complex						
Crinella						

[1] Indicate cattle (C), sheep (S) and/or horses (H)

[2] Indicate dense cover by non-native grasses (G) and/or forbs (F)

[3] Please list other factors you suspect are important in determining RTE plant population sizes

IV. Observations of the vernal pools: **What other interesting things have you seen on these properties?**

	unusual plant species	impressive floral displays	unusual animal species	other resources
Lagomarsino + Carinalli				
Cramer				
Todd Road				
FEMA				
SW Santa Rosa Bank				
Gobbi				
Broadmoor				
Haroutunian				
Alton Lane				
Airport				
Bennett				
Wikiup				
Abrams				
Calton Homes				
Piner Road Complex				
Crinella				

V. Other people you know who have records. **Who else has inventoried, monitored, or conducted experiments on these propertie**

Give the name and phone number under the appropriate column

parcel	floristic inventory	population monitoring data	experiments	vernal pool creation/reint
Lagomarsino + Carinalli				
Cramer				
Todd Road				
FEMA				
SW Santa Rosa Bank				
Gobbi				
Broadmoor				
Haroutunian				
Alton Lane				
Airport				
Bennett				
Wikiup				
Abrams				
Calton Homes				
Piner Road Complex				
Crinella				

Appendix 4

THE SRVRS DATABASE

The SRVRS Database

The SRVRS Database is an electronic summary of information gathered on properties that have been placed under the regulatory auspices of the California Department of Fish and Game (DFG), either by purchase, mitigation agreements, or the establishment of conservation easements with private landowners. The information has been collated into three major sections: **property attributes**, **biological resources**, and **security** and entered into Microsoft Access (1997). These are displayed as nine tables: **Properties, AdjacentPropEast, North, South, or West** (the adajacent properties), **BioResources, Hydrology, Soils, and Security**. This appendix is an abbreviated introduction to opening, querying, reporting from, and entering data into the Access database. There is also a detailed set of guidelines and abbreviations that are used for data entry in the future. New information and periodic updates are essential for keeping this database useful as a planning and management tool.

Operation of the Database

1. Opening the SRVRS Database (SRVRS.mdb)
    a) Open Microsoft Access
    b) Choose from "existing databases" SRVRS
    c) To do Data Entry see section 2 for specific data entry instructions.
        Choose the specific table listed under the table tab. The tables will come up automatically when you enter Access.
    d) For run or design a query see section 3 for specific querying instructions
        Choose the specific query listed under the query tab.
    e) To run or design a report see section 4 for specific reporting instructions.
        Choose the specific report listed under the report tab

2. Querying

a) Choose the query tab which will list all existing queries associated with the SRVRS Database. Currently these include queries of each table including all the fields within that table

b) Choose "new" to create a new query

c) Choose "Design View" from list of possibilities (this allows you to query across all of the tables because it automatically links the tables)

d) Then choose the specific table or tables (use the shift key) that contain the fields you want to query

e) Each table will be displayed in the top window with connections pictured. If you want to choose all of the fields in one table, double click on the "*". Otherwise double click on each field you want to query. When you pick fields from the first table be sure to include the following fields: ID; Site #; and Parcel Name. For the remainder of the tables you do not need to include these fields because they have the same value across all of the tables.

f) Close the query (double click the "X") and this will prompt you to save it under a specific name. This finishes the querying. If you would like to view the results of your query then simply open the your query listed under the query tab. The results of the query will then be displayed.

3. Reporting

a) Choose the report tab which will list all existing reports associated with the SRVRS Database. Currently these include reports of each table including all the fields within that table.

b) Choose the report wizard from the list of possibilities (the wizard will create the report for you while reporting with design view is a labor intensive process involving individually dragging each field over and placing it in the report, and then a pagemaker-like arranging of the field labels and the data).

c) Choose the query from which you want to report from.

d) Since you are working from a query, you already have the desired subset of fields, so choose all fields by clicking on the "double arrow".

e) From this point you must choose how you want the report designed (Grouping Levels, Sort Order, Layout, and Style) which will depend on style preference and requirements for the individual report.

f) When you have finished designing the report, choose the "Finish" tab. This will prompt you to save and name your report. The report will be displayed for you automatically.

4. Data Entry

a) Open the table in which you wish to enter data. The nine tables-Properties, AdjacentPropEast, North, South, or West, BioResources, Hydrology, Soils, and Security-will automatically be displayed when the SRVRS Database is opened. The table will open in "datasheet view" which is the correct form for data entry.

b) The twenty sites are listed according to their "autonumber" which was assigned by Access when the record was first entered into the database. The autonumber acts as the primary key which links all of the tables together. The sites are otherwise in no particular order.

c) To enter data, move the cursor down to the site you are working on, and then horizontally to the field you are entering data into. The descriptor for the field (which provides a description of the specific type of data for a given field) will automatically be displayed in the left side of the horizontal scroll bar .

d) See the attached tables which act as data entry guides for each table. They list the fields of each table, the field descriptor, and any special instructions for data entry. These instructions include all searchable values found under that field, abbreviations, and special formats for fields containing complex data. Abbreviations have been placed in the special instructions of the fields that they are commonly found in, but they may also occur in other fields, especially "Comments". If the meaning of the abbreviation is not given, consult the list of all abbreviations used in the SRVRS. This list includes very general abbreviations that are used in many places and aren't in the special instructions. A few very general guidelines precede this list.

Guidelines and Abbreviations for Data Entry (see Table 3).

1) All searchable values should be capitalized, if appropriate abbreviate and note meaning in data entry sheet next to its field

2) Listing Conventions

";" is used to list values (A Semi-Colon)

":" is used to separate sentences or notes from listings (A Colon)

For fields in which multiple types of data are listed, specific formats are followed which are described in the special instructions.

3) Don't spell out numbers, put them in as numbers

4) * = Further detail found in Comments field.

5) General Abbreviations (Probably Not found in special instructions)

1) SOR = State of Repair - a qualifier used in many places
2) b/c = because
3) priv = private
4) sig=significant
5) dis=disturbed
6) comp=competition
7) ssan=sensitive species animal
8) sspl=sensitive species plant
9) appx=appendix
10) Directions=N,S,E,W
11) SoCo=Sonoma County
12) S.R.=Santa Rosa
13) DFG=Department of Fish and Game
14) dist=distribution
15) maint=maintenance

6) Abbreviations in Special Instructions (May be used in more than one field)

16) CG = Cattle Grazing - a value used in many place
17) EUKS=Eucalyptus Tree
18) AG=Annual Grassland (BioRes-Vegunits
19) AGR=Agriculture (Prop-PrevUses, AdjProp-CurrUses)
20) SPM=Semipermanent Marsh (BioRes-Vegunits)
21) OW=Oak Woodland (BioRes-Vegunits)
22) VP=Vernal Pools
23) VS=Vernal Swales

24) PERGRASS=Perennial Grasses
25) RES=Residential (Prop-PrevUses, AdjProp-CurrUses)
26) SED=Sediment (AdjProp-Pollution)
27) WDR=Wetland Delineation Report
28) IRR=Irrigation
29) SWE=Seasonal Wetlands (BioRes-Vegunits)
30) WET=Wetland (BioRes-Vegunits)
31) MS=Mitigation Site; MB=Mitigation Bank
32) alum=aluminum (Prop-DetFence)
33) VY=Vineyards (Prop-PrevUses, AdjProp-CurrUses)
34) ConsEas=Conservation Easement (Prop-Access)
35) CHELV=Change in Elevation (Prop-Topo)
36) G=Grazing (Prop-PrevUses, AdjProp-CurrUses)
37) RD=Residential Development (Prop-Proposed Uses)
38) BARB=Barbed Wire (Prop-DetFence)
39) CYCLFENCE=Cyclone Fence (Prop-DetFence)
40) HI=High Impact; MI=Medium Impact; LI=Low Impact (Prop-Impact Weeds, DomAnimals)
41) HORT=Horticulture (AdjProp-CurrUse)
42) OUTB=Outbuildings (AdjProp-DetBldgs)
43) OVPOWER, OVPHONE=overhead power, overhead phonelines; UNPOWER, UNPHONE=underground power, underground phonelines; WP=waterpipes (AdjProp-DetUtils)
44) PF=Peregrine Falcon (BioRes)
45) TG=Tiger Salamander (BioRes)
46) UPG=Upland Grassland (BioRes-Vegunits)
47) RIPVEG=Riparian Vegetation (BioRes-Vegunits)

Table 3. Data Entry Instructions for the SRVRS Database

TABLE FIELDS	DESCRIPTIONS	SPECIAL INSTRUCTIONS
PROPERTIES		
ID		
Site#	Unique Site Indentifier	
Parcel Name	Name of Parcel	
APN	Assessors Parcel#	
PIN	Property Index#	
HIST#	History#	
Township	Township that Parcel is Located In	
Range	Range that Parcel is Located In	
Section	Section that Parcel is Locate In	
NearReserve	Nearest Reserve to Parcel	
Address	Parcel Address	
Access	Special Instructions for Access to the Parcel	ConsEas=conservation easement
Directions	Directions to the Parcel	
InterRoads	Occurrence and Description of Internal Roads	
Parking	Parking Detail	
Cars	Number and Type of Cars the Parcel Can Accommodate	=Maximum number of cars that can fit
LgVehicles	Type and Number of Large Vehincles the Parcel can Accommodate	=Maximum number of large vehicles that can fit
Size acres	Size of Parcel in Acres	
Shape	Shape of the Parcel	Lookup Field: Rectangle, Square Polygon
Elevation feet	Range of Singular Elevation Value	
Drainage	Directions of Drainage	Lookup Field: Southwest, South, Southeast, Northwest, North, Northeast, East, West
Topo	General Microtopographical Features	CHELV = Change in Elevation
VPool	Occurrence of Vernal Pool on the Parcel	
VSwales	Occurrence of Vernal Swales on the Parcel	
Wetlands	Occurrence of Wetlands on the Parcel	
Streams	Stream Classification	Look up field: Intermittent, Permanent, Ephemeral
Channels	Occurrence of Channels on the Parcel	
Hillocks	Occurrence of Hillocks on the Parcel	
RegionalMap	Reference for Regional Map	See Citations

Table 3 (cont). Data entry instructions

SiteMap	Reference for Site Specific Map with Stree Detail	See Citations
TopoMap	Reference for Topographic map with Parcel Features	See Citations
PrevUses	What the Parcel was Previously Used For	G=Grazing, CG = Cattle Grazing, RES=Residential, AGR=Agriculture, VY=Vineyard, HAYCULT=Hay Cultivation, ORCHARD, OAT, PLOWED, DISCING, GRADING, PLANTING, BURNED, HORSE, GOATS, PASTURE, FARM, HUNTING, ConsEas=Conservation Easement
PropUses	What are the Proposed Uses of the Parcel	MB = Mitigation Bank, MS=Mitigation Site, RD=Residential Development
ParcelValue dollars	The Value the Parcel is Appraised At	
DetFencing	Detail about the Type of Fencing and the State of Repair of it	Format: Type of fence; gate description(s); SOR E.g. BARB; 20' alum. Gate, locked; SOR=Fair BARB = Barbed Wire, WOOD, WIRE, REBARB, CYCLFENCE=Cyclone Fence, alum=aluminum, SOR=State of Repair (Excellent, Good, Fair, Poor)
HeightFence(feet)	Height of the Fence	
StrandFence	Number of Strands in the Fence	
ExcluFence	List the Type of Animals the Fence can Exclude	CATTLE HORSE DEER
Weeds	Presence and Detail About Transposable Weed Impacts	HI = high impact MI = medium impact LI = low impact Sometimes="Yes" if impact unknown
DomAnimals	Presence and Detail About Transposable Domestic Animal Impacts	HI = high impact MI = medium impact LI = low impact Include Type and Number of Animals and What Their Impacts Have Been
Pollutants	Presence and Detail About Transposable Pollution Impacts	HERBICIDE, PESTICIDE, IRRIGATION HI = high impact MI = medium impact LI = low impact

Table 3 (cont). Data entry instructions

IrrWater	Presence and Detail About Transposable Irrigation Water Impacts	HI = high impact MI = medium impact LI = low impact
Garbage	Presence and Detail About Transposable Garbage Impacts	HI = high impact MI = medium impact LI = low impact
Comments	Comments About the Parcel	
ADJACENT PROPERTIES		
ID		
Site#		
Parcel Name		
CurrUse	Current Use of the Adjacent Property	HORT = Horticulture, FARM, FEEDLOT, PLANTNURSERY, OPENSPACE, MOBILEHOMES, RANCH, PADDOCK, DAIRY, IRR=Irrigation, RES=Residential, PASTURE; AGR=Agriculture, VY=Vineyard, G=Grazing, GRASSLAND, RR=Railroad, EUKS=Eucalyptus Trees, OS=Oak Savanna
NameOn-Site	Name of On-Site Owners/Tenants	
AddrOn-Site	Address of On-Site Owners/Tenants	
PhoneOn-Site	Phone # of On-Site Owners/Tenants	
DispositionOn-Site	Disposition of On-Site Owners/Tenants	
NameOff Site	Name of Off-Site Owners/Tenants	S.R.=Santa Rosa DFG=Deparment of Fish and Game
AddrOff Site	Address of Off-Site Owners/Tenants	
PhoneOff Site	Phone of Off-Site Owners/Tenants	
DispositionOff Site	Disposition of Off-Site Owners/Tenants	
DetBldgs	Detail about On-Site Buildings (Note #, Type, State of Repair)	Format: #; Type 1, Type 2, ...; notes (wood, rooftype, etc); SOR E.g. 2; HOUSE, OUTB; WOOD; SOR=Good HOUSE, GARAGE, SHED, RES/FARM, BARN, FEEDBARN, TRAILER, OUTB=Outbuilding
DistBldgs feet	Distance of Buildings to Parcel Boundary	

Table 3 (cont). Data entry instructions

DetUtils	Detail about On-Site Utilities (Power lines and Phones lines - can be overhead or underground; and water pipes)	OVPOWER = Overhead Power Lines UNPOWER = Underground Power Lines OVPHONE = Overhead Phone Lines UNPHONE = Underground Phone Lines WP = Water Pipes
TypeRoad	Type of Road That Bounds the Parcel	Lookup Field: Dirt, Gravel, Paved
RepairRoad	State of Repair of the Road	Lookup Field: Excellent, Good, Fair, Poor
DetFirePrev	Detail about Fire Prevention on Adjacent Properties (note width and state of prevention feature)	CLEARING FIRE BREAKS PLANTINGS ON-SITE HYDRANTS
DetPLTaxa1	Detail About 1 of 3 RTE Plant Taxa (note species - use full scientific name, #, year, condition, reference)	
DetPLTaxa2	Detail About 1 of 3 RTE Plant Taxa (note species - use full scientific name, #, year, condition, reference)	
DetPLTaxa3	Detail About 1 of 3 RTE Plant Taxa (note species - use full scientific name, #, year, condition, reference)	
DetANTaxa	Detail About RTE Animal Taxa (note species - use full scientific name, #, year, condition, reference)	
DetNNWoody	Detail About Non-Native Woody Species	
DetNNHervs	Detail About Non-Native Herbaceous Species	
DetNNAN	Detail About Non-Native Animal Species	
Wetlands	Occurrence of Wetlands on Parcel	
VegUnits	Listing of Major Vegetation Units Occuring on the Parcel and the %	
VPool	Occurrence of and Detail About VPs on the Parcel (Note size and duration)	
DrainAdjtoParcel	Drainage Flow From Adjacent Property to Parcel?	
DrainParceltoAdj	Drainage Flow From Parcel to Adjacent Property?	

Table 3 (cont). Data entry instructions

DetDrainage	Detail About Drainage Features on Adjacent Property (such as dams, wells, flow regulation)	VP=Vernal Pool, VS=Vernal Swale
Pollution	Forms of Pollution Present On Adjacent Property (such as fecal, pesticides, sediments, hydrocarbons)	SED=Sediment, FECAL, PESTICIDE
SoilType	Type of Soils (according to soil survey)	
CommActivity	Amount of Commercial Activity	
Plowing	Currently Plowed?	
DetGrazing	Type and Number of Grazing Animals	CATTLE, HORSE, GOATS, SHEEP
FeatGrazing	Existing Grazing Features (such as paddocks, range or feedlot)	PADDOCK, PASTURE, RANGE, FEEDLOT
ImpGrazing	Apparent Impacts from Grazing	
Burns	Evidence of Controlled Burns on Property	
Chemicals	Evidence of Chemical Applications on Property	
PropDevelop	Prospects for Future Development	Low, Moderate, High
PropBioRes	Prospects for Enhancement of Biological Resources	Low, Moderate, High
Comments	Comments About the Adjacent Property	
BIORESOURCES		
ID		
Site#		
Parcel Name		
PlantTaxa1	Occurrence of 1 of the 3 RTE Plant Taxa on the Parcel	Lookup Field: Limnanthes vinculans, Lasthenia burkeii, Blemnosperma bakeri
PlantTaxa2	Occurrence of 1 of the 3 RTE Plant Taxa on the Parcel	Lookup Field: Limnanthes vinculans, Lasthenia burkeii, Blemnosperma bakeri
PlantTaxa3	Occurance of 1 of the 3 RTE Plant Taxa on the Parcel	Lookup Field: Limnanthes vinculans, Lasthenia burkeii, Blemnosperma bakeri
DetPLTaxa1	Detail About 1 of the 3 RTE Plant Taxa on the Parcel (note species - use full scientific name, #, year, condition, reference)	
DetPLTaxa2	Detail About 1 of the 3 RTE Plant Taxa on the Parcel (note species - use full scientific name, #, year, condition, reference)	

Table 3 (cont). Data entry instructions

DetPLTaxa3	Detail About 1 of the 3 RTE Plant Taxa on the Parcel (note species - use full scientific name, #, year, condition, reference)	
DistPLTaxa(%)	Note General Distribution of Noted RTE Plant Taxa on the Parcel	
LocalPLExp	Local Expertise on Specific RTE Plant Taxa	
RecordsPL	Note any Photographs or Record Any Reference of RTE Plant Taxa	Format for BioRes-RecordsPL: Surveys Name1 Date(s); Name2 date(s).....: Photographs Name1 Date(s) E.g. Surveys Patterson 1989; Guggolz 1991; Waaland 1992-93: Photographs Patterson 1989
ConsPLTaxa	Occurrence of Plant Taxa of Conservation Concern on the Parcel	
DetConPL	Detail About Plant Taxa of Conservation Concern on the Parcel	
ANTaxa	Occurrence of RTE Animal Taxa on the Parcel	Lookup Field: CTS=California Tiger Salamder, FAIRY SHRIMP, PF=Peregrine Falcon
DetANTaxa	Detail About RTE Animal Taxa on the Parcel (note species - use full scientific name, #, year, condition, reference)	
DistANTaxa	General Distribution of RTE Animal Taxa	
LocalANExp	Local Expertise on RTE Animal Taxa	
RecordsAN	Note Any Photographs or Record References of RTE Animal Taxa	
ConsANTaxa	Occurrence of Animal Taxa of Conservation Concern on Parcel	
VegUnits	Listing of Major Vegetation Units Occurring on Parcel and Their %	UPG=Upland Grassland, SWE=Seasonal Wetland, WET=Wetland, OS=Oak Savanna, AG=Annual Grassland, OW=Oak Woodland, VS=Vernal Swales, VP=Vernal Pools, SPM=Semipermanent Marsh, PERGRASS=Perrenial Grassland, RIPVEG=Riparian Vegetation
DistVegUnits	Map Reference	See Citations

Table 3 (cont). Data entry instructions

Comments	Comments About Biological Resources	
HYDROLOGY		
ID		
Site#	Unique site identification	
Parcel Name	Name of the parcel	
VPool	Occurrence of Vernal Pool on the Parcel	
VSwales	Occurrence of Vernal Swales on the Parcel	
Wetlands	Occurrence of and percentage of Wetlands on the Parcel	Give percentage or Yes/No
Streams	Stream Classification	Look up field: Intermittent, Permanent, Ephemeral
Channels	Occurrence of Channels on the Parcel	
Drainage	Directions of Drainage	Lookup Field: Southwest, South, Southeast, Northwest, North, Northeast, East, West
Up Wet	Ratio of uplands to wetlands on parcel	
Map Reference	Reference for topo map showing hydrological systems on parcel	See Citations
DetVP1	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP2	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP3	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP4	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP5	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP6	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP7	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP8	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetVP9	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	

Table 3 (cont). Data entry instructions

DetVP10	Detail about designated VP (ID, Size, Duration, Water Depth, and Nat. vs. Creat.)	
DetST1	Detail about designated stream, incl. Type (Intermittant, ephemeral, permanent), Direction of drainage (pool-pool and/or off-site)	
DetST2	Detail about designated stream, incl. Type (Intermittant, ephemeral, permanent), Direction of drainage (pool-pool and/or off-site)	
DetST3	Detail about designated stream, incl. Type (Intermittant, ephemeral, permanent), Direction of drainage (pool-pool and/or off-site)	
DetST4	Detail about designated stream, incl. Type (Intermittant, ephemeral, permanent), Direction of drainage (pool-pool and/or off-site)	
Comments	Comments about hydrology	WDR=Wetland Delineation Report
SOIL		
ID		
Site#	Unique Site identification	
Parcel Name	Name of the parcel	
DetSoils1	Detail about soils (Unit name, description, reference)	
DetSoils2	Detail about soils (Unit name, description, reference)	
DetSoils3	Detail about soils (Unit name, description, reference)	
DetSoils4	Detail about soils (Unit name, description, reference)	
DetPrevGraz	Detail about any previous grazing on the site	CG=Cattle Grazing, G
DetPrevPlow	Detail about any previous plowing on the site	PLOWING, HAYCULT=Hay Cultivation
DetPrevImpacts	Detail about any other previous impacts (burning, grading, excavation/deposition)	DISCING, BURNED
Comments	Comments about soils	S1=Soil 1, S2=Soil 2, etc. dist=distribution
SECURITY		
ID		
Site#	Unique site identification	
Pacel Name	Name of the parcel	

Table 3 (cont). Data entry instructions

DetVisRoads	Detail about visibility of the parcel from main roads (includer oad and degree of visibility-high, moderate, low)	
DetAdjParcel	Detail about visibility of the parcel from adjacent properties (include from which adjacent property and degree of visibility)	
DetAttParcel	Detail about how attractive the parcel is to trespassers	VP=Vernal Pools, VS=Vernal Swales, WET=Wetland, attr=attractive, B.b.=Blemnosperma bakeri
Fencing	Existance of fence enclosing property	
Gates	Existance of gates in fence system	
Locks	Existance of locks on the gates	
DetSignage	Existance of and details about signage (DFG, No Trespassing, etc)	
DetEvTress	Detail about any evidence of trespassing	
DetVand	Detail about any evidence of vandalism	
DetHost	Detail about any evidence of local hostility to accessing site or general ill will towards project	
ListEnfAuth	A list of enforcement authorities	
CoopNeighb	Are the neighbors cooperative	
WatchNeighb	Is there a neighborhood watch program	
Comments	Comments about security issues on the parcel	

Sample Database File: Cramer Property

This is only a partial printout of the SRVRS database file on the Cramer property. The first page includes property attributes, the second and third pages biological resources, and the fourth page gives security information.

ID:	5
Site #:	6
Parcel Name:	Cramer
APN#:	035-051-23(135.30ac.); 035-051-14(38.35 ac)
PIN:	
HIST#:	
Township:	
Range:	
S:	
NearReserve:	Lagomarsino (SW), Crinella
Address:	
Access:	
Directions:	Along Occidental Rd, E. of "Riccas Corner" @ Irwin Lane, Rounded by Hall Rd on
InterRoads:	No
Parking:	Along dirt rd off of Occidental, park on W
Cars:	2-3
LgVehicles:	1-2
Size (acres):	174
Shape:	Polygon
Elevation(feet):	90
Drainage:	West
Topo:	Flat w/shallow drainage
☑ VPool	
☑ VSwales	
☑ Wetlands	
Streams:	Intermittent
☑ Channels	
☑ Hillocks	
RegionalMap:	AAA
SiteMap:	
TopoMap:	AAA
PrevUses:	G
PropUses:	Golf Course and Recreation Park; MB
ParcelValue(dollars):	3000-5000$/acre AG value, 1995
DetFencing:	BARB w/WOOD posts; wire gate; SOR=poor (needs new gate, fence along W)
HeightFence (feet):	4
StrandFence:	4
ExcluFence:	CATTLE; HORSE
Weeds:	

BioResources.ID:	5
Site#:	6
Parcel Name:	Cramer
PlantTaxa1:	Limnanthes vinculans
PlantTaxa2:	Lasthenia burkei
PlantTaxa3:	
DetPLTaxa1:	*L.v. (1988 10-10,000, AB); (1991 5000-10,000, AB); (1992-94 10-100,00
DetPLTaxa2:	L.b. (1988 100-500, AB); (1991-93 500-1000, AB): (1991 1000, ?); (1992
DetPLTaxa3:	
DistPLTaxa(%):	See Map, AAA, partially updated 1998
LocalPLExp:	Waaland, Guggolz, Patterson
RecordsPL:	Surveys Waaland 1988; Guggolz 1988; Patterson 1991-1994: Photos Patt
ConsPLTaxa:	Pogognye douglasii; Ranunculus lobbii; Quercus lobata
DetConPL:	
ANTaxa:	Fairy Shrimp
DetANTaxa:	
DistANTaxa:	
LocalANExp:	
RecordsAN:	
ConsANTaxa:	
VegUnits:	
DistVegUnits:	
Bio.Comments:	Problem weed=Mentha: List of AG and VP species in datasheet hardcopy
Hydrology.ID:	5
Hydrology.Site#:	6
Parcel Name:	Cramer
Wetlands(%):	
Up/Wet:	
DetVP1:	
DetVP2:	
DetVP3:	
DetVP4:	
DetVP5:	
DetVP6:	
DetVP7:	
DetVP8:	
DetVP9:	
DetVP10:	
DetST1:	
DetST2:	

DetST3:	
DetST4:	
Hydro.Comments:	3 Drainage channels constructed. 2 northern ones drain inflow from E and
Soils.ID:	5
Soils.Site#:	6
Soils.Parcel Name:	Cramer
DetSoils1:	WhA; SCS 72
DetSoils2:	WgC; SCS 72
DetSoils3:	WoA, CfA; SCS 72
DetSoils4:	
DetSoils5:	
DetPrevGraz:	
DetPrevPlow:	
DetPrevImpacts:	
Soils.Comments:	See WDR, AAA

ID: 5

Site#: 6

Parcel Name: Cramer

DetVisRoads: High

DetAdjParcel: High

DetAttParcel: Low from a distance but High for showy VPs

- [x] Fencing
- [x] Gates
- [ ] Locks

DetSignage:

DetEvTress:

DetVand:

DetHost:

ListEnfAuth:

- [ ] CoopNeighb
- [ ] WatchNeighb

Comments:

ID: 6

Site#: 3

Parcel Name: Todd Road

DetVisRoads: Todd Rd, High

DetAdjParcel: High

DetAttParcel: Low

- [x] Fencing
- [x] Gates
- [x] Locks

DetSignage: Hazmat sign on powerhouse

DetEvTress: Deer and Waterfowl Hunters

DetVand:

DetHost:

ListEnfAuth:

- [x] CoopNeighb
- [ ] WatchNeighb

Comments: CoopNeighbors to S7: 4 access gates; 1=Todd Rd main gate, Water Age