Appendix X
Draft Operations and Management (O&M) Plan for the WRSP Open Space Preserve

Operations and Management Plan

for the

West Roseville Specific Plan Open Space Preserve

Placer County, California

DRAFT

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Prepared for:

City of Roseville
Tradition • Pride • Progress

Signature Properties
Westpark Associates

ECORP Consulting, Inc.
Environmental Consultants

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1.0 INTRODUCTION

1.1 Setting

The West Roseville Specific Plan (WRSP) is located in Placer County, California and is currently (2003) proposed for annexation into the City of Roseville. More specifically, the WRSP area corresponds to portions of Sections 22, 23 and 26, Township 11 North, and Range 5 East, of the Pleasant Grove, California 7.5-minute topographic quadrangle (U. S. Department of the Interior, Geological Survey 1967, Photo Revised 1981); all of Sections 13, 24, 25, Township 11 North, and Range 5 East; and portions of Sections 18 and 19, Township 11 North, and Range 6 East, of the Roseville, California 7.5-minute topographic quadrangle (U. S. Department of the Interior, Geological Survey 1992). The WRSP area is shown on Figure 1 - *Project Site and Vicinity*. The WRSP consists of 3,162 acres proposed for primarily residential development with a significant parks and open space component. The West Roseville Specific Plan Open Space Preserve (Preserve) is approximately 699.3 acres in size. This includes 684.6 acres of open space parcels and 14.7 acres along Kaseberg Creek. This area along Kaseberg Creek is covered by the conservation easement/declaration of restrictions (deed restrictions) and consists of a 100-foot corridor (50 feet from either side of the creek) as required by the U.S. Army Corps of Engineers (Corps). This is the only portion of Fiddyment Park covered by the conservation easement/declaration of restrictions. Figure 2 - *WRSP Development and Open Space Areas* shows the parcels of the WRSP that are to be developed and the parcels that are part of the Preserve. It is important to note that with a project of this size, this Operations and Management Plan must be a "living document". Changes will likely be made to items such as exact outfall locations as further planning and engineering occurs, until the plan and the project development is final. That is not to say that significant effort has not gone into planning around the Preserve and the resources, only that unanticipated changes may need to be made after this plan is approved.

1.1.1 Regulatory Background

During the federal regulatory permitting process, the WRSP was also called the Westpark/Fiddyment Ranch project. Both names refer to the same area. An individual permit authorization (Permit) for the Westpark/Fiddyment Ranch project was obtained from the U.S. Army Corps of Engineers, dated, ________ (Regulatory Branch #200200666) for the impacts to waters of the United States (including wetlands) anticipated as part of the project (Attachment A). Table 1 – *Wetland/Waters Impacts and Preserve Acreages*, outlines the wetland/waters impacts associated with the WRSP. Additionally, a Biological Opinion (Biological Opinion), dated November 20, 2003 (Service File #1-1-03-F-0013) for the project was written by the U.S. Fish and Wildlife Service (Service) as a result of a federal Endangered Species Act (ESA), Section 7 consultation between the Corps and the Service (Attachment B). A Section 7 consultation is the process by which federal agencies, permitting an otherwise legal activity, consult with the Service to authorize the "incidental take" of species listed as threatened or endangered under ESA. A special condition of the Permit and a requirement of the Biological Opinion, was the establishment of a long-term management plan for the portions of the project that contain preserved or mitigation wetlands, and the recordation of a conservation easement/declaration of restrictions (deed restrictions) over these areas protecting them from further development and establishing them as wetland and wildlife habitat in perpetuity (Attachment C). This document, the *West Roseville Specific Plan Operations and Management Plan* (Plan), fulfills that requirement.

Table 1. Wetlands/Waters Impact and Preserve Acreage				
	Existing	**Direct Impact**	**Indirect Impact**	**On-Site Preserve**
Habitat Type				
Vernal Pool	33.91	13.8	8.83	20.11
Vernal Swale	8.05	3.29	0.74	4.76
Wet Swale/Channel	17.39	4.17	--	13.22
Seasonal Wetland	3.92	1.33	--	2.59
Emergent Marsh	0.62	0.62	--	--
TOTAL:	**63.89**	**23.21**	**9.57**	**40.68**

1.1.2 Prehistoric and Historic Uses

Prior to the development of the WRSP, the area was historically used for mostly agricultural purposes such as grazing. Figures 3 through 6 show pre-project photos and their locations. To give background on the prehistory and history of the area and the Fiddyment Ranch, the following text was taken directly from the West Roseville SOI Amendment Area Draft EIR, (September 15, 2003), Cultural Resources section.

1.1.2.1 Prehistory

The Native Americans who occupied the project vicinity at the time of Euroamerican contact (ca. 1850s) are known as the Nisenan, also referred to as the Southern Maidu. Several ethnographers have studied the Maidu people and generally agree that Nisenan territory included the drainages of the Bear, American, Yuba, and southern Feather rivers. Their permanent settlements were generally located on ridges separating parallel streams, either on crests, knolls, or terraces part way up these ridges.

A typical village consisted of several conical houses covered with bark slabs. The nearest ethnographic village in relationship to the project was called *Pichiku*. The name *Pich-u-gut* is also given for a village site in Roseville. The exact location of these villages has never been determined but many long time residents of Roseville indicate that a village was located in the vicinity of present-day Roseville Square off of Douglas Boulevard. Also, a village site has been identified and preserved at Maidu Park in Roseville.

The lower foothills and valley were rich in natural resources and the Maidu took advantage of many available foods. Acorns were important to their diet and were supplemented with seeds, nuts, berries, herbs, and fruit. Virtually every animal was hunted or trapped, excluding lizards, snakes, and grizzly bears. The Maidu were nomadic throughout much of the year, moving from place to place following game migration patterns and gathering seasonal plants.

In the 1860s, the owners of both the Fiddyment Ranch and Kaseberg ranch, located a few miles north of the project site, allowed Maidu families to collect acorns, tubers, and grasshoppers on their property during the late summer and fall. These activities took place along Pleasant Grove Creek. Families traditionally went to special places to get acorns, and may have owned certain trees.

The Nisenan hunting and gathering cycle was altered drastically with the discovery of gold in Coloma in 1848. As miners poured into the Roseville and Auburn areas, the Native Americans were forced out of their winter villages, land was fenced, streams were silted, and food resources became increasingly difficult to procure. The Nisenan survived as best they could, working for Euro-Americans in mines or on ranches, panning for gold, and other activities.

1.1.2.2 Fiddyment Ranch

The Fiddyment family has a long history in the Roseville area. Elizabeth Jane Fiddyment came to the Sacramento area from Illinois in 1854, a widow with a four-year-old son, Walter Frederick Fiddyment. Upon arriving in the Elk Grove area in southern Sacramento County, she met and married a local farmer and stock-raiser, George Hill. The new family moved to the Pleasant Grove District in Roseville in 1856 to live and work with her sister's family on their farming operation. Around this time, Elizabeth's brother-in-law repaid a debt to her with a parcel of land, the first of what would eventually become extensive land holdings. This property was west of modern Roseville in the Pleasant Grove District. By the time of her death in 1912, Elizabeth reportedly owned over 13,000 acres in southern Placer County, between Lincoln and present-day Folsom Lake.

In 1879, Elizabeth's son, Walter, left his mother's home when he married Ella Bond. He bought 80 acres in the Pleasant Grove District, the first of 240 acres he eventually owned in the Plan Area. This property had been occupied as early as 1855, when government surveyors recorded farming activity there including fences and a field. Walter, 29, and Ella, 24, moved into a small cabin already on the property and Walter started farming. A year later their first child, Ira, was born. The Fiddyment family ranch, which dates to the 1870s, is located in the Fiddyment Ranch property near the eastern boundary of the WRSP Area. When the soil and natural irrigation proved too poor for farming, Walter turned to raising horses and mules, which also proved unprofitable. His next venture was raising cattle and sheep.

During the 1880s, the Fiddyments continued to expand their ranch. Ella's father, a brick mason, helped by building a smokehouse, cooler, reservoir, hog scalder, and chimneys on the house. The family reportedly modified and enlarged the original cabin on the property into a two-story ranch house. This was necessary to accommodate their growing family, which eventually numbered seven children and probably farm hands as well.

By the turn of the century land north of Pleasant Grove Creek was used for rangeland. In the northeastern quarter of Section 13, a small complex of structures was built, including a barn, a bunkhouse for farm hands, and a concrete horse trough with a windmill. The red barn was a standard barn with eight-foot eaves and two-pole supports. The original windmill was a wooden structure on concrete footings. It was later replaced by a 1920s-era Aerodyne metal windmill, set on the same footings. The small complex also included a blue stone vat on a concrete pad. When side panels were attached, it created a pen where sheep were corralled for the treatment of hoof diseases.

Within the next few years, Walter diversified his farming income by acquiring commercial and residential property in Roseville. He purchased a half interest in G. W. Lohse's general merchandising store in 1906, buying out his partner in 1911 and changing the store's name to W. F. Fiddyment and Son.

Walter himself stopped farming in 1918. Around 1920, his son, Russell, started raising bronze turkeys at the ranch, supplementing the family sheep and cattle operations. While Walter had previously tried domesticating wild turkeys, Russell's was the first commercial turkey venture. At that time, Walter, 69, and Ella, 64, continued to live at the ranch with their adult children and a servant. Later in 1920, Russell married and moved with his wife, Cora, to a house in Roseville. In 1927, Walter and Ella left the ranch house and Russell and Cora moved in.

After Walter died in 1933, his sons continued agricultural land use on the property, although in independent operations consisting primarily of raising livestock and turkeys. Walter's son, Russell, became the head of the household, living in the farmhouse with his wife, Cora, and their four children. Russell and Cora continued to develop their turkey production and added chickens in the late 1930s. They switched from the bronze to white turkeys in the 1940s. Russell gave John and David the chicken operation, which David bought out entirely around 1942.

A relative, Eric Fiddyment, built a turkey house and pens. One feature at the site was a cooking trough, moved from an unknown location elsewhere on the ranch. Water was boiled with grain and food scraps to make hog feed in the metal-lined brick trough. The family also moved a salvaged duplex from Camp Beale Air Force Base to the ranch for farm working housing.

The extended Fiddyment family has continued to be active throughout the ranch. The Fiddyments were using airplanes by the 1950s to assist in their livestock operations, leading to the construction of a private airstrip there. During the 1950s and 1960s there was an effort to grow rice irrigated by a ditch and well. After this proved unsuccessful, that area was used as irrigated pasture until it was eventually allowed to return to a natural state.

During the early 1970s David Fiddyment began raising pistachios on a portion of the site near Pleasant Grove Creek. In 1971, he built a removable dam on Pleasant Grove Creek to impound irrigation water for use during the dry season. Today (2003) he runs a pistachio operation with a small roadside sales stand, continuing a long family tradition of working close to the land.

In the early 1990s, turkey and sheep ranching ended on the property. Today (2003) only cattle operations remain an active part of the Fiddyments' long history of ranching on the land.

1.1.3 Surrounding Land Uses

Pre-development, the land use surrounding the Preserve was almost exclusively agriculture/grazing. Upon build-out within the project area, land uses adjacent to the Preserve will be a mix of uses including business/commercial, light industrial, with the majority as residential, schools, and parks. Outside of the WRSP, adjacent land uses to the north and the west are currently agriculture/grazing and their future is not know at this time.

1.1.4 General Preserve Description

The Preserve consists of a series of riparian/oak woodland corridors and vernal pool concentrations dispersed throughout the WRSP (see Figure 2). The Preserve is made up of several different units, and each has been given a parcel number. The acreage of each parcel number is shown on Table 2 – *Preserve Acreage by Parcel* and each is shown on the *Preserve Detail Maps*, Figures 7-22. One exception is that a 100-foot corridor along Kaseberg Creek where it passes through Fiddyment Park (a 50 foot buffer on either side of the creek) is covered by the conservation easement/declaration of restrictions and is considered part of the Preserve even though it is in a park parcel (see Figure 22). This is the only portion of Fiddyment Park covered by the conservation easement/declaration of restrictions. The development of Fiddyment Park to include the amenities shown on Figure 23 – *Fiddyment Park Amenities*, is not precluded by the conservation easement/declaration of restrictions, however the impacts to develop the park will require a separate Corps permit.

Table 2. Preserve Acreage by Parcel

Fiddyment Ranch	
Parcel #	Acreage
F-80	132.7
F-83	54.9
F-84	81.2
F-85	26.4
F-86	12.2
F-87	10.3
F-88	16.7
F-89	0.8
Subtotal	335.2
Westpark	
Parcel #	Acreage
W-81	267
W-82	5.2
W-83	77.2
Subtotal	349.4
Kaseberg Creek	
Parcel #	Acreage
F-54*	14.7
Subtotal	14.7
Total for all Parcels	**699.3**

*Only a 50-foot buffer on either side of Kaseberg Creek is included.

A total of 40.68 acres of waters of the U.S., including wetlands, are located throughout the Preserve. These include vernal pools, vernal swales, seasonal wetlands, and wetland swales/channels. Included in the last category are portions of Pleasant Grove Creek, South Branch Pleasant Grove Creek, Kaseberg Creek and unnamed tributaries to Pleasant Grove Creek and Curry Creek (See Figure 2). Additionally, approximately 8 acres of on-site wetland restoration are planned for the Pleasant Grove Creek (see Figure 24 - *On-Site Wetland Mitigation Area*). This is expected to consist of seasonal and perennial wetlands. In this Plan, all restrictions, uses, monitoring, and management guidelines are assumed to apply to all of these areas unless explicitly stated otherwise.

1.2 Topography and Soils

The topography of the site is gently rolling, with a centrally located low area containing wetlands with drainage flowing towards Pleasant Grove Creek, which then conveys flows westward as it traverses the center of the site. The southwestern portion of the site is drained by the heads of several unnamed tributaries to Curry Creek. Elevations at the project site range from approximately 85 feet above mean sea level (MSL) to 120 feet above MSL.

All of the soils mapped on-site by the Soil Conservation Service (U. S. Department of Agriculture, Soil Conservation Service 1980) are terrace and alluvial bottom units. Associations are the San Joaquin-Cometa, Fiddyment-Cometa-Kaseberg, and Cometa-Ramona. They are all undulating soils of variable depth over dense clay subsoils or partially eroded siltstone. Primary individual units are Cometa-Fiddyment complex 1-5% slopes (141), Cometa-Ramona sandy loam 1-5% slopes (142), Fiddyment loam 1-8% slopes (146), Fiddyment-Kaseberg loams 2-9% slopes (147), and San Joaquin-Cometa sandy loam 1-5% slopes (182). Most of these units occur across broad areas of the terraces along Pleasant Grove Creek. Alluvial units are complex and discontinuous along the narrow stream bottom and are most frequently or occasionally flooded Xerofluvents (193, 194). Figure 25 - *NRCS Soil Types* shows the soil types that occur on-site.

1.3 Biological Resources

The WRSP Preserve has several habitat types that support a variety of wildlife species, some of them special-status.

1.3.1 Upland Habitat Types and Associated Wildlife

The dominant habitat type within the Preserve is non-native annual grassland (and associated wetlands – see Section 1.3.2) with smaller components of riparian and oak woodland along Pleasant Grove and Kaseberg Creeks. Each of these habitat types is described below and shown on Figure 26 - *Preserve Habitat Map*. These various habitats can be seen in Figures 4 and 5.

1.3.1.1 Blue Oak Woodland

Aside from the dominant blue oaks (*Quercus douglasii*), other species found in oak woodland can include hoary coffeeberry (*Rhamnus tomentella*), coyote brush (*Baccharis pilularis*), toyon (*Heteromeles arbutifolia*), and poison oak (*Toxicodendron diversilobum*). Other Herbaceous understory plants include a variety of non-native grasses such as ripgut brome (*Bromus diandrus*), medusahead grass (*Taeniatherum caput-medusae*), soft brome (*Bromus hordeaceus*), wild oats (*Avena fatua*), Mediterranean barley (*Hordeum marinum*), and Italian ryegrass (*Lolium multiflorum*). Purple needle grass (*Nassella pulchra*), a native perennial bunch grass, may be found scattered amongst the non-native species.

In areas along intermittent channels that do not support a full suite of riparian species, woody species may include interior live oak (*Q. wislizenii*), California buckeye (*Aesculus californica*), and button bush (*Cephalanthus occidentalis*).

Blue oak woodland provides a number of important wildlife resources, including food, cover, shade, roosting, and breeding sites. Acorns are preferred or essential food items in the diets of acorn woodpecker (*Melanerpes formicivorus*), western scrub-jay (*Aphelocoma californica*), western gray squirrel (*Sciurus griseus*), and many other species. Insects found in association with oak foliage and bark also attract insectivorous birds such as yellow-rumped warbler (*Dendroica coronata*) and Hutton's vireo (*Vireo* *huttoni*). Larger, dead, and/or decaying trees provide nesting sites for cavity-nesting birds such as American kestrel (*Falco sparverius*), western bluebird (*Sialia mexicana*), tree swallow (*Tachycineta bicolor*), and white-breasted nuthatch (*Sitta carolinensis*).

Other common wildlife species that may be found in the oak woodland include coyote (*Canis latrans*), western gray squirrel (*Sciurus griseus*), mule deer (*Odocoileus hemionus*), Mexican free-tailed bat (*Tadarida brasiliensis*), big brown bat (*Eptesicus fuscus*), palid bat (*Antrozous pallidus*), pacific chorus frog (*Pseudacris regilla*), western fence lizard (*Sceloporus occidentalis*), California kingsnake (*Lampropeltis getulus*), sharptail snake (*Contia tenuis*), and striped racer (*Masticophis lateralis*).

1.3.1.2 Grassland Habitat

The annual grassland community is comprised primarily of non-native naturalized Mediterranean grasses. These include ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), wild oats (*Avena fatua*), ryegrass (*Lolium multiflorum*), Mediterranean barley (*Hordeum marinum*), and medusahead grass (*Taeniatherum caput-medusae*). Other herbaceous species in this community may include bur clover (*Medicago polymorpha*), filaree (*Erodium botrys*), clover (*Trifolium* spp.), blue dicks (*Dichelostemma capitatum*), spikeweed (*Hemizonia fitchii*), and yellow-star thistle (*Centaurea solstitialis*).

The annual grassland habitat supports a modest diversity of wildlife species. Small mammals present may include California vole (*Microtus californicus*), black-tailed jackrabbit (*Lepus californicus*), deer mouse (*Peromyscus maniculatus*), and pocket gopher (*Thomomys* spp.). These mammals represent potential foraging items for predators such as northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawks (*Buteo swainsoni*) white-tailed kite (*Elanus leucurus*), gopher snake (*Pituophis catenifer*), western rattlesnake (*Crotalus viridus*), and coyote (*Canis latrans*). Birds that may find the grasslands suitable for nesting include the horned lark (*Eremophila alpestris*) and western meadowlark (*Sturnella neglecta*). Other birds which do not necessarily nest within the grasslands but may forage in this habitat include Brewer's blackbirds (*Euphagus cyanocephalus*) and tricolored blackbird (*Agelaius tricolor*).

1.3.1.3 Riparian Habitat

Riparian woodland is typically comprised of a canopy of mature trees, an intermediate shrub layer, and herbaceous ground-cover. The stratified community provides important elements for the completion of the life cycle of many wildlife species and provides important migration corridor for a variety of wildlife, in addition to providing forage and cover.

The canopy of the typical valley riparian forest is comprised primarily of Valley oak (*Quercus lobata*) with scattered large willows (*Salix* spp.), Fremont cottonwood (*Populus fremontii*), and California buckeye (*Aesculus californica*). The mid-level of the typical riparian habitat is made up of scrub-shrub species such as arroyo willow (*Salix* *lasiolepis*), button bush (*Cephalanthus occidentalis*), and other willows (*Salix species*). This understory or mid-level vegetation is missing in the majority of the Pleasant Grove Creek corridor because of cattle grazing. The herbaceous understory may include Canada thistle (*Cirsium arvense*), bull thistle (*Cirsium vulgare*), tall flatsedge (*Cyperus eragrostis*), hairy willow-herb (*Epilobium ciliatum*), willow-herb (*Epilobium species*), smilo grass (*Piptotherum miliaceum*), prickly sowthistle (*Sonchus asper*), vetch (*Vicia species*), California wild grape (*Vitis californica*), and rough cockle-bur (*Xanthium strumarium*).

The riparian communities in this region typically support a wide variety of wildlife species, including Bewick's wren (*Thryomanes bewickii*), downy woodpecker (*Picoides pubescens*), Swainson's hawk (*Buteo swainsoni*), golden-crowned sparrow (*Zonotrichia atricapilla*), wood duck (*Aix sponsa*), red-shouldered hawk (*Buteo lineatus*), great horned owl (*Bubo virginianus*), and tree swallow (*Tachycineta bicolor*). Several bat species could occur within the riparian areas. The western red bat (*Lasiurus blossevilli*) is tree roosting bat which prefers riparian habitat. Little is known about the local distribution of this species, but it could potentially be a resident bat or occur during annual migration periods. Mexican free-tailed bats (*Tadaria brasiliensis*), Yuma myotis (*Myotis yumanensis*), and big brown bats (*Eptesicus fuscus*) are common species that prefer bridges and other structures, but may roost in tree cavities or hollow trunks.

The understory scrub community provides nesting habitat for wrentit, Bewick's wren, song sparrow, and California towhee. Resident and migratory songbirds such as hermit thrush (*Catharus guttatus*), Bewick's wren (*Thryomanes bewickii*), fox sparrow (*Passerella iliaca*), and spotted towhee (*Pipilo maculatus*) also utilize willow scrub community for foraging and nesting cover.

Other wildlife species observed within the riparian communities include Pacific chorus frog, western gray squirrel, mule deer, striped skunk (*Mephitis mephitis*), beaver (*Castor canadensis*), common garter snake (*Thamnophis sirtalis*), and raccoon (*Procyon lotor*).

1.3.2 Jurisdictional Wetlands/Waters of the U.S.

A variety of wetlands and waters of the U.S. occur in the Preserve. Each is described in detail below.

1.3.2.1 Intermittent Drainage/Creeks

Intermittent drainages are characterized by a defined bed and bank with a distinct high-water level. They convey flows during storm events but standing water generally does not persist except in areas where deeper pools form. These types of drainages are largely unvegetated due to the scouring effects of fast flowing water, but hydrophytic vegetation may be prevalent at the upper edges of the drainage. Creeks also have a defined bed and bank with a distinct high-water level, but may have water flowing in them year round (perennially) or intermittently. The following creeks occur within the Preserve along with several unnamed tributaries to Pleasant Grove and Curry Creeks.

Pleasant Grove Creek

Pleasant Grove Creek flows from east to west along the central portion of the project site. In this reach, Pleasant Grove Creek is perennially inundated due to surface runoff from surrounding terraces and from upstream activities. The soil types associated with Pleasant Grove Creek are Xerofluvents, occasionally flooded (193) and Xerofluvents, frequently flooded (194) (Figure 25 – *NRCS Soil Types*).

South Branch of Pleasant Grove Creek

The mouth of South Branch of Pleasant Grove Creek is located within the Preserve. It is a perennially inundated drainage due to surface runoff from surrounding terraces and from upstream activities. The soil types associated with South Branch of Pleasant Grove Creek are Xerofluvents, occasionally flooded (193) and Xerofluvents, frequently flooded (194) (Figure 25 – *NRCS Soil Types*).

Kaseberg Creek

The confluence of Kaseberg Creek and Pleasant Grove Creek is located in the east-central portion of the subject parcel near what was the Fiddyment Ranch farming complex. It is a perennially inundated drainage due to surface runoff from surrounding terraces and from upstream activities. The soil types associated with Kaseberg Creek are Xerofluvents, occasionally flooded (193) and Xerofluvents, frequently flooded (194). (Figure 25 - *NCRS Soil Types*).

1.3.2.2 Vernal Pools

Vernal pools are poorly drained, isolated depressions that occur within the Preserve's annual grassland habitat. Water ponds in vernal pools for several weeks at a time during the rainy season and may dry completely if the duration between storm events is long. Vernal pools are fed by direct rainfall or surface run-off.

In the Mediterranean climate of California's Central Valley, fall rains initiate the "wetting" stage during which seeds germinate and dormant perennials re-sprout. As soils saturate and standing water accumulates, the pool enters the "aquatic" phase. Inundation may be periodic or continuous, and this variability supports a diverse plant and animal community. As water levels recede, thought to be primarily through evaporation, the "drying" phase begins during which pool basins begin drying and plant flowering reaches its peak followed by the setting of seeds. The final phase is the "drought" phase and is characterized by dry soils and dead or dormant vegetation.

Vernal pools on-site range from well-defined basins with distinct boundaries to those with indistinct boundaries that have been altered over time through previous agricultural usage of the site. These pools are dominated by such typical vernal pool community plants as slender popcorn-flower (*Plagiobothrys stipitatus*), annual hairgrass (*Deschampsia danthonoides*), Downingia (*Downingia* species), and Vasey's coyote-thistle (*Eryngium vaseyi*). Typical wildlife associated with vernal pools include various aquatic invertebrates and amphibians such as the Pacific chorus frog (*Pseudacris regilla*). On occasion, various bird species may forage and/or rest within vernal pools.

Vernal pools provide habitat for a variety of endemic and often special-status plant and animal species (see Section 1.3.3). As such, vernal pools are remnant patches of the native plant landscape within a grassland community dominated by non-native species.

1.3.2.3 Seasonal Wetland/Drainage Swales

Within the Preserve, seasonal wetlands and drainage swales occur within the annual grassland as shallow depressions underlain by slowly permeable soils. Seasonal wetland depressions follow a similar hydrological cycle to that of vernal pools, however some may never have visible ponding. Rather, these depressions/swales may remain saturated only during the "wet" period (see vernal pool description above).

A variety of plants and wildlife can be found within seasonal wetlands and drainage swale communities at the Preserve. The "drier" seasonal wetlands/drainage swales may be dominated by low-growing grasses and annual herbs including Italian ryegrass (*Lolium multiflorum*), Mediterranean barley (*Hordeum marinum*), and hyssop loosestrife (*Lythrum hyssopifolium*). The "wetter" seasonal wetlands/drainage swales are potentially dominated by species such as baltic rush (*Juncus balticus*), annual rabbit-foot grass (*Polypogon monspeliensis*), Bermuda grass (*Cynodon dactylon*), and creeping spikerush (*Eleocharis macrostachya*). When inundated, these seasonal wetlands and drainage swales provide habitat for aquatic invertebrates and amphibians. For most of the remainder of the year, wildlife usage is similar to that of typical Central Valley non-native annual grassland habitat.

1.3.3 Special-Status Species

Several special status species were found within the WRSP during surveys conducted at the site or have historic records of being present on-site.

1.3.3.1 Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp is an invertebrate listed as threatened. This species is protected under the federal Endangered Species Act (ESA) as administered by the U.S. Fish and Wildlife Service. Only approved biologists with a federal permit can survey for, net, or handle this species. The U.S. Fish and Wildlife Service authorized impacts to this species' habitat through the issuance of a Biological Opinion, (Attachment B), and mitigation for the direct and indirect impacts will occur off-site.

<u>Species Account</u>

This was directly adapted from the U.S. Fish and Wildlife website (USFWS 2003a). The vernal pool fairy shrimp (*Branchinecta lynchi*), is a small branchiopod crustacean in the family Branchinectidae. It ranges in size from ½ to one inch long. Fairy shrimp are aquatic species in the order Anostraca. They have delicate elongate bodies, large stalked compound eyes, no carapaces, and eleven pairs of swimming legs. They glide gracefully upside down, swimming by beating their legs in a complex, wavelike movement that passes from front to back. Fairy shrimp feed on algae, bacteria, protozoa, rotifers and bits of detritus.

The vernal pool fairy shrimp occupies a variety of different vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools. Although the species has been collected from large vernal pools, including one exceeding 25 acres, it tends to occur in smaller pools. It is most frequently found in pools measuring less than 0.05 acre. Vernal pool fairy shrimp have been collected from early December to early May.

Female fairy shrimp carry their cysts in a ventral brood sac. The cysts are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks. When the pool dries out, so do the cysts. They remain in the dry pool bed until rains and other environmental stimuli hatch them. Fairy shrimp cysts are capable of withstanding heat, cold and prolonged desiccation. When the pools refill, some, but not all, of the cysts may hatch. The cyst bank in the soil may contain cysts from several years of breeding. The average time to maturity is only forty-one days. Under warmer conditions, it can be as little as eighteen (Eriksen and Belk 1999).

The vernal pool fairy shrimp is widespread but not abundant. Known populations extend from Southern Oregon through most of the length of the Central Valley. Along the central coast, they range from northern Solano County to Pinnacles National Monument in San Benito County. Additional disjunct populations exist: one near Soda Lake in San Luis Obispo County, one in the mountain grasslands of northern Santa Barbara County, one on the Santa Rosa Plateau in Riverside County, and one near Rancho California in Riverside County.

The vernal pool fairy shrimp was identified relatively recently, in 1990. There is little information on its historical range. However, since it is currently known to occur in a wide range of vernal pool habitats, the historic distribution may have coincided with the historic distribution of Central Valley and Southern California vernal pools.

1.3.3.2 California Fairy Shrimp

Another vernal pool invertebrate, which is a U.S. Fish and Wildlife Service species of concern, but is not protected under ESA, is known to be present in the Preserve. California linderiella (*Linderiella occidentalis),* is another invertebrate that lives in vernal pools and seasonal wetlands. Its life cycle and habitat requirements are similar to the vernal pool fairy shrimp.

<u>Species Account</u>

This was directly adapted from the U.S. Fish and Wildlife website (USFWS 2003b). The California fairy shrimp (*Linderiella occidentalis*), also known as the California linderiella, is a small (about 0.4 inch long) crustacean in the family Linderiellidae. Fairy shrimp are aquatic species in the order Anostraca. They have delicate elongate bodies, large stalked compound eyes, no carapaces, and eleven pairs of swimming legs. They glide gracefully upside down, swimming by beating their legs in a complex, wavelike movement that passes from front to back. Fairy shrimp feed on algae, bacteria, protozoa, rotifers and bits of detritus.

Most fairy shrimp found in California belong to the Branchinectidae family. These include the threatened vernal pool fairy shrimp (see above), which is often found in the same pools.

California fairy shrimp tend to live in large, fairly clear vernal pools and lakes. However, they can survive in clear to turbid water with pH from 6.1 to 8.5, and they have been found in very small pools. They are tolerant of water temperatures from 41° to 85° F, making them one of the most heat tolerant fairy shrimp in California.

Female fairy shrimp carry their cysts in a ventral brood sac. The cysts are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks. When the pool dries out, so do the cysts. They remain in the dry pool bed until rains and other environmental stimuli hatch them.

Cysts are capable of withstanding heat, cold and prolonged desiccation. When the pools refill, some, but not all, of the cysts may hatch. The cyst bank in the soil may contain cysts from several years of breeding.

Average time to maturity is about forty-five days. Thirty-one seems to be the minimum time required, which is the longest minimum for any Central Valley fairy shrimp. (Eriksen and Belk 1999) Adults have been collected from late December to early May.

The California fairy shrimp is the most common fairy shrimp in the Central Valley. It has been documented on most land forms, geologic formations and soil types supporting vernal pools in California, at altitudes as high as 3,800 feet above sea level.

1.3.3.3 Dwarf Downingia

Dwarf downingia (*Downingia pusilla*) is a California Native Plant Society List 2 plant. This means that it is rare, threatened or endangered in California, but more common elsewhere. The habitat of dwarf downingia is threatened by development, agriculture, grazing, and off-road vehicles (CNPS 2001). Dwarf downingia was found within vernal pools in the WRSP area during pre-project surveys.

<u>Species Account</u>

Dwarf downingia is an annual herb in the bellflower family (Campanulaceae), 3 to 8 cm tall, with small linear leaves. Its small, radially symmetric flowers are less than 1 cm, in contrast to all other *Downingia* species, which have larger, showy, asymmetric flowers. The flowers, borne at the ends of branches, are five-petaled white or blue with two small yellow spots near the throat. The fruits are 20-27 mm long, with tough lateral walls that are dehiscent along translucent lines (Hickman 1993).

Dwarf downingia grows at the margins of vernal pools and lakes and other mesic areas in valley and foothill grassland, both in alkaline (saline) and non-alkaline soils less then 150 m. It occurs with other rare wetland and vernal pool species such as alkali milkvetch (*Astragalus tener* var. *tener*), legenere (*Legenere limosa*), Bogg's Lake hedge-hyssop (*Gratiola heterosepala*), Heckard's peppergrass (*Lepidium latipes* var. *heckardii*), and little mouse-tail (*Myosurus minimus* sp. *apus*). It flowers March through May (Hickman 1993, CNPS 2001).

Dwarf downingia occurs from Merced and Mariposa counties in the south to Tehama County in the north. Sonoma County is the only coastal county known to support dwarf downingia (CNPS 2001).

1.3.3.4 Greene's Legenere

Greene's legenere (*Legenere limosa*) is a federal species of concern and a California Native Plant Society List-1B species. List 1B species are plants that are rare, threatened, or endangered in California and elsewhere. Legenere was not found in the WRSP area during recent surveys, historic records show that they were present.

This annual forb typically occurs within vernal pools and seasonal wetlands, and they are known from scattered locations in the Sacramento Valley from 1 to 880 m. Flowering occurs during April through June. Legenere is known from Lake, Napa, Placer, Sacramento, Shasta, San Mateo, Solano, and Tehama Counties.

1.3.3.5 Cooper's Hawk

Cooper's hawk (*Accipiter cooperii*) is a California Department of Fish and Game species of special concern, but has no federal special-status. Typical nesting and foraging habitat includes riparian woodland, dense oak woodland, and other woodlands near water. Breeding range generally includes the Central Valley and the Sierra Nevada and Coast Range foothills. Cooper's hawks were observed during surveys of the WRSP area.

1.3.3.6 Burrowing Owl

Burrowing owl (*Speotyto cunicularia*) has no protected status under either state or federal Endangered Species Acts, but is currently a California Department of Fish and Game species of special concern, federal species of special concern, and U.S. Fish and Wildlife Service migratory bird of management concern. Burrowing owls typically utilize abandoned ground squirrel (or other mammal) burrows, abandoned culverts, rubble piles, or any other substrate that is a burrow analog within open grasslands and savannah in the Central Valley. They may feed upon insects, small rodents, and lizards.

Nesting season occurs during April through July. Burrowing Owls were observed during surveys of the WRSP area.

1.3.3.7 Ferruginous Hawk

Ferruginous hawk (*Buteo regalis*) is currently a California Department of Fish and Game species of special concern, federal species of special concern, and U.S. Fish and Wildlife Service migratory bird of management concern. This species typically occurs in open habitats and nests from Oregon into Canada, and nesting has recently been documented to occur in Lassen County, California (Small 1994). For the remainder of the state, including the Central Valley, ferruginous hawk occurrences are restricted to the non-breeding season (September through April). Winter foraging occurs within a variety of open habitats including open grassland and savannah. Ferruginous hawks were observed during surveys of the WRSP area.

1.3.3.8 Swainson's Hawk

Swainson's hawks (*Buteo swainsoni*) are state-listed threatened species and are protected pursuant to the California Endangered Species Act. The Swainson's hawk is considered a neotropical migrant; it nests in North America (Canada, western United States, and Mexico) and winters in South America (mainly Argentina). However, recent telemetry studies indicate that some or all of Swainson's hawk nesting in California migrate as far as Mexico or Southern California, or stay within the Central Valley region during winter months. In California, the Swainson's hawk nesting season ranges between mid-March and late August.

Swainson's hawks nest within tall trees in a variety of wooded communities including riparian, oak woodland, roadside landscape corridors, urban areas, and agricultural areas, among others. Foraging habitat includes open grassland, savannah, low-cover row crop fields, and livestock pastures. Typical dietary composition of Swainson's hawks within the Central Valley include California vole (*Microtus californicus*), California ground squirrel (*Spermophilus beecheyi*), ring-necked pheasant (*Phasianus colchicus*), many passerine birds, and grasshoppers (*Melanopulus* spp.). The relationship of Swainson's hawks and agricultural mowing, harvesting, discing, and irrigating has been well documented (Estep 1989), where prey becomes increasingly available as vegetative cover is reduced by such farming activities. Swainson's hawks and one potential active nest was observed during surveys of the WRSP area.

1.3.3.9 Northern Harrier

Northern harrier (*Circus cyaneus*) has no federal status, but is a California Department of Fish and Game species of special concern. It is known to nest within the Central Valley, along the Pacific Coast, and in northeastern California. Northern harriers are ground nesters, and typical nesting substrates include emergent wetland/marsh, open grasslands, or savannah habitats. Foraging occurs over a variety of open habitats, such as marshes, agricultural fields, and open grasslands. Northern harriers feed upon rodents, birds, amphibians, reptiles, crustaceans, and insects. Northern harriers were observed during surveys of the WRSP area.

1.3.3.10 White-tailed Kite

White-tailed kite (*Elanus leucurus*) has no special status pursuant to either state or federal Endangered Species Acts. However, white-tailed kite are fully protected according to the Fish and Game Code of California, Section 3511, federal species of concern, and USFWS migratory bird of management concern. White-tailed kites nest in trees within riparian, oak woodland, and savannah habitats of the Central Valley and Coast Range, typically during May through August. White-tailed kite forage within open grassland, savannah, and agricultural cropland habitats, mainly on rodents, but may also take insects, reptiles, amphibians, and birds. White-tailed kites were observed during surveys of the WRSP area.

1.3.3.11 Western Spadefoot Toad

The western spadefoot toad (*Spea hammondii*) is a CDFG and USFWS species of special concern, and California Code of Regulations fully protected species. Historic records exist within the WRSP area, however the species was not found during recent surveys (CDFG 2003). They are most commonly associated with lowland annual grassland habitats but also occur within chaparral and pine-oak woodlands (Stebbins 1985). Within the California, western spadefoot toads are known from the vicinity of Redding, Shasta County southward to northwestern Baja California, at elevations below 1363 m (CDFG 1994).

Necessary habitat components of the western spadefoot toad include suitable underground retreats and breeding ponds. The species is mostly terrestrial but requires temporary rain pools or pools within intermittent drainages to reproduce. Spadefoots spend most of their adult life within underground burrows excavated in loose soil, or other suitable refugia, such as rodent burrows. Suitable breeding sites include temporary rain pools, such as vernal pools and seasonal wetlands or within portions of intermittent drainages (CDFG 1994). Breeding and egg laying occurs at night typically between late February and May (CDFG 1994). Eggs are deposited on submerged debris and vegetation. After hatching, larvae complete their development within 3-11 weeks, and postmetamorphic juveniles feed and immediately seek underground refugia.

1.4 Plan Goal

The goal of this Plan is to ensure that the preserved wetland, riparian, and upland habitats within the Preserve are maintained in good condition such that they will continue to support the flora and fauna that the Preserve were established to protect (Conservation Values) in perpetuity, and to define the specific methods necessary to meet this goal. Conservation Values are defined as the physical, biological, and environmental processes needed to maintain the suitability of habitats in the Preserve. Specific management strategies and biological monitoring designed to maintain the Conservation Values are discussed in Sections 5.0 and 8.0.

In order to realize the Plan Goal, the following biological goals are established:

- To maintain in perpetuity, the suitability of the vernal pool and swale ecosystem, associated watersheds, and uplands within the Preserve for listed crustaceans and other special status species that inhabit vernal pools.
- To preserve in perpetuity, the annual grassland areas habitat for foraging Swainson's hawks, and to preserve the riparian corridor for nesting.
- Preserve the abundance and diversity of the native plant and animal species within the wetland, grassland, riparian, and oak woodland habitats.
- Protect the Preserve from the effects of adjacent land uses that may adversely impact the Preserve.
- Repair or restore adverse conditions within the Preserve.

1.5 Definitions

Although these terms have been defined in the text, this definition section has been provided for a quick reference.

1.5.1 Annual Report

The yearly report prepared by the Monitoring Biologist in conjunction with the Preserve Manager that will be submitted to the Preserve Manager and the Corps by August 15th of each year.

1.5.2 Biological Opinion

The specific biological opinion issued by the U.S. Fish and Wildlife Service for the Westpark/Fiddyment Ranch project (Service File #1-1-03-F0013).

1.5.3 City

The City of Roseville.

1.5.4 CDFG

The California Department of Fish and Game.

1.5.5 Corps

The United States Army Corps of Engineers.

1.5.6 Exotic Pest Plants

Exotic pest plants are plants that are not native, and additionally are invasive, replacing native vegetation or native habitats. The Monitoring Biologist and the Preserve Manager can refer to the species found on the California Exotic Pest Control Council (CalEPPC) List A, List B, and Red Alert List to assist them in determining if a plant is an exotic plant species of concern.

1.5.7 Monitoring Biologist

The primary consulting scientist or firm hired to assist the Preserve Manager in performing the duties and obligations required by this Plan.

1.5.8 Native Plant Species

For the purposes of this Plan, plants native to the Preserve are defined as those plants believed by the scientific community to have been present in western Placer County prior to the settlement of Europeans. The Jepson Manual will be the primary reference for determining if a plant is native or non-native. However, because this reference is specific only as to subregions, which encompass portions of several counties, the Preserve Manager can consult with the Monitoring Biologist, local botanists, or the local chapter of the California Native Plant Society to determine if a plant should be considered native to the Preserve.

1.5.9 Non-native Plant Species

Any plant not considered a Native Plant Species as defined above.

1.5.10 Permit

The specific U.S. Army Corps of Engineers permit issued for the Westpark/Fiddyment Ranch project (Regulatory Branch #200200666).

1.5.11 Plan

The Operations and Management Plan for the West Roseville Specific Plan Open Space prepared in compliance with the Permit and the Biological Opinion.

1.5.12 Preserve

The West Roseville Specific Plan Open Space Preserve consists of a series of riparian/oak woodland corridors and vernal pool concentrations dispersed throughout the WRSP (see Figure 2). The Preserve is made up of several different units, and each has been given a parcel number. One exception is that a 100-foot corridor along Kaseberg Creek where it passes through Fiddyment Park (a 50 foot buffer on either side of the creek) is covered by the conservation easement/declaration of restrictions and is considered part of the Preserve even though it is in a park parcel (see Figure 22).

1.5.13 Preserve Function

Preserve function is defined as the physical, biological, and environmental processes needed to maintain the suitability of the habitats in the Preserve habitats.

1.5.14 Preserve Manager

The City of Roseville Environmental Coordinator will act as Preserve Manager and will be the contact for all matters concerning the Preserve.

1.5.15 Qualified Personnel

Professional biologists, botanists, and other specialists employed to assist the Preserve Manager in performing the duties and obligations required by this Plan.

2.0 PRESERVE MANAGEMENT DURING PROJECT CONSTRUCTION AND DEDICATION OF PRESERVE PARCELS TO THE CITY

2.1 Protective Measures to be Taken During Initial Project Construction

As the WRSP area is built out, construction will take place along the various Preserve boundaries and within the Preserve itself. Past experience has shown that biological resources in urban preserves are vulnerable to disturbance during construction. In general, the minimum necessary construction area will be used (if within the Preserve). Construction limits will be set that do not encroach on any preserved wetlands. To avoid impacts to the Preserve and the protected resources, the following protective measures will be taken during project construction.

2.1.1 Improvement Plans

To ensure that that contractors working on projects adjacent to the Preserve are aware of it's presence, improvement plans for projects adjacent to the Preserve will show the Preserve boundary and the Preserve will be labeled.

2.1.2 Pre-Construction Meetings

Pre-construction meetings for construction occurring adjacent to or in the Preserve will address the presence of Preserve, the sensitive habitats present and minimization of disturbance to the Preserve. The City inspectors can also conduct a post-construction inspection to determine if those conducting the construction need to do any post-construction remediation.

2.1.3 Temporary Grading within the Preserve

To achieve the appropriate grade to install several roads, pads, bike trails, and constructed wetlands, etc. within and along the Preserve boundaries, some temporary grading and slopes will occur in the Preserve. This temporary grading will not disturb or modify existing preserved wetlands. Portions of the Preserve that are graded will be hydroseeded with native seed as described below in Section 2.1.7 to re-establish vegetation.

2.1.4 Temporary Construction Fencing

Prior to construction within any phase of the WRSP, high visibility temporary construction fencing will be installed along all Preserve parcels within the phase under construction. Additionally, temporary construction fencing will be installed along any Preserve boundaries outside of the phase under development, but adjacent to where development is occurring. Fencing will also be installed at the limits of construction within the Preserve when improvements such as the bike trail, detention weir, etc, are installed (please see 2.1.3, below). In all cases, this fencing will be maintained daily until permanent fencing is installed. Prior to the completion of construction of each portion of the project, this temporary fencing must be replaced by the developer with permanent fencing, except where the Preserve is contiguous with the open space of neighboring projects (see Section 9.3).

2.1.5 Flagging Preserved Wetlands Adjacent to Construction Within the Preserve

If construction is occurring within the Preserve, prior to installation of temporary construction fencing denoting the limits of construction, the developer or the developer's contractor will hire a professional wetland biologist to flag the preserved wetland(s) within 25 feet of the limits of construction with three foot high, brightly colored pin-flags so that workers are aware of the location of the protected habitat and can install the temporary construction fencing accordingly.

2.1.6 Storm Water Pollution Prevention

Storm water best management practices (BMPs) prevent pollutant discharges into the Preserve and are required by the State Water Resources Control Board for any project over one acre in size. A Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented to control sediment and erosion during construction. This includes preventing runoff from dust control and dewatering. Oil, soil amendments (e.g., lime) or other chemicals used in construction activities shall not be allowed to contaminate site runoff that discharges to the Preserve. For all construction related activities in and adjacent to the Preserve, perimeter BMPs shall be installed (i.e., straw wattle, silt fencing, etc.) as a minimum sediment control measure at all times (year round).

2.1.7 Use of Native Grasses in Post Construction Revegetation

When construction work disturbs soil within the Preserve, all seed used to revegetate must be native to California, preferably ecotypes from the Placer or surrounding counties. Attachment D provides guidelines for seed mixes for different revegetation situations, but the project engineer will ultimately need to approve the seed mix to ensure that the seed mix will result in revegetation that meets required performance standards. Attachment D also provides local native grass seed companies.

2.1.8 Trash Removal and Post Construction Clean-Up

During construction, paper trash, food wrappers, and other trash often blows into preserve areas from adjacent construction sites. The developer or the developer's contractor will remove trash blown into the Preserve from adjacent construction on a daily basis. After construction is complete and the temporary construction fencing has been replaced by permanent fencing, temporary fencing and posts will be removed from the Preserve. Additionally, when disturbed areas adjacent to or within the Preserve (e.g. bike trail construction) have become revegetated and construction is complete, all temporary erosion control materials (e.g. straw bales, straw waddles and stakes, silt fencing) will be removed from the Preserve.

2.2 Preserve Management During Project Construction

During project construction, prior to turning the individual Preserve parcels over to the City, the developer will be responsible for the management and monitoring of the Preserve. The developer will hire a professional biologist to carry out the required monitoring activities. The degree of monitoring required depends on the proximity of active development to the Preserve parcel. Portions of the Preserve will be isolated from development during the initial phases of construction. Figure 27 - *Phasing of Development*, shows the phases of development in both the Westpark and Fiddyment Ranch portions of the WRSP. If development is occurring in any given phase, then the Preserve parcels in that phase will be managed and monitored according to Sections 3.0 – 11.0). If construction has not yet commenced in a given phase then less intensive monitoring is required but other management tasks remain (e.g. non-native species management, annual reporting, etc.). Grazing may or may not be implemented during project construction depending on access, fencing, and presence of active construction equipment.

2.3 Preserve Monitoring During Project Construction

Three monitoring visits are required each year, however they will not require the detailed floristic and invertebrate monitoring. One monitoring visit will be made in the period from December to February, one in the period from April to June, and one in late summer or early fall, and shall cover the following:

2.3.1 Habitat Function

The purpose of assessing habitat function is to ensure that the preserved wetland and upland habitats continue to have the appropriate hydrologic regime for that habitat type, monitor anthropogenic influences on the different habitats, and to informally document (make a species list as meandering transects are walked) the plant species that are present and animal species that are using the Preserve.

2.3.2 Thatch Accumulation

The Monitoring Biologist will make an annual determination as to the extent of thatch accumulation. If excess thatch is present, the monitoring biologist will work with the Preserve Manager to determine the best removal practice for the site. Several management practices can be used to address this issue including controlled burning, mowing, or grazing as described previously.

2.3.3 Newly Introduced Non-Native Plant Species

The Monitoring Biologist will assess the presence of any newly introduced non-native plant species and recommend corrective actions as needed. Special attention will be paid to exotic pest plants. The baseline map developed in the first few years will be used in this annual assessment.

2.3.4 Preserve Function

The overall Preserve function should be assessed, taking into account the above factors and the purpose of the Preserve, which is to support the flora and fauna of the wetlands and uplands in perpetuity.

2.4 Dedication Process for Preserve Parcels

The following section outlines the Community Development Department's procedures for dedicating a Preserve parcel to the City. Other Departments in the City may have additional requirements:

Prior to dedication, the Preserve Manager or other designated City staff member will conduct a walk-through with the parcel owner. The purpose of this walk-through will be to:

- Ensure that permanent fencing has been installed according to the O and M Plan.
- Ensure that cattle (grazing) fencing has been installed or the existing fencing has been repaired or upgraded, if needed.
- Trash and debris has been removed from the parcel.
- Ensure that any areas of erosion, sedimentation, or vandalism resulting from surrounding development have been corrected.

Additionally, these items/documents are required:

- Appropriate funding for Preserve management is available to the City.
- A title report less than 6 months old.
- Grant deed with legal description and map.
- Phase 1 Site Assessment for hazardous materials.
- Sign-off from the Corps or City Planning Department that wetland mitigation (Corps) or oak tree mitigation (Planning) has meet it's success criteria and the mitigation obligation has been met (if applicable for the individual parcel).

Upon dedication to the City, the Preserve parcel will be managed by the City according to this Plan.

3.0 PRESERVE OWNERSHIP AND FUNDING MECHANISM

3.1 Preserve Owner

The City of Roseville will ultimately become the Preserve Owner. See Section 2.4 for dedication process for open space parcels. The corridor along Pleasant Grove Creek will not be dedicated to the City until the oak woodland mitigation (if installed in the Preserve) is complete (see Section 11.5), and the Corps has signed off that the wetland mitigation within the corridor has met its final success criteria (see Section 11.5). Until that time, the developer is responsible for monitoring and maintaining the corridor according to this Plan. Upon dedication of any of the Parcels to the City, the City will manage and maintain each Preserve Parcel. The Preserve Manager will be responsible for implementing or overseeing the management and maintenance of this Preserve as outlined above. The following sections outline the funding sources for Preserve management and monitoring.

3.2 Funding Mechanism

Funding for the perpetual maintenance of the Preserve will be provided through an endowment and Community Facilities District (CFD). The amount of funding required to carry out the tasks described in this Plan were agreed upon by the City, the Service, and the Corps. A PAR analysis was used to calculate the amount needed.

3.2.1 What is a PAR?

A PAR is a property analysis record. PARs are generated through the use of a computer program written by the Center for Natural Lands Management to allow government agencies, land trusts, and preserve management foundations and organizations to better define and understand the financial obligations that come with managing natural areas. The program lists a number of activities, structures, and overhead costs associated with preserve management and allows the user to choose the tasks that apply. These costs are then tabulated and printed out for budgeting purposes.

3.2.2 Start-up Endowment

A start-up endowment of ______________, will be placed in an escrow account to ensure funding for the first _____ years of preserve management. This endowment fund will be provided by _______________. The developer will have access to the endowment fund for preserve management and monitoring tasks until the Preserve is turned over to the City.

3.2.3 Lighting and Landscape District Funding

The long-term preserve management and maintenance funding will be provided for by a Community Facilities District (CFD) funding. The CFD funds will be collected by the City of Roseville. A subset of the overall annual CFD assessment will be used to fund the perpetual maintenance of the Preserve. An estimate of the per-year costs of implementing this Plan for both the Westpark and Fiddyment Ranch portions of the WRSP have been determined using the PAR software, and the printouts are included in Attachment E. This analysis was used as a basis for determining the amount of the annual CFD assessment required to adequately maintain the Preserve in perpetuity.

3.2.4 Contingency Funds

A part of the funding for the management of the Preserve is a contingency fund as shown in the PAR. This fund is in place for emergencies such as vandalism of fencing, signage, or other unanticipated needs.

4.0 PRESERVE PERSONNEL

The two roles outlined below make up the primary personnel that will oversee, monitor and coordinate the maintenance of the Preserve. They are intended to work together as a team to accomplish the management of the Preserve by exchanging information, problem solving and generally having a proactive relationship.

4.1 Preserve Manager

The Preserve will be managed by the City of Roseville (City) pursuant to the conservation easement/declaration of restrictions (Attachment C) and this Plan. The City Environmental Coordinator will act as Preserve Manager. Funding for the perpetual management and care of the Preserve will be provided for by an endowment fund and a Community Facilities District annual assessment as described under Section 3.0.

4.1.1 Preserve Manager Responsibilities

The Preserve Manager's responsibilities and duties shall include but not be limited to:

- Reviewing construction activities in and adjacent to the Preserve.
- Monitoring and seeking correction for impacts to the Preserve from adjacent land uses.
- Coordinating General Inspections of the Preserve as required by this Plan.
- Assuring that gates, fencing and signage at the Preserve are maintained.
- Coordinating trash removal from the Preserves.
- Coordinating thatch or non-native (exotic) plant management.
- Coordinating grazing of the Preserve parcels as discussed in this Plan.
- Coordinating Biological Inspections of the Preserve by a qualified biologist ("Monitoring Biologist").
- Reviewing monitoring data and coordinate with the Monitoring Biologist, the Corps, and the Service for any remedial action.
- Submitting an Annual Report in coordination with the Monitoring Biologist regarding the status of the Preserve to the Corps and the Service.
- Maintain a File for the Preserves. This File will contain a record of management and maintenance related activities, correspondence and determinations regarding the Preserve.
- Arrange for any corrective action necessary to ensure the performance of the habitat within the Preserve.
- Coordinate use of the Preserve for education, restoration efforts, or other tasks such as grant proposals.
- Work with the Monitoring Biologist and agency staff.

4.2 Use of Qualified Personnel/Monitoring Biologist

If the Preserve Manager does not have the appropriately trained staff to carry out any of the specialized tasks required by this Plan, the City shall retain professional biologists, botanists or other types of specialists (the Qualified Personnel, including the Monitoring Biologist) to conduct specialized tasks. The Monitoring Biologist shall be familiar with California flora and fauna, and, in particular, shall have knowledge regarding vernal pool species and their ecology.

4.2.1 Qualified Personnel/Monitoring Biologist Potential Responsibilities

Overall, duties of the Qualified Personnel may include but are not limited to:

- Wetland function and erosion monitoring tasks.
- Evaluating the accumulation of dead vegetative matter (thatch) and recommending removal, if needed.
- Evaluating grazing practices and recommending changes, if needed.
- Evaluate the presence of newly introduced non-native (exotic) plant species and recommend management, if needed. (This will be limited to new populations or new species. It is understood that there is an existing suite of non-native invasive plant species in the Preserve.)
- Conducting the Biological Inspection, collecting data on the Preserve and preparing reports required by this Plan.
- Evaluating site conditions and recommending remedial action to the Preserve Manager.
- Assist in reviewing or planning restoration activities, use of the Preserve for education, or other tasks such as grant proposals.
- Work with the Preserve Manager and agency staff.

4.3 Changes in Personnel

If the Preserve Manager or the Qualified Personnel are changed, the outgoing and incoming personnel will tour the Preserve together and the former will advise the latter of trends, problem areas, and any administrative difficulties.

5.0 LONG TERM PRESERVE INSPECTIONS AND REPORTING

5.1 Schedule

Detailed monitoring of each Preserve parcel begins when construction begins in the phase (see Figure 27 - *Phasing of Development*) where that the open space parcel is located. See Section 2.2 for inspections required prior to the start of construction. The schedule of inspections for the Preserve is as follows:

- The Monitoring Biologist shall conduct three Biological Inspections each year, one in the period from December to February, one in the period from April to June, and one in late summer or early fall.
- The Preserve Manager shall conduct (at minimum) two General Inspections each year.

Please see Attachment F for a monitoring timeline.

5.2 General Inspections

The Preserve Manager shall arrange for the General Inspections to be made to ensure the integrity of the Preserve. Inspections will concentrate on an evaluation of the following factors: erosion, fire hazard reduction, fencing integrity, condition of signage, trash accumulation, and evidence of unauthorized use by motor vehicles. The entire perimeter of the Preserve should be covered, as well as meandering transects through its interior. A Preserve Inspection Sheet (Attachment G) will be utilized in order to evaluate the above criteria during each field visit. Previous inspection sheets should be reviewed before each visit in order to determine that a possible or recurring problem area is not missed. If any problems are identified, more frequent inspections will be done in order to closely track any problems as well as to ensure that remedial actions are effective. Evaluation and corrective actions for each factor are described below:

5.2.1 Erosion and Sedimentation

If it is determined during the inspection that adjacent sheet-flow drainage is causing any erosion, sedimentation or other adverse effects upon the Preserve, immediate standard erosion control measures (such as the installation waddles) will be implemented. This is most crucial during initial construction activities. If any significant erosion/sedimentation problems occur, the Corps and the Service will also be notified and a qualified erosion control specialist will be consulted. See Section 10.0 for remediation actions for sedimentation.

5.2.2 Fire Hazard Reduction

If at any time conditions at the Preserve become a fire hazard, the Preserve Manager will work with Corps, the Service and the local fire authorities to decide on the best method to reduce the fire risk at the Preserve. Fire breaks are allowed within the 50-foot buffer. Fire breaks in other locations within the Preserve would require Corps and Service approval.

5.2.3 Fencing, Gates, Bollards and Signage

The condition of the fencing, gates, bollards and signage at the Preserve should be checked during the General Inspection. The City will be responsible for maintaining the fencing, gates, bollards and signage.

5.2.4 Trash Accumulation

The Preserve Manager will arrange for the removal of trash from the Preserve quarterly.

5.2.5 Unauthorized Motor Vehicle Use

The perimeter of the Preserve will be inspected for evidence of unauthorized motor vehicle use/access. If necessary, corrective actions such as repairing locks and gates will be taken.

5.3 Biological Inspections

In managing the Preserve, measures must be taken to help ensure that the existing conditions are maintained over the long term. Inspections by a qualified biologist will help ensure the long-term integrity of the wetland and upland habitats.

The Biological Inspections of the Preserve will be conducted by the Monitoring Biologist three times per year in order to monitor specific aspects of the Preserve habits as well as general wetland function, thatch accumulation, newly introduced exotic species, overall Preserve function and potentially the grazing regime in Parcels F-80 and W-81. The entire perimeter of the Preserve should be covered, as well as meandering transects through its interior. The goal of all these surveys is to help ensure that the various habitat types are maintained in perpetuity. The surveys are more particularly described below. The first inspection will focus on the hydrology of the vernal pools and the presence of listed vernal pool crustaceans. The second inspection is intended assess the various wetland habitats during the floristic season in particular, the vernal pool habitat; and the third will focus on upland and riparian habitats, problem areas, grazing regime, and assessing the success of restoration efforts or remediation activities. Although each of these surveys has a focus, all aspects of the Preserve will be reviewed, generally, during each visit.

5.3.1 Biological Inspection Tasks

In general, the following aspects of the Preserve should be monitored during all Biological Inspections.

5.3.1.1 Habitat Function

The purpose of assessing habitat function is to ensure that the created/preserved wetland and upland habitats are continuing have the appropriate hydrologic regime for that habitat type, monitor anthropogenic influences on the different habitats, and to informally document (make a species list as meandering transects are walked) the plant species that are present and animal species that are using the Preserve.

5.3.1.2 Thatch Accumulation

The Monitoring Biologist will make an annual determination as to the extent of thatch accumulation. If excess thatch is present, the monitoring biologist will work with the Preserve Manager to determine the best removal practice for the site. Several management practices can be used to address this issue including controlled burning, mowing, or grazing as described previously.

5.3.1.3 Newly Introduced Non-Native Plant Species

The Monitoring Biologist will assess the presence of any newly introduced non-native plant species and recommend corrective actions as needed. Special attention will be paid to exotic pest plants. The baseline map developed in the first few years will be used in this annual assessment.

5.3.1.4 Preserve Function

The overall Preserve function should be assessed, taking into account the above factors and the purpose of the Preserve, which is to support the flora and fauna of the wetlands and uplands in perpetuity.

5.3.2 Survey Descriptions and Methods

The following paragraphs describe the methods for the surveys to be conducted on an annual basis during the three Biological Inspections.

5.3.2.1 First Survey

The purpose of this survey is to review the hydrologic conditions of the site's vernal pools and monitor for changes in the watershed that may affect vernal pool hydrology. As stated in the Biological Opinion, the hydrologic integrity of vernal pool habitat is of primary importance to maintaining any current populations of the listed crustacean species. This survey should occur during December, January, or February. The preserved wetlands will be qualitatively assessed for hydrologic function and notes will be made regarding the hydrology of any pools that appear too wet or too dry for the typical hydrologic regime for that wetland type. During this field visit, using a fine mesh dip-net, a USFWS permitted biologist will sample a minimum of five percent (5%) (randomly selected annually from throughout the Preserve) of the preserved vernal pools for listed crustacea. The Monitoring Biologist will note any vernal pool branchiopods. A sample data sheet is included in Attachment G for this purpose. When appropriate, management recommendations to preserve vernal pool hydrology and wetland function of other wetlands will be made by the Monitoring Biologist to the City, specifically the Preserve Manager. A 90-day report of findings will be submitted to the

Service each year that sampling takes place. The Monitoring Biologist's federal permit requires this report. Additionally, all items listed under 5.3.1 will be assessed.

5.3.2.2 Second Survey

The second survey will occur between April and June. Vernal pool flora will be qualitatively assessed for five percent (5%) of the vernal pools (randomly selected annually) located throughout the Preserve. A sample data sheet for this survey has been included in Attachment G. The Monitoring Biologist will assess the vegetative cover and determine if each monitored vernal pool continues to be dominated by vernal pool plant species, recognizing that some of the vernal pools in the Preserve may not currently be dominated by vernal pool plant species. Plant species having greater than twenty-five percent (25%) vegetative cover will be considered dominant. Of these species, at least eighty percent (80%) will be classified as "vernal pool indicators" or "vernal pool associates" as described in *"Plant and Animal Taxa Known to be Associated with Vernal Pools"* (California Department of Fish and Game, 1996). If the 80% threshold is not met for any of the vernal pools, then notes regarding possible causes for changes in species distribution and recommendations regarding remedial action, if any, should be included in the annual letter report. It should be recognized that, pre-project, some pools likely do not meet this 80% goal. Additionally, all items listed under 5.3.1 will be assessed.

5.3.2.3 Third Survey

The third survey will occur late summer of fall and will focus on upland habitats, problem areas, and assessing the success of restoration efforts or remediation activities, and potentially the grazing regime for the coming grazing season. See Section 8.2.3.4 for a description of the monitoring required to assess the grazing regime. Additionally, all items listed under Section 5.3.1 will be assessed.

5.4 Agency Monitoring/Inspection

The Corps and the Service may inspect and monitor the condition of the Preserve at any time.

5.5 Annual Reporting Requirements

The Monitoring Biologist will prepare an Annual Report in conjunction with the Preserve Manager, which will be submitted to the Corps and the Service by August 15th of each year. The letter report will include at minimum, a map of the Preserve, photos documenting the status of the Preserve, a description of proposed activities and maintenance or management actions as required by this Plan, a description of actions for which Corps and Service notification or approval was not needed, but were carried out during the year, observations from the Biological Inspections, and recommendations for altered management practices as needed. The report will refer to the Corps regulatory branch number for the project, which is 200200666 and the Service file number which is 1-1-03-F-0013. The reports will be sent to the attention of Chief, Sacramento Valley Office, Regulatory Branch, at the Corps and Division Chief, Endangered Species Branch, Sacramento Field Office, at the Service.

6.0 AGENCY NOTIFICATION

The Corps and the Service have expressed a desire to be notified when certain management and maintenance activities are undertaken within the Preserve. It is also recognized that the Preserve Manager needs be able to carry out management and maintenance activities in a timely and responsive manner. (In this section "Agency" or "Agencies" means the Corps and the Service.) Therefore, the following notification requirements have been defined:

6.1 No Notification Required

If an activity in this Plan does not have a specific requirement for notification, is not a Prohibited Activity (see Section 7.0), review and approval or a permit is not required, then no notification is required. If an activity was not anticipated by this Plan, and therefore is not mentioned, notification is required.

6.2 Notification

For those activities noted in this Plan as requiring Agency notification, the following action will be taken. All efforts will be made to outline the activities for the coming year in the annual letter report, which is submitted by August 15th of each calendar year. If this is not possible, then the Preserve Manager will submit a separate letter to the Agencies. Either will include a written description of the activity, including when the activity will take place and what methodology will be used, as well as a map showing what areas will be targeted. The Agencies will have 30 days to contact the Preserve Manager to discuss the activity if they do not approve. If the Preserve Manager is not contacted within 30 days, then the activity will be considered approved. Notification will be made either by fax, email, registered mail, or overnight transmittal.

6.3 Review and Approval

For those activities noted in this Plan as requiring Agency review and approval, the following action will be taken. All efforts will be made to outline the activities for the coming year in the annual letter report, which is submitted by August 15th of each calendar year. If this is not possible, then the Preserve Manager will submit a separate letter to the Agencies. Either will include a written description of the activity, including when the activity will take place and what methodology will be used, as well as a map showing what areas will be targeted. The Agencies will have 60 days to review, discuss, and approve or disapprove the activity. For these activities, the approval from the Agencies must be written. Submittal of activities for review and approval as well as written approval back from the Agencies will be made either by fax, email, registered mail, or overnight transmittal.

6.4 Activities Requiring a Permit

Some of the activities mentioned in this plan may have the potential to "impact" wetlands or waters of the U.S. The term "loss of waters of the U.S.", which is the closest term defined in the Federal Register to "impact", is defined on page 2094 of the Federal Register, Volume 67, No. 10 / Tuesday, January 15, 2002 / Notices, as follows:

> Waters of the U.S. that include the filled area and other waters that are permanently adversely affected by flooding, excavation, or drainage because of the regulated activity. Permanent adverse effects include permanent above-grade, at-grade, or below-grade fills that change an aquatic area to dry land, increase the bottom elevation of a waterbody, or change the use of a waterbody. The acreage of loss of waters of the U.S. is the threshold measurement of the impact to the existing waters for determining whether a project may qualify for a NWP; it is not a net threshold calculated after considering compensatory mitigation that may be used to offset losses of aquatic functions and values. The loss of stream bed includes the linear feet of stream bed that is filled or excavated. Waters of the U.S. temporarily filled, flooded, excavated, or drained, but restored to preconstruction contours or elevations after construction, are not included in the acreage or linear foot measurements of loss of waters of the U.S. or loss of stream bed, for the purposes of determining compliance with the threshold limits of the NWPs.

The purpose of this section is to clarify, that while this Plan may call out future activities as allowed in the Preserve, this does not mean that the activity does not require a separate authorization (permit) under Section 404 of the Clean Water Act if it will impact waters/wetland not previously permitted. Also, if a project will not result in the permanent loss of wetlands or waters of the U.S., only temporary loss or "impact", a permit is still required. There are several Nationwide Permits (Nationwide Permits, are permits for activities resulting in the loss of less than 0.50 acre of wetlands or waters of the U.S.) currently (2003) available for maintenance activities. These are NWP 3, *Maintenance*; NWP 7, *Outfall Structures and Maintenance*; NWP 12, *Utility Line Activities*; and NWP 31, *Maintenance of Existing Flood Control Facilities*. Issuance of a permit by the Corps may require the Corps to consult with the Service. Specific maintenance activities may also qualify for the Clean Water Act Section 404(f) exemption for maintenance. If there is a question regarding whether a maintenance activity will require a Corps permit, the Preserve Manager should seek guidance from the Corps.

Some of these activities may also need a Streambed Alteration Agreement from the CDFG. Pursuant to Section 1600- of the California Fish and Game Code, the CDFG requires entities obtain a Streambed Alteration Agreement for activities affecting the bed, bank, or channel of a lake, river, stream, or drainage, as defined by CDFG.

6.5 Emergency Situations

Should an emergency situation arise that requires immediate action in an upland area, and would normally require that the Corps be notified or have review and approval authority, the Corps will be notified verbally within forty-eight (48) hours, with written confirmation of the actions taken within one (1) week. In these situations, "emergency" is a situation which would result in an unacceptable hazard to life, a significant loss of property, or an immediate, unforeseen, and significant economic hardship.

Should an emergency situation arise that requires immediate action in a wetland or waters of the U.S., but would normally require that a permit be obtained from the Corps, the following applies as stated in the Code of Federal Regulations, Title 33, Chapter II, Part 325, Section 325.2 - Processing of Applications:

> Emergency procedures - Division engineers are authorized to approve special processing procedures in emergency situations. An "emergency" is a situation which would result in an unacceptable hazard to life, a significant loss of property, or an immediate, unforeseen, and significant economic hardship if corrective action requiring a permit is not undertaken within a time period less than the normal time needed to process the application under standard procedures.

California Fish and Game Code Section 1600- also has emergency procedures stipulations that may apply.

6.6 Notification Regarding Listed Species

Within three (3) working days of finding any dead or injured individuals of any species listed under the Federal Endangered Species Act, or any unauthorized take of the species listed in the Biological Opinion, the Preserve Manager must notify the U.S. Fish and Wildlife Service, Division Chief of Endangered Species at (916) 414-6600, or applicable number at that time. All such notices shall include the date, time and location of the incident or of the findings of a dead or injured animal.

6.7 Changes in Notification Requirements

The City, the Service, and the Corps may agree to change the notification requirements for certain activities that do not require a permit. These would be cases where repeated notification or requests for approval have been made for a certain activity and a course of action has been established. To reduce staff time required from both the City and the Agencies, the City would follow the approved course of action and notification would not be required.

7.0 PROHIBITED ACTIVITIES WITHIN THE PRESERVE

This section outlines the restrictions on activities that can take place in the Preserve. **It is understood that the following activities are prohibited, except as needed to accomplish the above-mentioned management and maintenance activities or as described below. Additionally, if any of these prohibited activities must be undertaken due to special circumstances, they may be reviewed and approved by the Corps and/or the Service on a case-by-case basis.**

7.1 Access to the Preserve

The intent of the Preserve is to maintain the habitats of the preserved habitats in perpetuity. Limited access to the Preserve will further this goal. Regular, off-trail pedestrian access to the Preserve should be discouraged through fencing and signage. See Section 8.2.1 for a description of authorized access. All other off-trail access to the Preserve is not allowed.

7.2 Vegetation Removal

No killing, removal, or alteration of any existing native vegetation will be allowed in the Preserve except as described in this Plan.

7.3 Burning and Dumping

No burning or dumping of rubbish, garbage or any other wastes or fill materials will be allowed in the Preserve. The foregoing prohibition shall not be interpreted to prohibit controlled burning as a method of thatch management.

7.4 Disking

No disking can occur in the Preserve except within the Community Garden (see Section 11.4).

7.5 Additional Roads, Trails, and Utility Lines

Roads, trails, and utility lines not called out in this Plan will not be allowed in the Preserve without review and approval of the Corps and the Service.

7.6 Equipment or Fuel Storage

There will be no equipment or fuel storage within the Preserve except within the Community Garden and then, only for the purpose of garden equipment.

7.7 Topography

Once adjacent development is complete and authorized structures (e.g., detention berms, outfalls, bike trails) have been constructed, no alteration may be made to the existing topography of the Preserve. This includes leveling or grading. If success monitoring indicates that a constructed wetland feature is not functioning correctly and regarding is needed to achieve proper wetland function, then that is allowed. Tilling the soil in the Community Garden (may include leveling or grading) is allowed. No exploration, development, or extraction of oil, gas or minerals may be made from the Preserve.

7.8 Pesticides and Chemical Agents

Except as needed for management of the Preserve's habitat, the 18" shoulder of the bike trail or within the Community Garden as outlined in this Plan (see Section 8.2.4.4) or as approved by the Corps and the Service, there shall be no use of any pesticides, fungicides, insecticides or any other chemical agents used to kill or suppress plants, animals, or fungi in the Preserve

7.9 Motor Vehicle Use

No motorized vehicles shall be ridden, brought, used, or permitted on any portion of the Preserve with the exception of the following. Motorized vehicular use will be restricted to that required for Preserve maintenance purposes such as stream maintenance (including flood control structures), non-native (exotic) plant species management, fencing repair or replacement, round-up or delivery of cattle for grazing or delivery of feed, for emergency or law enforcement situations requiring access by medical, fire or law enforcement vehicles, access as necessary for utility maintenance, and for access to and work within the Community Garden. This may include the use of tractors or other motorized garden/farm equipment.

7.10 Construction

Once adjacent development is complete and the structures and improvements called out in this Plan are in place (e.g. detention basin, water quality basins, outfalls, and in the future, the bike trail), no construction, placement of new structures, or new roads shall be allowed in the Preserve without the review and approval of the Corps and the Service.

7.11 Non-native Plants

No non-native plants will be planted in the Preserve except as allowed in the Community Garden (see Section 11.4).

8.0 LONG TERM MANAGEMENT OF THE PRESERVE

8.1 Adaptive Management

In preparing a management plan for habitat to be preserved in perpetuity, it must be acknowledged that there will undoubtedly be future developments in habitat and species management that may affect how the Plan Goal is met. This management plan can only provide guidance for adopting new technologies or practices as they are developed. Ultimately, the Preserve Manager in coordination with the Monitoring Biologist, the Corps, and the Service, must determine the appropriate management decision for a given situation. The following management strategies, approved uses, and restrictions are intended to provide a framework for the long-term management and operation of the Preserve. Before considering any management action, the Preserve Personnel must consider the Plan Goal, which is to ensure that the protected wetland and upland habitats within the Preserve are maintained in good condition such that it will continue to support the flora and fauna of the uplands and wetlands, in perpetuity. Furthermore, this Plan cannot anticipate all possible site conditions. Therefore, if a condition arises which is not specifically addressed by this plan, the Preserve Manager may upon review and approval by the Corps and the Service, adopt techniques not described here.

8.2 Preserve Management Activities and Guidelines

The following outlines management and maintenance activities that are allowed within the Preserve.

8.2.1 Authorized Access

The intent of the Preserve is to maintain the habitats of these areas in perpetuity. Limited access to the Preserve will further this goal. Public access to the Preserve should be through bike trails and interpretive trails (within Kaseberg corridor – See Figure 23 - *Fiddyment Park Amenities*) and is encouraged. The public can learn to respect and enjoy the protected habitats if they are provided appropriate access. Off-trail pedestrian access to any of the Preserve parcels will be discouraged through fencing and signage. The exception is the Community Garden, where full access to the Preserve within the defined Community Garden area is allowed. Access to the Preserve for maintenance activities (such as utility maintenance) is allowed, but should be restricted to the immediate area where maintenance is occurring. Access to the Preserve by the grazing contractor is allowed. Access to the Preserve in emergency or law enforcement situations, by medical, fire or law enforcement personnel or vehicles is allowed. Approved access to the Preserve for educational, clean-up, or habitat restoration activities is allowed (See Section 11.0).

8.2.2 Thatch Management

Historically, grassland, and oak savannah/woodland habitats burned periodically due to the occasional wildfire. These fires would burn dead plant material or thatch, keeping it from building up. Native ungulates, and later cattle, have inhabited the grasslands within the Preserve. The grazing and trampling action of these animals also would have reduced the amount of dead plant material. In urban preserves, thatch has an opportunity to build up because of the lack of fires and grazing. This buildup of thatch can be detrimental to the Preserve habitats, especially vernal pools and seasonal wetlands (Barry 1996). During the one of the biological surveys (as discussed below in the section titled Inspections), the Monitoring Biologist will make a determination as to the extent of thatch accumulation and if it is adversely impacting the Preserve habitats. Three methods for managing thatch are outlined below:

8.2.2.1 Controlled Burns

Controlled burning is an excellent way to eliminate accumulated plant matter and also serves to reduce cover of non-native annual grasses (Pollak and Kan 1996). While prescribed burning is an effective tool in the long-term management of thatch accumulation, this Preserve will have residential buildings in close proximity, making controlled burns a potential public safety hazard. A controlled burn would require a burn permit and Fire Department staff. In this case, prevailing winds would carry smoke toward development (Terri Shirhall, pers. comm.). Therefore, controlled burns may not be the preferred method of thatch management. However, controlled burns are not prohibited by this Plan. When carefully planned with the local fire authorities, some controlled burns have been successfully conducted in urban areas. If a controlled burn is planned for the Preserve, the Corps and the Service will be notified.

8.2.2.2 Mowing

Another method to remove thatch is the mechanical mowing. In order for mowing to be effective for thatch removal, the cut material would need to be removed from the site. In addition, the mowing regime should be timed in order to minimize the invasion of non-native weedy upland species, particularly yellow star-thistle. To date, little research has been conducted on mowing for thatch management. However, mowing would be expected to be effective for thatch management and is probably a realistic management practice for the smaller portions of this preserve such as Parcels F-86 through F-88 and W-82. It is anticipated that such mowing practices would be needed, at the most, once every five years. Mowing equipment is allowed in the Preserve for thatch management. Mowing does not require agency notification.

8.2.2.3 Grazing

Grazing can be used to reduce thatch build-up in both wetland and upland areas. Grazing with cattle requires a large continuous preserve that can realistically support a grazing herd for an amount of time that would make it economically feasible. The two vernal pool preserves F-80 and W-81 are large enough to support winter grazing with cattle. The area to be grazed in F-80 is approximately 122 acres and the area to be grazed in W-81 is 188 acres. Goats and sheep have been recently employed in smaller areas to effectively remove unwanted vegetation. These smaller grazers would be surrounded by an electric fence and moved periodically. Currently the only proposed grazing for the Preserve is cattle grazing. In the future, if other grazing will occur, the Corps and the Service will be notified. Figures 28-29 - *Grazing Components, Parcels F-*

80 and W-81 shows the areas proposed for grazing and location of fencing installed for grazing. Residents living adjacent to the open space will be/have been notified of cattle grazing via deed disclosures. A 50-foot setback has been established between development and agricultural (grazing) land use. See Section 8.2.3 below, for a further discussion of grazing to be used for habitat management.

8.2.3 Grazing for Grassland Habitat Management

The goals of grazing within the Preserve will be to maintain species diversity and desired species composition by reducing the accumulation of thatch within the wetland and upland areas and to manage the site for Swainson's hawk foraging habitat. The availability of grazing land and potential income through grazing leases is a side benefit.

Portions of the Preserve to be grazed would be leased annually, and adjustments would be made each year to manage the site for the target residual dry matter (RDM - the amount of plant material remaining after a season of grazing) and grass height. Preliminary research presented by Barry (1996) indicates that the removal of livestock from vernal pool landscapes results in the both the invasion of exotic annual species and the reduction in species diversity within and around vernal pools. Since current (2003) or recent past land management practices in the WRSP area included grazing and areas proposed for grazing are in excess of 100 acres each (large enough to support a small grazing herd), grazing is the logical first choice for grassland management.

The following discusses the primary grazing management practices to be implemented within the Preserve, assuming the City elects to graze the identified areas. It should be noted that these practices may be adjusted as new facts are learned about optimal grazing practices within a vernal pool landscape.

8.2.3.1 Grassland Management for Swainson's Hawk

Management of both the two larger parcels of the Preserve will include grazing for the purpose of managing the habitat for Swainson's hawk foraging. After excluding the 50 foot buffer between development and the grazing areas, ±300 to ±360 acres of the two parcels will be available for grazing.

The recent management/agricultural practice at both of these parcels has been grazing. Management for Swainson's hawk within a grassland situation means some reduction of annual grassland cover during the spring/summer nesting season. This reduction in cover allows prey items to be more visible to raptors (Babcock pers. comm.). No studies have been done on the ideal grazing regime for Swainson's hawk foraging habitat management, but keeping the grass between six inches to a foot in height is what Swainson's hawk experts feel would be appropriate (Estep pers. comm., Babcock pers. comm.). Monitoring and active management will have to be used to find the appropriate stocking rate to achieve the desired grass height.

The regime will be timed so that the cattle are removed or reduced in number in the Spring when the vernal pools are drying down (see Section 8.2.3.3). Cattle tend to focus on the vernal pools when the grassland begins to dry out because they hold the remaining water and have green growth. After the grassland is dry the cattle can be brought back to their original numbers or left on at a reduced stocking rate with supplemental feed and water as needed to keep the grass at an appropriate height for Swainson's hawk foraging. Depending on the year's rainfall, summer grazing may not be required to keep the grass at the desired height.

8.2.3.2 Baseline Data

An initial analysis of existing conditions must first be undertaken to create baseline data. This involves determining the current level of grazing use and then measuring the resulting levels of residual dry matter at the end of the grazing season. The property owner will be contacted to determine what the current grazing regime is, when the cattle have been put on and taken off the land, and if supplemental food, salt, water, etc. have been given in the past.

Once the cattle have been removed, a single survey occurring between June 1 and September 15, using a combination of dry clipping and visual estimates, will be conducted by the Monitoring Biologist or Qualified Personnel (see Attachment H) in order to determine the baseline RDM level (Sugnet and Associates 1997). Data will be taken from sample areas located throughout the Preserve. During this baseline study, photo guides will also be compiled to assist in the subsequent monitoring of RDM. Photo guides represent the thatch cover by utilizing a simple technique. Different sized balls (golf balls, tennis balls, softballs, etc.) are placed in the grass, a photo is taken. Which of the smallest balls is visible establishes the baseline for the photo guides.

A photo guide will be taken with each RDM sample. Ten (10) RDM samples will be collected to establish the baseline (See Attachment G for sample field data sheet). Each will be random representative samples throughout the grazing areas. The baseline sample sites will be mapped to indicate where samples are taken.

Once the baseline data is collected, the results of this study will be used to determine target levels of residual dry matter. Previous research has indicated that in order to maintain low thatch density, vernal pool landscapes should be managed for approximately 600-800 pounds/acre but the final target level shall be determined for this specific site through analysis of the monitoring data (Sugnet and Associates 1997). The final target level will be established in consultation with the agencies. The goal is to ensure that the grassland is being managed appropriately for both the Swainson's hawk foraging and for the vernal pool habitats.

8.2.3.3 Management Guidelines

Since cattle have historically been the grazers on this site, this grazing plan recommends that cattle continue to be used to graze the site. Both the number of cattle and the class of cattle (i.e. mature bulls, cow/calf pairs, yearlings etc.) can be adjusted in order to maintain the target RDM. It is also possible that other classes of grazers including horses, sheep and goats, could be utilized on the site. If a different class of grazer were to be used, an evaluation of the effect of that particular species would be made to account for the difference in grazing behavior between species.

Grazing within the Preserve will begin after November 1 and will not extend beyond May 1 of the following year, until after the pools have completely dried and browned. This timing is based on best management practices recommended by the U.C. Cooperative Extension Farmers Advisory. The Preserve Manager and Monitoring Biologist/Qualified Personnel in conjunction with the grazing contractor may use discretion in determining when the appropriate time for removal of the herd is desirable. In general, removal timing should coincide with the upland grasses turning brown and the reduction in the water available to the herd, since this is when the animals are most likely to directly effect the vernal pools (Sugnet and Associates 1997). The appropriate removal time will vary annually according to site specific rainfall and weather conditions. The animals can be returned to the pasture later in the summer to graze on the remaining dry matter (if needed to maintain the grass height for Swainson's hawk foraging), since they will not be likely to concentrate in the pools once they dry out.

The grazing contractor will be responsible for ensuring that the two portions of the Preserve receive appropriate levels of grazing pressure. Gates will be provided in order to allow the grazing contractor to easily transfer the herd from one area of the Preserve to the other (see Figures 8 and 18). Maintenance of the fencing and gates to control grazing may be the responsibility of the grazing contractor under the terms of the grazing contract. This responsibility will be written into the grazing contract. The Preserve Manager will inform the grazing contractor of any maintenance not being carried out.

The only water will be available to the herd without supplementing would be in the vernal pools and intermittent drainages. A water spigot will be available in each of the grazing areas, see Figures 8 and 18 for the locations. It will also the grazing contractor's decision as to whether or not additional food and/or water supplements are needed for that year. The location of those food and/or water supplements, if deemed necessary, will be away from the most dense vernal pool aggregations as the cattle tend to congregate around these feeding stations. To prevent damage due to intensive grazing, the stations will be moved periodically. The placement of these stations shall be away from high quality pools and conveniently located for the grazing contractor to access so as to minimize extensive driving through the Preserve.

8.2.3.4 Monitoring

In order to ensure that the management goals of grazing are being met, the Preserve will be monitored annually, following each grazing season (usually in September). This will be done during the third biological inspection (see Section 9.3.2.3). This monitoring will serve to evaluate the effectiveness of grazing to maintain the target RDM, as well as, to identify any areas that have been overused or damaged. Using the methods described in Attachment H and the reference photos established for the site, the annual RDM will be estimated by the Monitoring Biologist or Qualified Personnel. This monitoring will take place for several years, until a stocking rate that achieves the goals of managing the grassland is established. Every few years after an appropriate stocking rate is established, the monitoring should be conducted to ensure that the grass height and RDM falls within the guidelines. Like the baseline RDM, data will be taken from sample areas located throughout the preserve. Ten (10) RDM samples will be collected during each monitoring year. Four (4) will be collected at one of six (6) set locations in the Preserve and six (6) will be collected randomly throughout the Preserve at representative sites. At each of these sites the grass height will also be measured. The sample sites will be mapped to indicate where samples are taken each year in order to prevent specific areas being omitted.

The annual RDM and grass height number will be compared to the target RDM and grass height and, if appropriate, management recommendations will be included in the Annual Report and will be submitted to the grazing contractor. These recommendations may include making adjustments to one or more factors including the number or class of cattle grazed, the distribution of the herd, the timing of grazing, or the location of food/water supplements in order to optimize the RDM value and result in an appropriate grass height. In addition, if specific areas within the Preserve appear to be overused or subject to erosion, temporary fencing will be placed around those damaged areas. This fencing will remain in place long enough for that area to recover. Relocation of supplemental food/water stations may also serve to relieve damaged areas from intensive cattle impacts. Additionally, abundance of exotic pest plant species (e.g., star thistle and medusa head grass) will be used as indicators of grazing pressure (either too high or too low).

Finally, an essential component of the success of this grazing management plan to meet its goal of reducing thatch build-up and management for Swainson's hawk foraging, without significant damage to the wetland resources, is regular communication between the Preserve Manager, the Monitoring Biologist or Qualified Personnel, and the grazing contractor regarding decisions about adjusting the above mentioned grazing variables. Coordination of grazing practices with the other long-term Preserve management methods will enhance the overall long-term viability the Preserve. Additionally, the grazing contractor will be oriented from the start as to the sensitivity of the of the habitat on the preserve and of the goal of this Plan to preserve the vernal pools and federally-listed species on site and general vernal pool communities.

8.2.4 Non-native Plant Species Management

Management of non-native plant species can be a complex and expensive task. It is important to recognize that the City can only conduct as much non-native (exotic) species management as can be accomplished with the funding provided as part of this Plan or by obtaining other funds such as grant funds (not required by this Plan).

Exotic pest plants (defined below) that are currently known from the Pleasant Grove Creek and Kaseberg Creek watersheds include Himalayan blackberry (*Rubus discolor*), purple loosestrife (*Lythrum salicaria*), tamarisk (*Tamarix* sp.), water hyacinth (*Eichornia crassipes*), and yellow star-thistle (*Centaurea solstitialis*).

8.2.4.1 Native And Non-Native (Exotic) Plant Species Definitions

Native and non-native plant species are mentioned in several sections of this Plan. The following definitions of these terms have been included to assist the Preserve Manager in determining the status of plant species found in the Preserve.

Native Plants

For the purposes of this Plan, plants native to the Preserve will be defined as those plants believed by the scientific community to have been present in western Placer County prior to the settlement of Europeans. The Jepson Manual can be a reference for determining if a plant is native or non-native. However, this reference only gets as specific as subregions. As a result, this reference is not necessarily specific enough, and therefore the Preserve Manager can consult with the Monitoring Biologist, local botanists, or the local chapter of the California Native Plant Society to determine if a plant should be considered native to the Preserve.

Non-Native (Exotic) Plants

Based on the above definition of plants considered to be native to the Preserve, there are several ways to view what a non-native plant is: there are plants that are not locally native (native to Placer County), plants that are not regionally native (native to Northern California), and plants that are not native to California or the U.S.

Exotic Pest Plants

Exotic pest plants are plants that are not native, and can be invasive, replacing native vegetation or native habitats. The Monitoring Biologist and the Preserve Manager can refer to the species found on the California Exotic Pest Control Council (CalEPPC) List A, List B, and Red Alert List to assist them in determining if a plant is an exotic plant species of concern. The current lists have been included as Attachment I, however this list may be updated from time to time by CalEPPC. The new list will be appended to this Plan as it is updated. The list can be found at http://www.caleppc.org/.

Under current baseline conditions (prior to project implementation), the site is known to support a number of exotic species, many of which have become naturalized. They are predominantly annual species that occur in grasslands, however tree of heaven has also been noted along Pleasant Grove Creek. During the first two or three years of surveys, a general map of exotic pest plants on the Cal EPPC "A-1" and "A-2" list will be mapped either through the use of aerial photographs or GPS technology. When finalized, the map can be added to this Plan. The map should be updated every 5 years or as needed. In these years and for the initial mapping, funding for mapping will be from the CFD funds set aside for non-native species management. This map can be used in subsequent years as a baseline of existing conditions. It is unreasonable to require or expect eradication of established exotic species as identified in baseline surveys at the site. The required management of non-native plants will therefore be limited to the management of newly introduced exotic pest plants and working to contain the spread of existing exotic pest plant populations that are a threat to the Conservation Values as limited by available funding outlined in Section 10.2.

Beyond management activities, if the Preserve Manager would like to pursue more extensive removal of non-native species through volunteer efforts or grant funding, that is encouraged. The Monitoring Biologist and the Preserve Manager can refer to the species found on the California Exotic Pest Control Council (CalEPPC) List A, List B, and Red Alert List to assist them in determining if a plant is an exotic plant species of concern, and which species should be given priority for management. The current lists have been included as Attachment I, however this list may be updated from time to time by CalEPPC. The new list will be appended to this Plan as it is updated.

In addition to looking for these species during the General Inspections, the Monitoring Biologist will also assess the presence of any newly introduced exotic pest plant species during the Biological Inspections and recommend removal as needed. Three methods of removing or controlling these species are outlined below:

8.2.4.2 Hand/Mechanical Removal

Hand removal or use of small hand powered or handheld equipment (such as a Weed Wrench or a chainsaw) should always be the preferred method of removing exotic pest plant species from the Preserve, if practical. If hand removal methods are tried and found to be ineffective, or the problem is too widespread for hand removal to be practical, then mechanical methods (use of larger equipment with motors such as mowers) or biological controls as described below can be implemented.

8.2.4.3 Biological Controls

Biological controls are natural parasites, predators or pathogens that are released to combat non-native species. For example, there are several natural enemies of yellow star thistle that have been introduced from Europe to act as biological controls against this invasive species. The insects begin life within the seed head of the flower and develop there, feeding on the seeds. County Agricultural Commissioner would be the point of contact for use of these biological controls within the Preserve. They currently (2003) do not have a program for providing the hairy weevil for biological control, however, they must be contacted if it biological controls obtained from other sources are proposed for use.

Biological controls should be used with caution and only after contact with the Agricultural Commissioners Office. If biological control methods are tried and found to be ineffective or if biological control methods are not available for the target species, then herbicides can be used, but only as outlined below. The Corps and the Service will be notified if biological controls will be used in the Preserve.

8.2.4.4 Use of Herbicides for Non-Native/Exotic Pest Plant Management

Herbicides can be used only for the management of non-native invasive plant species. Hand or mechanical removal should be the first choice for all non-native invasive plant species removal. Herbicides can be potentially harmful, however invasive species can also be extremely detrimental to native habitats. The use of chemicals should be considered carefully and the most recent research regarding the appropriate herbicide for the target plant should be consulted. Chemicals must be applied according to the label. This approval does not obviate the need for the City to obtain any other applicable approvals for the use of these chemicals.

8.2.5 Tree Removal

If any of the native trees at the Preserve become diseased and are a threat to other trees or are a danger to public safety or private property, removal will be allowed. This statement does not imply permission to undertake the removal of any tree without obtaining any appropriate tree removal permits, if applicable. Non-native tree removal is allowed, consistent with Section 8.2.4. In addition, removal will be consistent with CDFG regulations if the tree is in a riparian area. Removal may require a nesting raptor survey consistent with applicable laws. If a tree has died, is not a threat to other trees, a danger to public safety, or to private property, removal is not required. Dead trees are often important habitat elements for wildlife and should remain in the Preserve.

8.2.6 Vegetation Debris Removal within Perennial and Intermittent Drainages

Vegetation removal for the maintenance of the intermittent and perennial drainages in the Preserve will be done according to the City's 1601/Memorandum of Understanding (MOU) with the California Department of Fish and Game. It should be noted that this type of work only be done if truly needed, to minimize disturbance to the drainages. Disturbance or removal of soil or sediment from the drainages will most likely require a Permit from the Corps. As such, written authorization or a permit will be required prior to undertaking such activities. The Preserve Manager should contact the Corps to determine what type of authorization for the maintenance work is required.

8.2.7 Beaver Management

The City will be responsible for assessing the beaver population within the Preserve. Reduction of predator populations due to development in the region has apparently lead to an increase in beavers throughout the area. If beaver dams become established, the Preserve Manager should consult with the Monitoring Biologist to determine if it is best to: leave the beavers alone as they are a natural part of the ecosystem, install beaver baffling devices and allow the beavers to remain, breach the beaver dam, or if removal of the beavers is appropriate. The use of beaver baffling devices is allowed. Situations where beaver management may be prudent are when beaver dams are causing water levels to rise such that they inundate vernal pools or oak woodland. It is likely that high water situations occurred prior to development from time to time, so care should be taken to weigh the effects of the beaver's presence. Beaver dams can also result in positive impacts to streamside habitat. Work should be done by hand, but if the dam is too large, equipment such as backhoe with rubber tracks/tires can be used. If the Preserve Manager determines removal is appropriate, the Preserve Manager will work with the local California Department of Fish and Game to trap and relocate or hunt the beaver population.

8.2.8 Mosquitoes

If mosquito control within the Preserve is necessary, the local Mosquito Vector Control District will be consulted to select control mechanisms that are the least damaging to the Preserve's habitats. A plan outlining those mechanisms will be submitted to the Corps and the Service for review and approval.

8.2.9 Altered Hydrology

In order to the maintain hydrology of the Preserve, the Preserve Manager will take steps to work with individual landowners or adjacent developments adjoining the Preserve from directing the flow of drainage, landscaping, and storm water runoff from their property into the Preserve from outside the WRSP area. This does not preclude the use of drip irrigation in the Preserve for the establishment period for native plantings if used in future restoration/enhancement. During planning meetings for the WRSP area, considerable discussion regarding avoiding altered vernal pool hydrology within the Preserved has taken place between the developer, the agencies, and the City. Drainage for WRSP will be specifically designed to avoid inappropriate discharge into the vernal pool preserve areas. This consideration is especially important in vernal pool landscapes. Biologists in the vernal pool field have observed that altered hydrology, specifically too much water in vernal pools during the summer months when the vernal pool landscape is normally completely dry, can significantly and adversely influence their function. This is especially true in smaller, urban preserves (Clark and others 1998). To do this, a series of typical outfall designs and situations where they would be used has been developed (see Section 9.6).

8.2.10 Homeowner Liaison

The Preserve Manager will be responsible for informing residents whose property adjoins the Preserve if they are in violation of any of the stipulations of the Preserve's conservation easement/declaration of restrictions and to require remediation if needed (see Section 10.0).

8.2.11 Trash Removal

At minimum, the Preserve Manager will remove accumulations of trash and other unwanted debris from the Preserve quarterly.

9.0 INSTALLATION AND LONG TERM MAINTENANCE OF STRUCTURES AND IMPROVEMENTS

The following paragraphs outline the allowed maintenance of structures and improvements present within the Preserve. Vegetation removal type maintenance (e.g., mowing vegetation along underground sewer line alignments) associated with these structures is not allowed unless explicitly stated below. **If maintenance or replacement activities associated with these structures will directly impact or indirectly impact (where indirect impacts have not already been mitigated) preserved wetlands or waters of the U.S., the Corps will be notified and any appropriate permits will be obtained (see Section 4.4).** If wetlands or waters of the U.S. will not be impacted by maintenance or replacement of any of these structures or improvements, then the Preserve Manager will review the plans for the activity to be sure that as little disturbance to the Preserve occurs as possible, but the Corps and the Service will not have to be notified. These activities will be described in the Annual Report. In addition, areas disturbed will be restored (see Section 10.0).

9.1 Protective Measures to be Taken During Construction Within the Preserve

After the WRSP has been built out, occasional construction may take place in the Preserve (e.g., replace or repair sewerline). Past experience has shown that biological resources in urban preserves are vulnerable to disturbance during construction. In general, the minimum necessary construction area will be used (if within the Preserve). Construction limits will be set that do not encroach on any preserved wetlands. To avoid impacts to the Preserve and the protected resources, the following protective measures will be taken during project construction.

9.1.1 Pre-Construction Meetings

Pre-construction meetings for construction occurring adjacent to or in the Preserve will address the presence of Preserve, the sensitive habitats present and minimization of disturbance to the Preserve. The City inspectors can also conduct a post-construction inspection to determine if those conducting the construction need to do any post-construction remediation.

9.1.2 Temporary Construction Fencing

After the WRSP has been built out, occasional construction may take place in the Preserve (e.g., replace or repair sewerline). When this occurs, temporary construction fencing and flagging will be required to define the limits of construction within the Preserve. This fencing will be maintained daily until construction is complete and the fencing is removed.

9.1.3 Flagging Preserved Wetlands Adjacent to Construction Within the Preserve

If construction is occurring within the Preserve, prior to installation of temporary construction fencing denoting the limits of construction, the City will hire a professional wetland biologist (or the Monitoring Biologist) to flag the preserved wetland(s) within 25 feet of the limits of construction with three foot high, brightly colored pin-flags so that workers are aware of the location of the protected habitat and can install the temporary construction fencing accordingly.

9.1.4 Stormwater Pollution Prevention

Stormwater best management practices (BMPs) prevent runoff into the Preserve and are required by the State Water Resources Control board for any project over one acre in size. A Stormwater Pollution Prevention Plan (SWPPP) will be prepared and implemented to control sediment and erosion during construction. This includes preventing runoff from dust control, oil, or other chemicals used in construction activities, from entering the Preserve.

9.1.5 Use of Native Grasses in Post Construction Revegetation

When construction work disturbs soil within the Preserve, all seed used to revegetate must be native to California, preferably ecotypes from the Placer or surrounding counties. Attachment D provides guidelines for seed mixes for different revegetation situations, but the project engineer will ultimately need to approve the seed mix to ensure that the seed mix will result in revegetation that meets required performance standards. Attachment D also provides contact information for local native grass seed companies.

9.1.6 Trash Removal and Post Construction Clean-Up

During construction, paper trash, food wrappers, and other trash often blows into preserve areas from adjacent construction sites. The City or the City's contractor will remove trash blown into the Preserve from adjacent construction on a daily basis. After construction is complete and the temporary construction fencing has been replaced by permanent fencing, temporary fencing and posts will be removed from the Preserve. Additionally, when disturbed areas adjacent to the or within the Preserve (e.g. bike trail construction) have become revegetated and construction is complete, all temporary erosion control materials (e.g. straw bales, straw waddles and stakes, silt fencing) will be removed from the Preserve.

9.2 Buffers

For the purpose of identifying areas of indirect impact to listed vernal pool branchiopod habitat within the WRSP area, and allowing active management and structures within the Preserve, these two buffers are defined.

9.2.1 50-Foot Buffer

The WRSP Preserve has a 50-foot buffer area adjacent to the various land uses within the project. This buffer is depicted on the Preserve detail maps (Figures 7-22). Mitigation for indirect impacts to listed vernal pool branchiopod habitat resulting from the allowed uses/structures within the 50-foot buffer were mitigated as part of the overall mitigation required by the federal agencies for the Westpark/Fiddyment Ranch project. Therefore, the implementation of the listed activities, in perpetuity, will not require further mitigation unless direct impacts are anticipated. This 50-foot buffer is in addition to the 250-buffer present to the Preserve side of the 50-foot buffer. Indirect impacts to listed vernal pool branchiopod habitat within the 250-foot buffer were mitigated for as well. If a use is outlined in this Plan as allowed, or the structure location is depicted in this Plan, then no notification to the agencies is required to carry it out. The placement of benches, trash cans, and preserve or interpretive signs does not require agency notification even though the locations of these items is not currently (2003) known. If the structure is allowed (such as an outfall) within the 50-foot buffer, but the exact location is not depicted in the Plan, then only agency notification is required for installation (see Section 6.2) unless a new impact is anticipated. If a use or placement of a structure would result in a direct impact or fill of waters of the U.S. (including wetlands) not anticipated as part of the federal permits for the Westpark/Fiddyment Ranch project, then a permit for that impact will be required (see Section 6.4). The following specific uses and structures are allowed within the 50-foot buffer:

- Outfalls and Constructed Drainage Swales
- Water Quality BMPs (including water quality basins)
- Bike trails/Interpretive trails
- Pedestrian Walkways and Associated Landscaping
- Utility Lines / Utility Line Crossings
- Benches
- Trash cans
- Preserve Signs and Interpretive Signs
- Mowing (includes fire breaks)
- Maintenance of the above items

9.2.2 250-Foot Buffer

As mentioned above, the 250-foot buffer is located to the Preserve side (inside) of the 50-foot buffer. This buffer is depicted on the Preserve detail maps (Figures 7 - 22). The only defined allowed structure/use in the 250-foot buffer are drainage swales that will take flows from outfalls in the 50-foot buffer to drainages, keeping low or "nuisance" flows away from preserved vernal pools. It will be treated the same as the remainder of the Preserve. The primary purpose of defining this buffer was for the calculation of indirect impacts to listed vernal pool branchiopods resulting from the development of the WRSP.

9.3 Fencing, Signage, and Bollards

9.3.1 Fencing

9.3.1.1 Temporary Construction Fencing

See Sections 2.1.2 – 2.1.3 and 9.1.2 and 9.1.3 for information on temporary fencing required during construction.

9.3.1.2 Initial Installation of Fencing and Fencing Types

The initial installation of fencing is the responsibility of the developer. Existing cattle fencing (barbed wire) will be assessed for integrity and will be repaired as needed for it to be functional for grazing (5 strand barbed wire). The type of fencing will vary according to the adjacent parcel land use (roadway, residential, business, etc.), however, in all cases, fencing has been designed to prevent vehicle access and allow unrestricted visual access into the Preserve. Fencing types include barbed wire, post and cable, concrete rail fence, and wrought iron (tubular steel) with knee wall. Fencing will be installed adjacent to the Preserve as shown in the Preserve Detail Maps (Figures 7-22). A detail for each type of fencing to be installed adjacent to the Preserve is included as Attachment J. Fencing will be installed and maintained according to these specifications. If a land use change adjacent to the Preserve dictates a change in the type of fencing between those listed above, that is allowed.

9.3.1.3 Maintenance and Repair

Maintenance and replacement of fencing and signage must be restricted to the minimum area needed to fix the fencing. Whenever possible, maintenance and replacement of fencing should take place from outside the Preserve. The different fencing treatments, who is responsible for maintenance of each, and funding sources for the fencing are addressed below:

Cattle Fencing

For Parcels W-81 and F-80 where cattle grazing can occur, additional cattle fencing (barbed wire) will be installed at the edge of the 50-foot buffer. This fencing will be 5 strand barbed wire with metal posts. Funding for maintenance of the cattle fencing is included in the CFD financing (see Section 3.0).

Roadway and Bike Trail Fencing

Along roadways and bike trails, fencing will be post and cable or concrete rail fencing. The City will be responsible for the maintenance and replacement of fencing along roadways and bike trails. The funding for this fencing is through the CFD.

School Fencing

In places where the Preserve shares a boundary with a school the fencing is post and cable. The school district is responsible for maintenance and replacement of the fencing.

Park Fencing

Park Fencing

In places where the Preserve shares a boundary with a park, the City Parks Department is responsible for maintenance and replacement of the fencing. Funding will be provided through the CFD.

Residential Fencing

The maintenance and replacement of fencing, where the Preserve is adjacent to private property within the WRSP, is the responsibility of the adjacent property owner(s). The City will be responsible for enforcing the fencing requirements.

Adjacent Open Space Fencing

If other projects are developed adjacent to any of the Preserve parcels, and the open space of that project is adjacent to the Preserve, the fencing between the two can be taken down if it is desired or practical. The removal of common fencing could allow for wildlife passage or joint management.

9.3.1.4 Covenants, Conditions and Restrictions Required

Each development within the WRSP will have Covenants, Conditions and Restrictions (CC&Rs) that require each landowner adjacent to a Preserve area to maintain their fencing in good repair. The CC&Rs will also have descriptions and diagrams of fencing types present along their Preserve parcel, and specifications for such fencing.

9.3.2 Preserve and Interpretive Signs

Preserve signage will be installed to inform the public of the presence of the Preserve. Sample sign language has been included as Attachment K. A minimum number of sign locations are shown on Figures 7-22. If the City feels that additional signage is warranted then more may be installed. In addition to the smaller signs posted along Preserve boundaries, interpretive signs along the Pleasant Grove Creek corridor are required by the EIR (Mitigation Measure MM 4.7-13). The content of those signs will educate the public about riparian and oak woodland habitats, their conservation, common species observed, and would encourage respect for the Preserve. The signs will be placed at approximately 500-foot intervals along the corridor. Exact locations should be determined in the field after construction to ensure the best view of the Preserve's habitats in conjunction with each sign. The developer is responsible for the initial cost of installing Preserve and interpretive signage. The City will be responsible for the maintenance and replacement of the signage. Funding is provided through the CFD.

9.3.3 Bollards and Gates

The City will be responsible for the maintenance of authorized gates into the Preserve and for keeping them locked to prevent unauthorized motor vehicle access. Authorized gates are used for allowing access for grazing, maintenance vehicles, and emergency access to the Preserve. Gates for the grazing contractor to access the Preserve are shown on Figures 8 and 18. These gates must be 12 feet in width to accommodate the cattle trucks. All other gates, such as gates installed by residents or other entities allowing access into the Preserve are prohibited. The Preserve Manager will be responsible for notifying any party that has installed an unauthorized gate into the Preserve and require its removal and replacement with the appropriate fencing. Bollards will be placed at each point where a bike trail enters the Preserve. The Preserve Manager will be responsible for the maintenance and replacement of the bollards and for keeping them in the upright position when maintenance vehicles are not accessing the Preserve.

9.4 Detention/Retention Structures

To contribute to a reduction in peak flows downstream resulting from development of the WRSP in the Curry Creek watershed, some on-site detention will occur within Preserve Parcels W-81 and W-83 (Figure 30 - *Detention Areas*). In Parcel W-81 an earthen berm with culverts will be placed across the unnamed tributary to Curry Creek. These culverts will be sized to allow normal flows to pass, but during large storm events, water will back up behind the berm and will pass through the culverts at a regulated rate. Depending on the size of the storm event, water will be detained for 6 to 8 hours. The bike trail will cross the tributary on top of the berm to minimize impacts within the Preserve. In Parcel 83, detention will occur where West Side Drive crosses the unnamed tributary to Curry Creek. These culverts will also be undersized allowing water to be detained (again for 6 to 8 hours) and released at regulated rates. The existing Phillip Road is currently (2003) at the northern boundary of Parcel W-82. While the asphalt in the Preserve will be removed, the culvert will remain to passively retain flows during storm events. This will not result in impacts to vernal pools because the water will not back up to inundate any vernal pools. During the federal regulatory permitting process, impacts were assessed for direct impacts to wetlands/waters resulting from the implementation of the other two detention structures (the berm and the roadway) and indirect impacts were assessed for the placement of the berm and the use of the Preserve within the detention areas. Both the direct and indirect impacts were mitigated as part of the overall mitigation required by the federal agencies for the Westpark/Fiddyment Ranch project.

9.5 Bike Trails

As depicted on the Preserve detail maps (Figure 7-22) a paved bike trail will meander through all of the Preserve parcels except Parcel F-80. The bike trail alignment shown in the preserve detail maps is the expected route, but the exact alignment of the bike trail is not known at this time (2003). As the alignment is finalized, the following steps will be taken to minimize impacts to the Preserve:

- The bike trail will be located in the 50-foot buffer (see Section 9.2.1). The exception to this will be the bike trail through the Pleasant Grove Creek corridor and where the trail crosses over the detention berm.
- Where the bike trail crosses drainages, bridges will span the drainages to avoid impacting wetlands/waters.
- The bike trail will meander around wetlands within the 50-foot buffer to avoid directly impacting these features (indirect impacts have already been anticipated and mitigated).

- In locations where the entirety of the 50 foot buffer is a vernal pool and will not allow the bike trail to be constructed within the 50 foot buffer, the bike trail will meander into the land use and out of the Preserve.

If, for any reason, the bike trail must directly impact a wetlands/waters feature in the Preserve not anticipated and mitigated as part of the Permit and the Biological Opinion, an amendment to these documents or a new Corps permit will be required. See Section 6.4 for more information on activities requiring a permit.

Post and cable fencing to the Preserve side of the trail is required when the trail is directly adjacent to the Preserve boundary. If the bike trail meanders away from the Preserve boundary such that there are wetlands/waters on both sides of the trail, then post and cable is required on both sides. Bollards will be placed at each location where the bike trail enters the Preserve. Routine maintenance activities including repainting stripes, fixing cracks, and mowing on either side of the bike trail are allowed. Use of herbicides to maintain the 18" bike trail shoulder is allowed.

9.6 Maintenance Roads

While the bike trails will double as maintenance roads to lessen impacts to the Preserve, one portion of the existing (2003) Phillip Road will remain in place for access to storm drain outfalls in that area of the Preserve. The remainder of the road within the Preserve will be removed.

9.7 Outfalls and Drainage Swales

Run-off from developed areas within the WRSP must reach the creeks or drainages within the Preserve. Past experience has shown that ill-designed or inappropriately placed outfalls can permanently and adversely impact the hydrology of vernal pools. Additionally, with an entire specific plan area, it is difficult to predict now where all the outfalls will need to occur. The City, the developer, the Corps, and the Service worked to develop guidelines for implementing the future placement of outfalls and drainage swales that obviates the need for the City to continuously request approval for outfall placement from the Corps and the Service. The following guidelines apply for outfall placement:

- Outfalls will not result in drainage flows being discharged into vernal pools. Where needed, swales will be used to carry flows from outfalls to drainages to bypass vernal pools.

- Outfalls and drainage swales that are shown in this Plan and are designed according to the typical details presented in Attachment L, are approved and require no further notification to the Corps or the Service. These outfalls may shift locations by several feet upon actual design/installation. If the design/function of the outfall does not change then these outfalls are still considered approved.

- Outfalls and drainage swales that are designed as shown in the typical drawings included in Attachment L, but are not identified in this Plan, require only notification of the Corps and the Service. This notification can be in the form of a figure included in the Annual Report (see Section 5.5) showing the locations and the type of outfall or drainage swale to be installed.

- Outfalls and drainage swales that cannot be designed as shown in the typical drawings and are not shown in this Plan require review and approval of the Corps and the Service.

- Outfalls and drainage swales that will directly impact wetlands/waters not anticipated as part of the Permit and the Biological Opinion will require an amendment to the Permit or a new Corps permit and potentially a new Biological Opinion.

Maintenance (including the removal of vegetation within the drainage swales or adjacent to outfalls) or repair activities for drainage outfalls may occur as needed. If maintenance or replacement activities will impact preserved wetlands or waters of the U.S., the Corps will be notified and any appropriate permits will be obtained.

9.8 Fire Breaks

The Preserve Manager can implement up to a 50-foot firebreak within the 50-foot buffer, although it is not required by the Corps, the Service, or this Plan. The Corps requires that a survey for ground nesting birds be conducted if firebreaks are to be cut before July 1st to eliminate impacts to these species. Therefore, the Preserve Manager will be responsible for arranging for a ground nesting bird survey to be conducted each year prior to the mowing of firebreaks. Firebreaks may be mowed (not disked) such that vegetation is 2 inches high or less.

9.9 Bridge Crossings and Detention Culverts

To keep water flowing at the various bridge crossings, vegetation and large woody debris can be cleared from within these structures within the Preserve in accordance with the City's MOU with CDFG.

9.10 Utilities

As depicted in Figure 31 – *Utility Line Locations*, there are several areas of the Preserve that are or will be crossed by utility lines. Only the utility lines that fall outside of the 50-foot buffer are shown on this figure. Access to the Preserve for the installation, maintenance, and replacement of existing and proposed utility lines and poles is allowed and will be restricted to the minimum area needed to accomplish the task.

10.0 REMEDIATION/RESTORATION ACTIVITIES

10.1 Post-Construction Remediation/Restoration

The replacement of the previously mentioned structures or improvements in the Preserve may require post-construction restoration. These structures or improvements were originally permitted as part of the project through the Corps, the Service, and CDFG. For these cases, post-construction remediation/restoration means, for example, hydroseeding areas of the Preserve that were disturbed by equipment, restoring the original grade where the intent was not to alter it, cleaning up construction debris, and generally reverting the area back to pre-construction conditions. A list of native grass species and other locally native plants that can be used in revegetation/restoration is included in this plan as Attachment M.

10.2 Restoration of Conservation Easement/Declaration of Restrictions Violations/Vandalism

It is difficult to anticipate and provide a mitigation measure for all potential violations of the Preserve's conservation easement/declaration of restrictions, however, the following table outlines some potential violations and mitigation guidelines. If a particular situation is not listed here, that does not mean that restoration is not required. In these cases, determining an appropriate mitigation measure will be at the discretion of the Preserve Manager in coordination with the Monitoring Biologist.

Type of Disturbance	Mitigation Guideline
Disturbance of Grassy Upland Areas	Restoration of grassy upland areas due to disturbance resulting in bare ground should include seeding the area with appropriate native grass seed (Attachment D) and implementing the proper erosion control measures until the bare ground becomes vegetated again.
Removal of Native Tree or Shrub Habitat	Restoration for the removal native trees or shrubs should result in the replacement of the habitat. This could be in the form of planting tree/shrub seeds or seedlings in an amount sufficient to ultimately result in the survival to maturity of the same number of trees or shrubs that were removed. Monitoring of the replacement plants should be done for at least two seasons.
Sedimentation in Vernal Pools	If sedimentation within a vernal pool occurs, the Preserve Manager will notify the Corps and the Service. The Preserve Manager will wait until summer when the vernal pool is dry. The Monitoring Biologist will make an assessment of the vernal pool at that time to determine if remediation (i.e. removal of the sediment) is warranted, or if the pool is recovering sufficiently on its own. Indicators of recovery include the re-establishment of vernal pool plant species and recovery of the pool's vegetative cover. If the first year of monitoring indicates that no remediation will be needed, one more year of monitoring will be conducted. Monitoring

	will consist of one winter visit and one summer visit to assess the overall health of the vernal pool. If the first year of monitoring/first summer assessment indicates that removal of the sediment is warranted, it will be conducted during the summer months when the pool is completely dry. The sediment will be removed by hand shovel. Care will be taken to remove only the sediment and not disturb the original grade of the vernal pool. Two years of monitoring after the remediation has taken place are required. The City may also require mitigation in the form of mitigation bank credits if after two years the remediated pool is not showing progress toward recovery.
Wetlands/Waters of the U.S.	Restoration for fill/loss of waters of the U.S. should result in the removal of fill from the feature, potentially the minor re-grading and revegetation of the feature (if appropriate) and monitoring for at least two seasons to gauge the feature's recovery. The Preserve Manager will contact the Corps if fill/loss of wetlands or waters of the U.S. has occurred and submit for review and approval what remediation/restoration is proposed (see Section 6.3). The Corps may have to consult with the Service if the situation involves endangered species habitat. While the normal time period for the Corps to review and approve an action is 60 days, the Corps will make every effort to respond in a timely manner to requests regarding wetlands/waters of the U.S. so that restoration can be implemented at the appropriate time of year (e.g. before the rainy season).
Fencing	Restoration for the destruction or modification (e.g., installing an unauthorized gate) of Preserve fencing should include fixing or replacing the section of fencing to its original specifications.
Structures, Landscaping, Other Improvements, etc.	Any unauthorized structure, landscaping, or other improvement should be removed from the Preserve. If any of the above habitats was disturbed, mitigation will be required using the above mitigation measures as guidelines.

10.3 Timing/Process for Corrective Actions

Minor corrective measures not requiring notification or approval of the Corps and the Service (e.g., prevention of unexpected runoff, prevention of unauthorized access to the area by placing locks on gates, etc.) will be carried out by the Preserve Manager within sixty (60) days, unless site conditions warrant delay (i.e., if soil is saturated and equipment would damage the upland habitat in the Preserve, it may be necessary to delay work until conditions improve). All other corrective actions will take place when conditions are best suited for restoration to occur, and after the Corps and/or the Service have been notified or the Preserve Manager has received approval.

11.0 RECREATION, EDUCATION, RESTORATION, AND THE COMMUNITY GARDEN

11.1 Educational Activities in the Preserve

The Preserve represents an opportunity to encourage a sense of ownership and respect for open space and wildlife habitat in local students. Use of the Preserve for education will be limited to students, parents, and faculty of the local school district, local area residents, or other persons with the consent of the Preserve Manager. Individuals or groups using the Preserve for educational purposes will coordinate their use with the Preserve Manager. If the educational activities will be passive in nature, such as an occasional walk through the Preserve to discuss plants and animals of the wetland habitats, then the consent of the Preserve Manager is sufficient. If active use (other than restoration activities) of the Preserve is proposed, or regular, but passive use of the Preserve is proposed, review and approval of the Corps and the Service is required. To avoid repeated inquiries with the Corps and the Service, a use plan could be developed by the interested school or school district for a one-time approval. See Section 11.6, below, for review and notification information on restoration activities.

11.2 Recreation

The Preserve is intended for passive recreational uses including biking, walking, and birding. These uses are allowed on the designated trails.

11.3 "Creek Week" or Community Clean-up Days

Communities located in the watersheds in and around the City of Roseville currently participate in Creek Week, a week-long celebration of the local creeks that takes place in April. This event includes a clean-up day where teams of residents "adopt" a portion of creek and the adjacent open space area and pick up trash. Individuals or groups participating in the Creek Week clean-up will coordinate their use of the Preserve with the Preserve Manager, and no further approvals shall be required to undertake Creek Week cleanup activities. More extensive use of the Preserve during Creek Week, such as restoration or educational activities may require notification of the Corps and the Service. See Sections 11.1 and 11.6.

11.4 Community Garden

A 2-acre community garden is planned for Preserve Parcel F-83 (See Figure 21). Prior to development, a portion of this parcel (2003) was an active pistachio orchard. Given the historic agricultural use of the area, a community garden is a compatible use within this portion of the Preserve. The Community Garden will be fenced and may include a small parking lot, which will also be allowed within the Preserve. Although the exact location of the garden within Parcel F-83 is not known at this time, there are no wetlands or waters (besides Pleasant Grove Creek) present in the area and so there will be no impacts associated with the garden. The garden will also avoid impacting existing oak woodland adjacent to the creek. At the time the garden is established, no agency notification is required. Within the defined community garden area, restrictions on pesticides and chemical agents (although an organic garden could be encouraged), planting (native or non-native plants), grading, plowing, cultivation, storing or placing materials or debris, leveling or grading, etc. do not apply as they do to the remainder of the Preserve. Additionally, motorized equipment, such as tractors or other motorized garden/farm equipment, can be operated in the Community Garden. A list of species that have the potential to spread out of the community garden and become problematic in the remainder of the Preserve has been included as Attachment N. These species should not be planted in the garden, or should be planted with caution. If additional species are discovered to be problematic in the future, they should be appended to the list.

11.5 Planned Mitigation/Restoration within the Preserve

Currently (2003), there are two mitigation/restoration activities that are planned for the Preserve, oak woodland restoration and wetland mitigation/restoration. These two activities are outlined in more detail below.

11.5.1 Oak Woodland Mitigation

There is potential for oak woodland mitigation and restoration in the Preserve within the Pleasant Grove Creek corridor (Parcels F-85, F-84, and F-83). The corridor has been grazed, resulting in a reduced oak riparian/oak woodland canopy and understory. Replanting in these areas would be beneficial to restoring the creek habitat. Prior to planting, site-specific conditions and revegetation methods should be reviewed by an arborist, biologist, or restoration specialist. An oak regeneration handbook has been attached to this Plan (Attachment O). Potential oak planting areas were identified in the West Roseville Specific Plan draft EIR (see Figure 32 - *Oak Planting Areas*).

The draft EIR outlined approximately 45.6 acres that would be planted with 150 trees per acre or 6,840 trees. The developer is responsible for the purchase, installation, and maintenance of these trees. When the success monitoring is complete and the trees have met their success criteria (to be determined), the parcels where the oak mitigation took place will be deeded to the City, which will then assume long-term monitoring and maintenance responsibility. See Section 2.4 for the dedication process for Preserve parcels.

11.5.2 Wetland Mitigation

To mitigate for impacts within the WRSP area, approximately 8 acres of perennial and seasonal wetland habitat adjacent to Pleasant Grove Creek will be created (see Figure 24 – *Wetland Mitigation Area*). This habitat will be monitored in compliance with a Corps-approved Mitigation and Monitoring Plan for 5 years or until the final success criteria set forth in the Mitigation and Monitoring Plan are met. The monitoring and success criteria requirements of this area will remain the responsibility of the developer for the duration of the monitoring period. When the wetland mitigation has been signed off by the Corps, the developer will deed the parcels to the City, which will then assume the long-term monitoring and management responsibility. See Section 2.4 for the dedication process for Preserve parcels.

11.6 Future Habitat Restoration/Enhancement

In the future, the Preserve Manager or other group/organization may want to conduct habitat restoration or enhancement within the Preserve. This could include the removal of non-native (exotic) plant species, planting native plants, or other restoration activities. A list of native plants that can be used in restoration has been included as Attachment M. This list is not all-inclusive, other locally native plants can be used in restoration. Restoration activities that involve work in wetlands or waters of the U.S. may require a permit under Section 404 of the Clean Water Act, and/or a Streambed Alteration Agreement from the California Department of Fish and Game (CDFG). Nationwide Permit (NWP) 27, *Stream and Wetland Restoration Activities*, is available from the Corps for these type of activities. An example of a restoration activity that does not require Corps approval, is planting acorns or oak seedlings in the Preserve. An example of a restoration activity that would require Corps approval is the recontouring of a creek bank and planting it with riparian species to stabilize an area of erosion. The Preserve Manager will not need to notify the Corps if restoration activities do not require a permit from the Corps, however, these activities should reviewed by the Monitoring Biologist and will be described in the Annual Report. If there is a question regarding whether a restoration activity will require Corps approval, the Preserve Manager should seek guidance from the Corps.

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LIST OF FIGURES

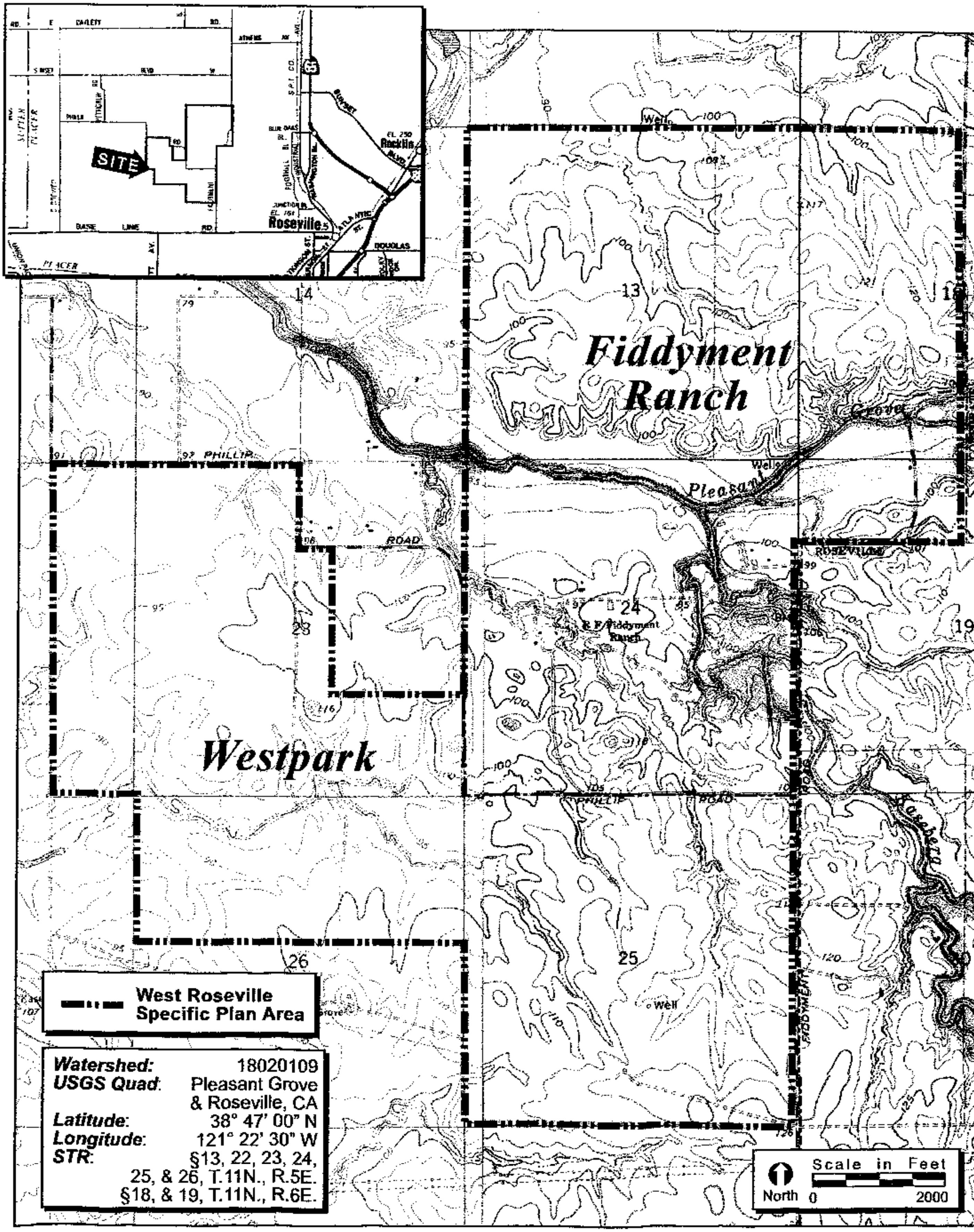

FIGURE 1. Project Site and Vicinity Map

2000-169 West Roseville Specific Plan

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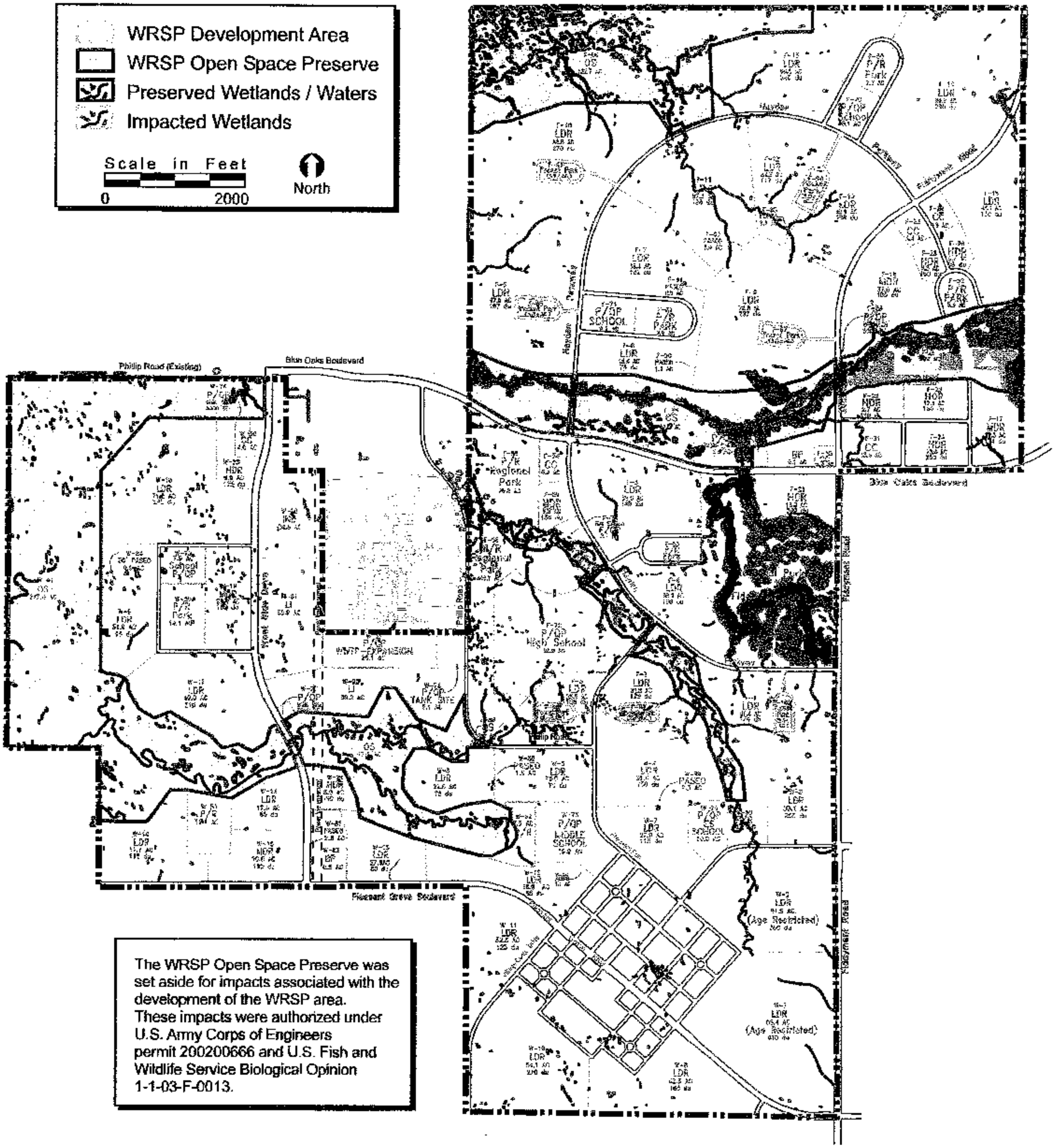

The WRSP Open Space Preserve was set aside for impacts associated with the development of the WRSP area. These impacts were authorized under U.S. Army Corps of Engineers permit 200200666 and U.S. Fish and Wildlife Service Biological Opinion 1-1-03-F-0013.

FIGURE 2. WRSP Development and Open Space Areas

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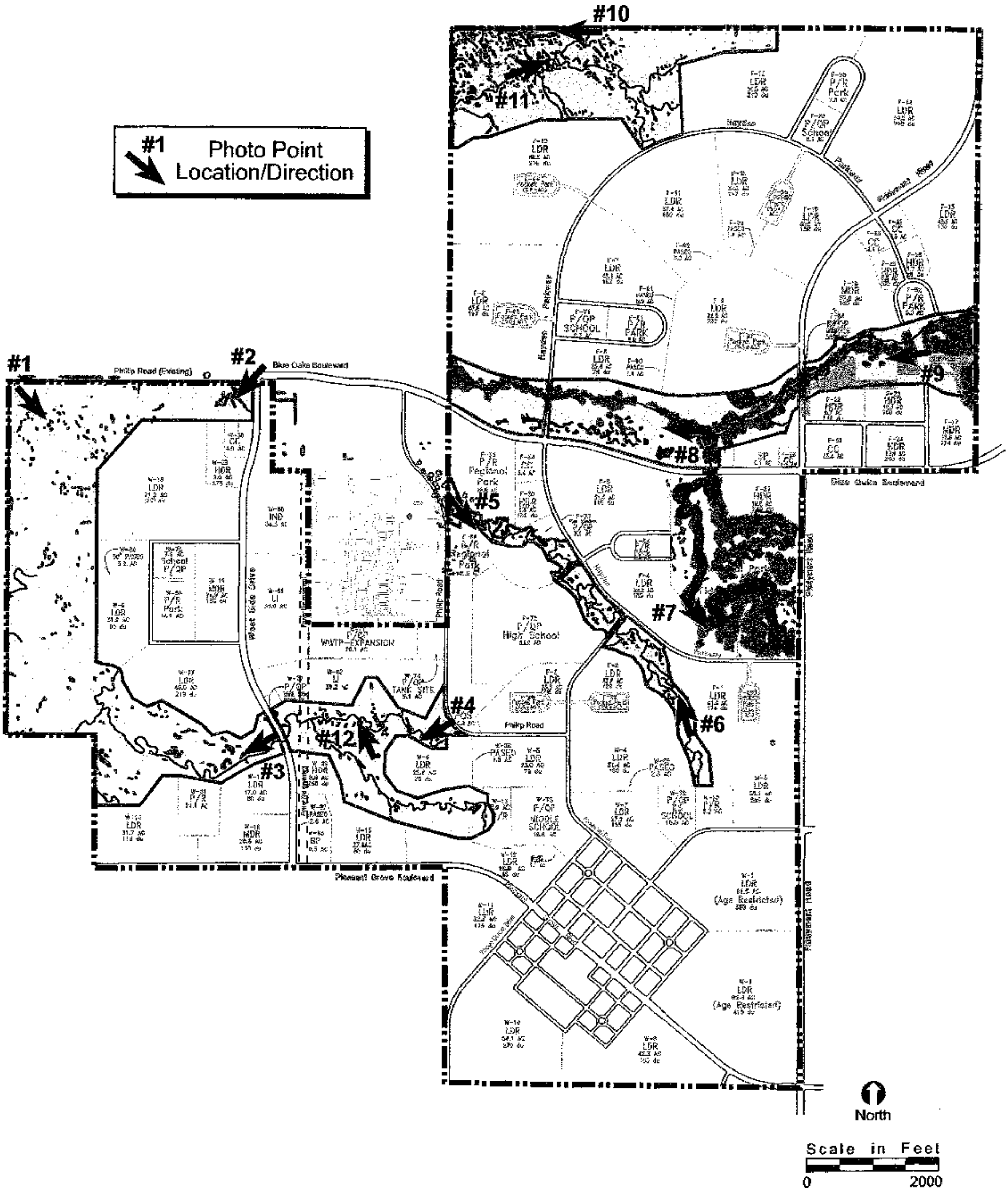

FIGURE 3. Pre-project Photo Point Locations

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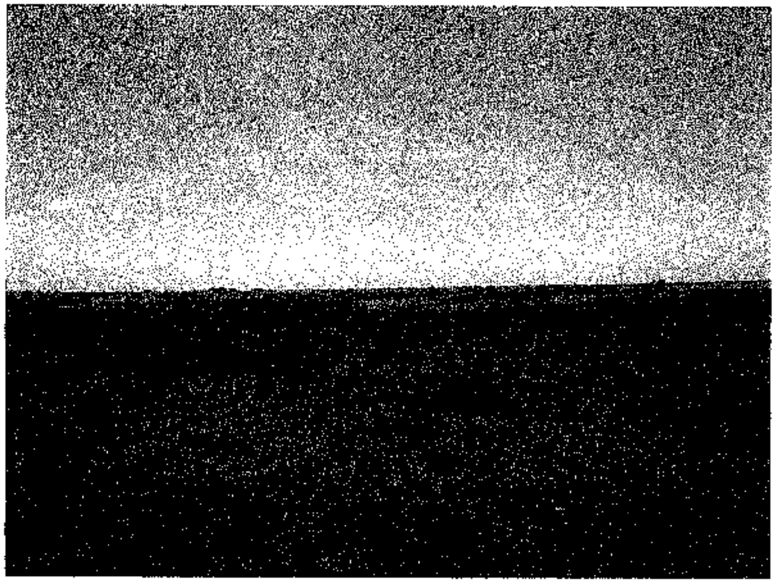

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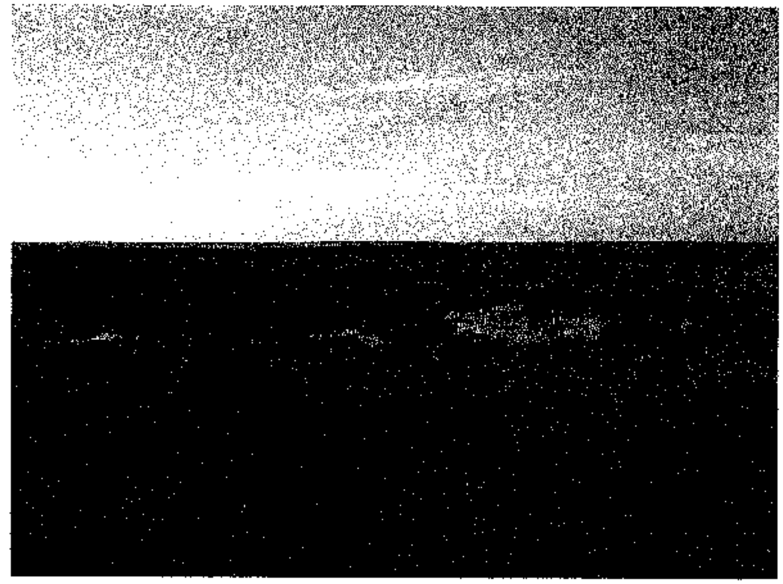

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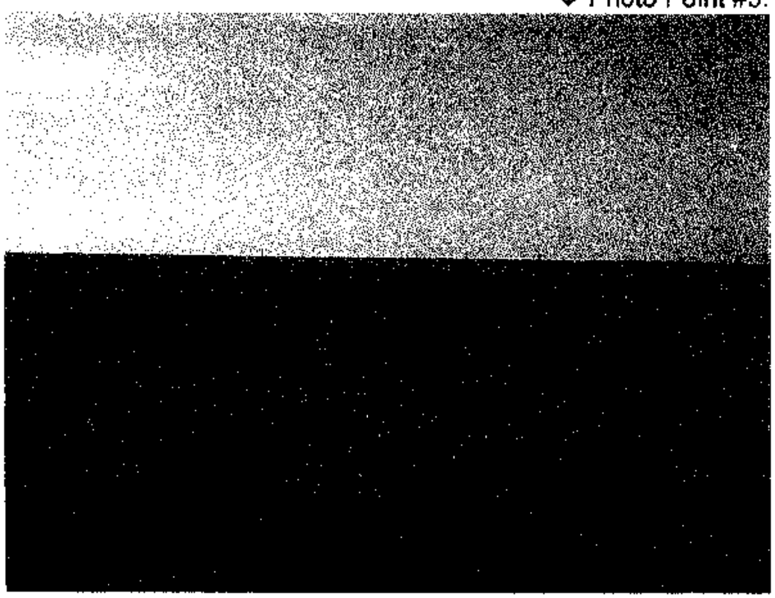

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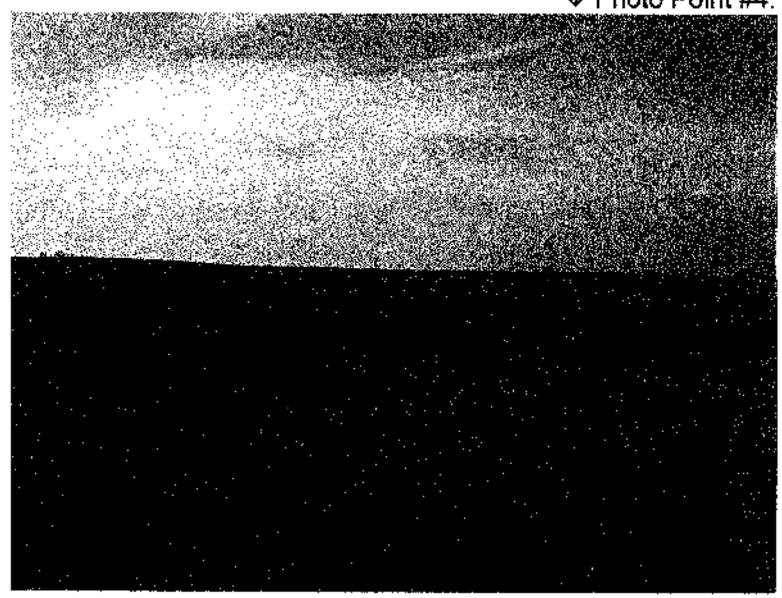

FIGURE 4. Photo Plate 1

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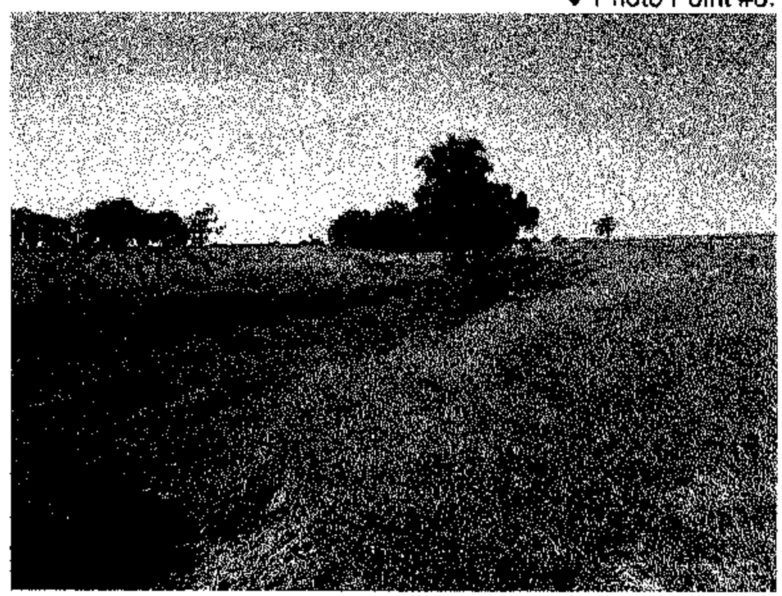

FIGURE 5. Photo Plate 2

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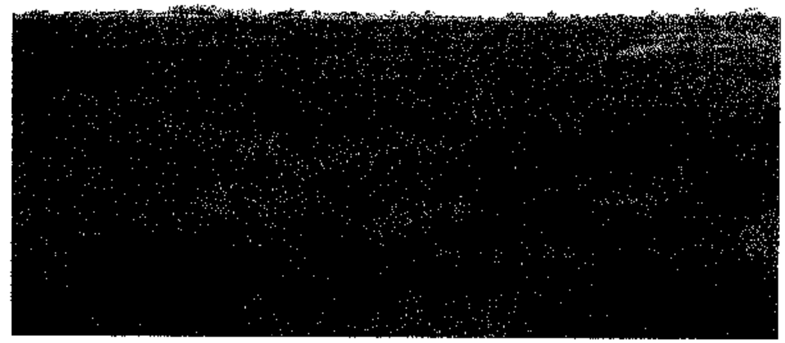

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↓ Photo Point #11.

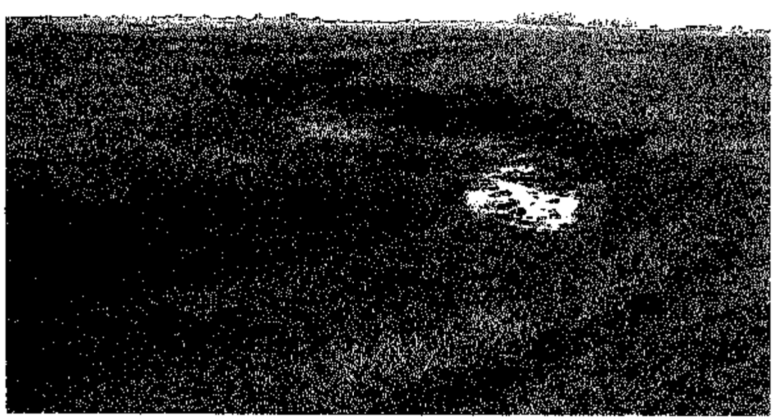

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FIGURE 6. Photo Plate 3

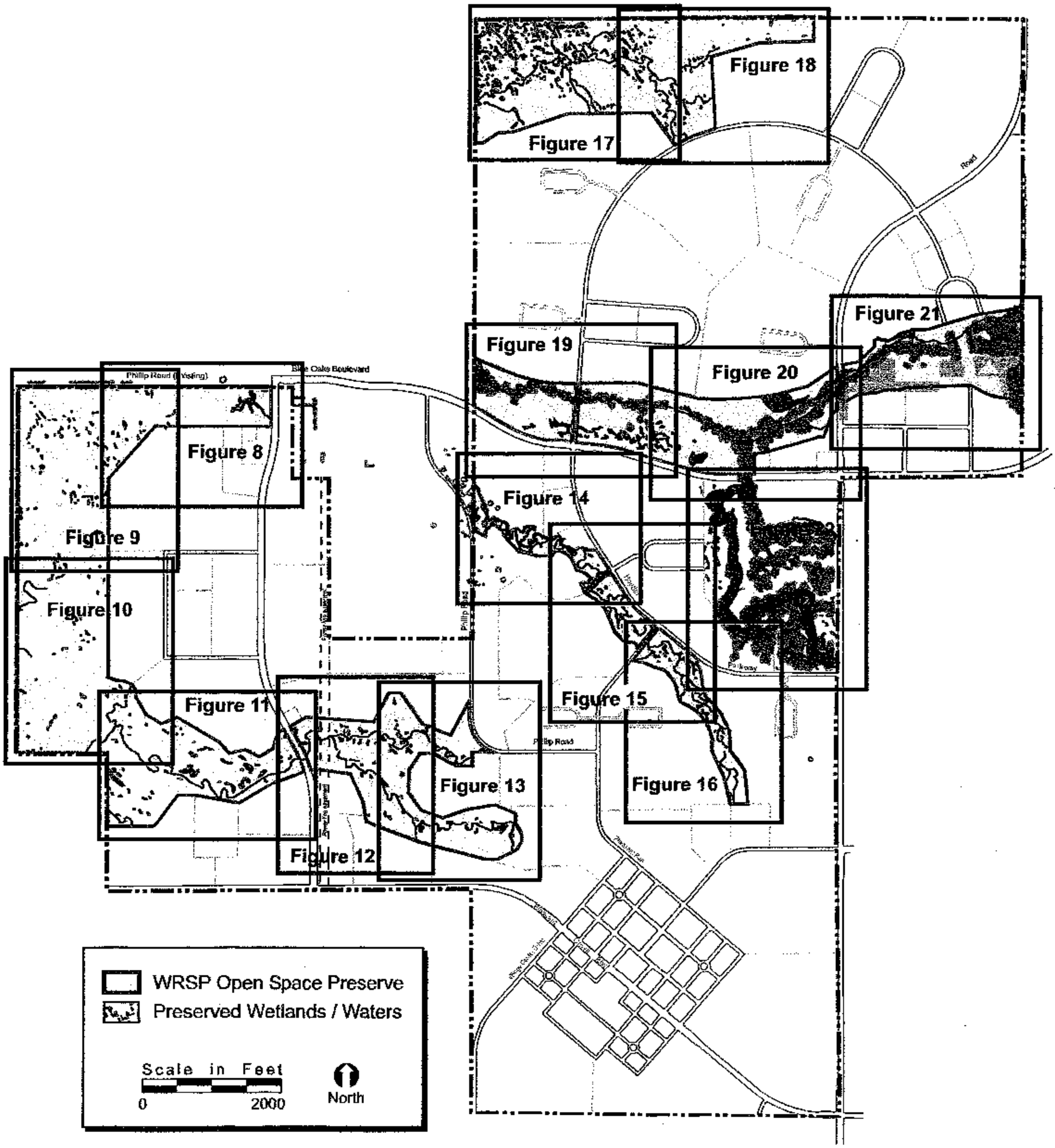

FIGURE 7. Preserve Detail Map Key

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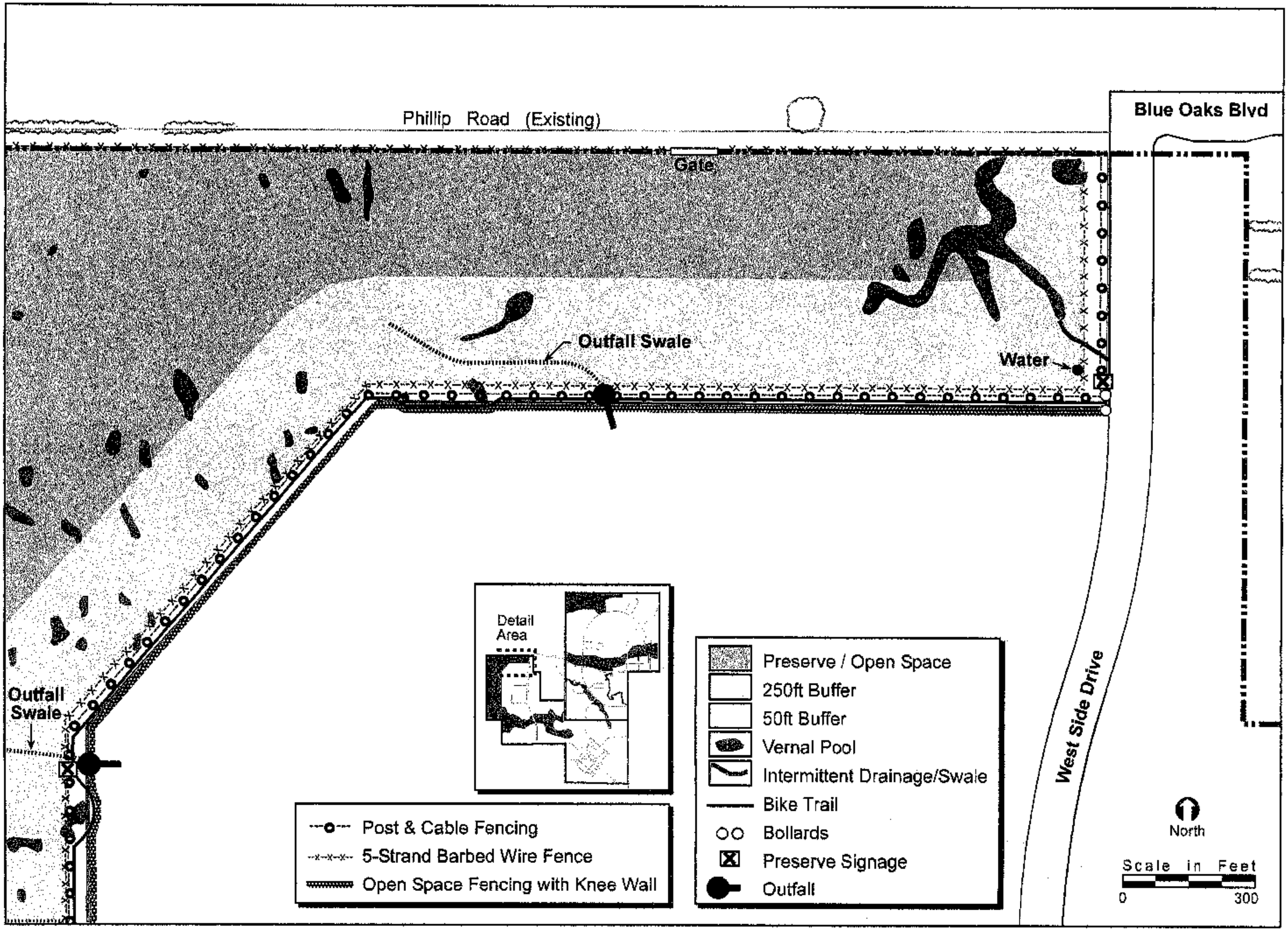

FIGURE 8. Preserve Detail: Parcel W-81 (northeast)

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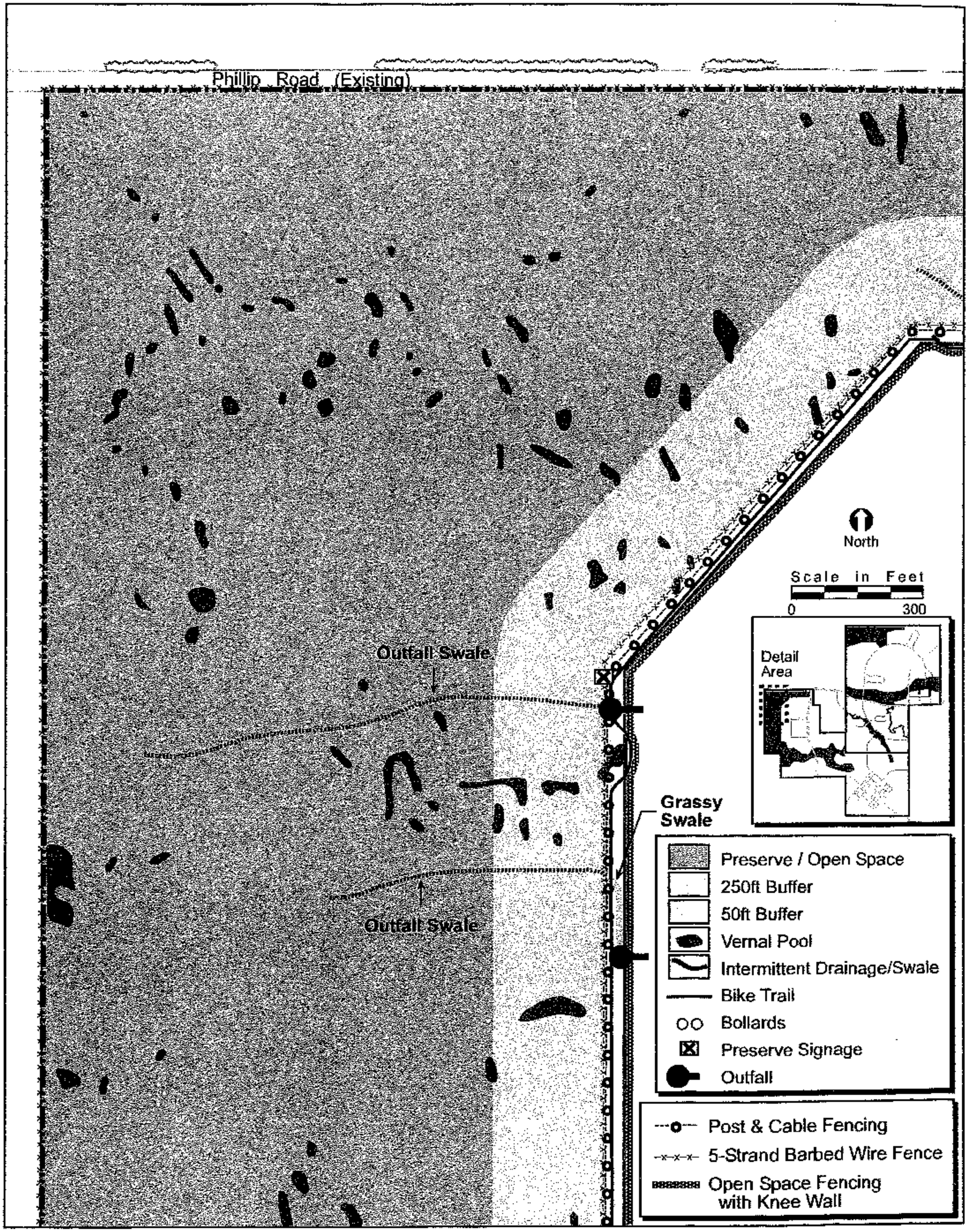

FIGURE 9. Preserve Detail: Parcel W-81 (northwest)

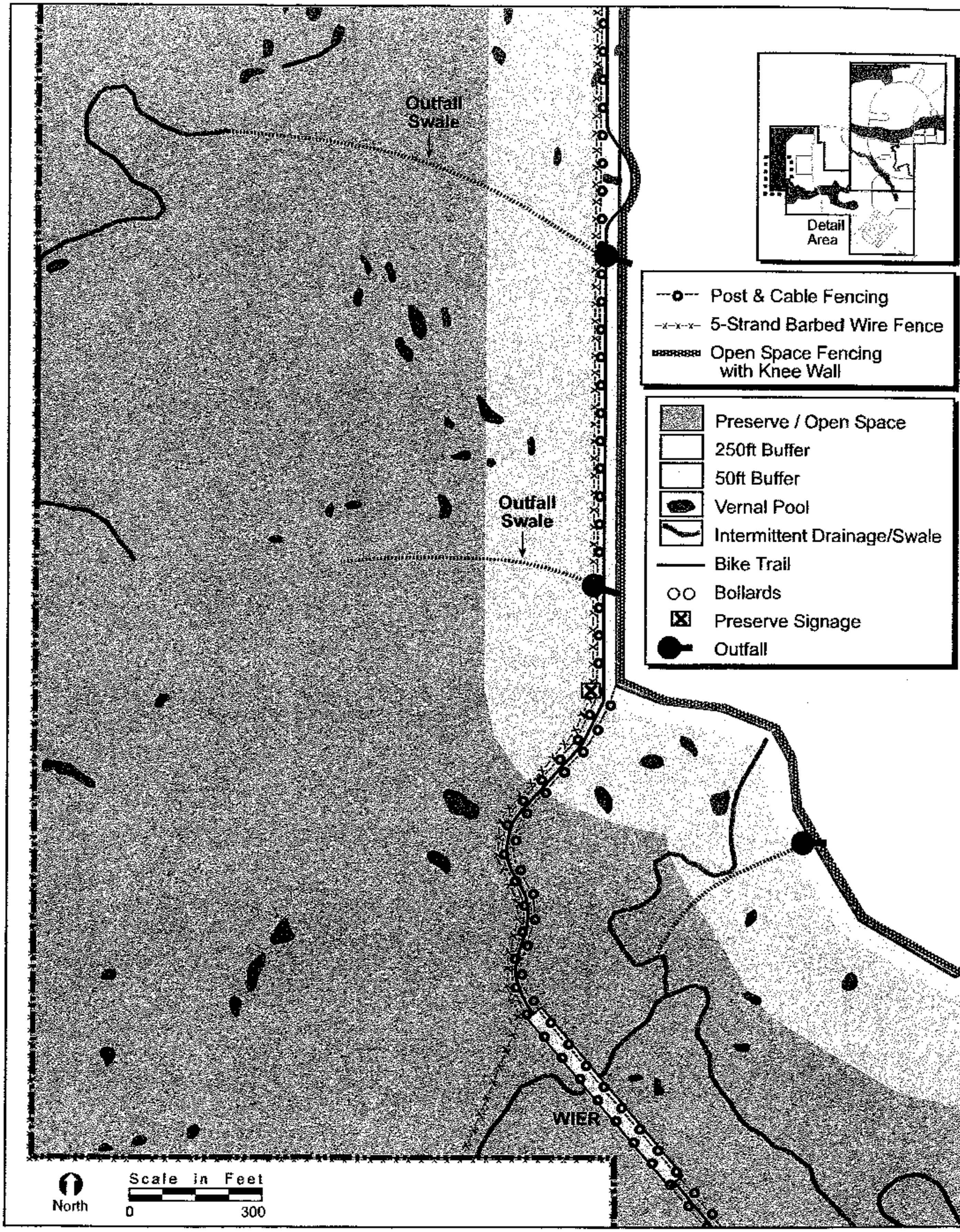

FIGURE 10. Preserve Detail: Parcel W-81 (southwest)

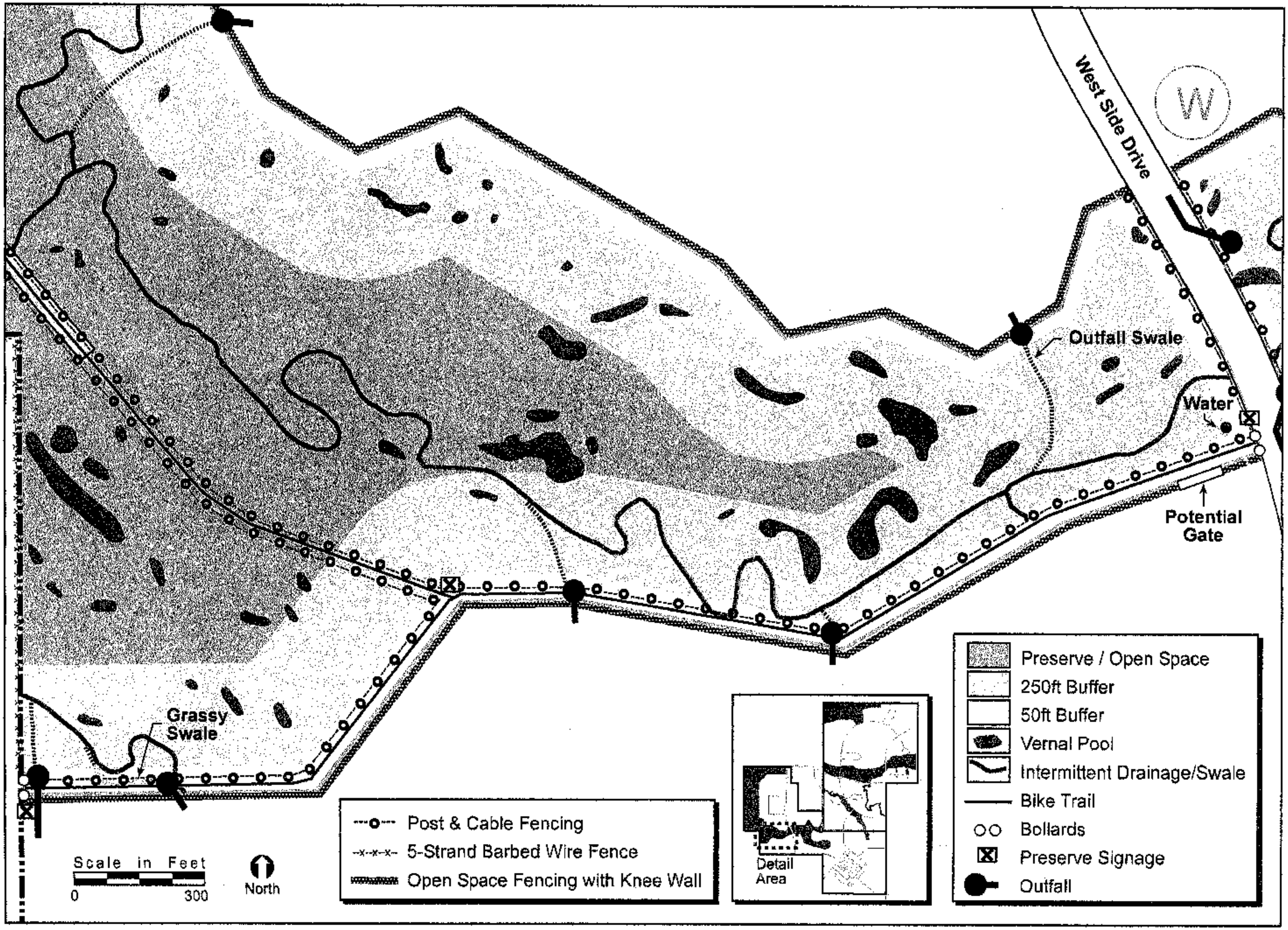

FIGURE 11. Preserve Detail: Parcel W-81 (southeast)

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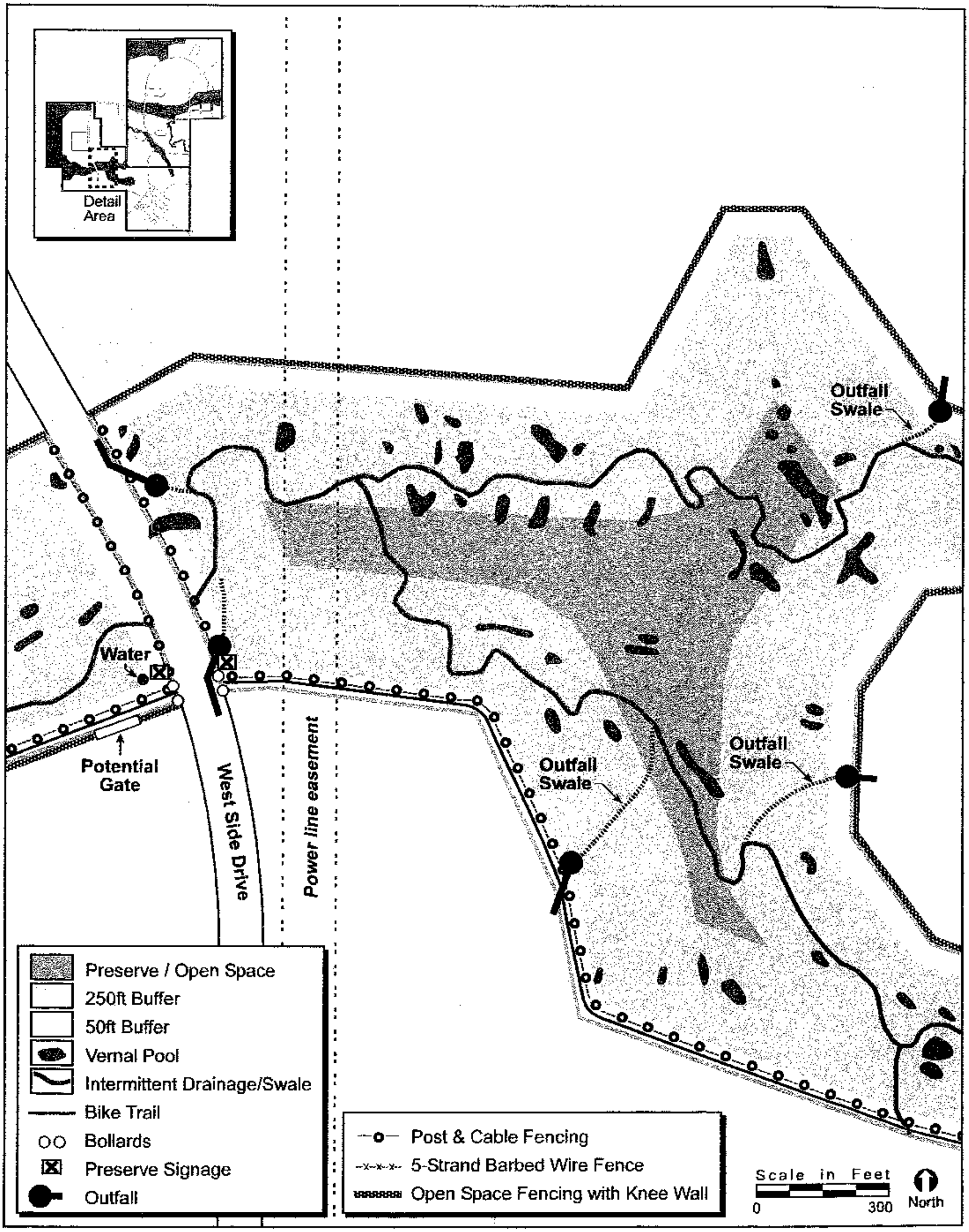

FIGURE 12. Preserve Detail: Parcel W-83 (west)

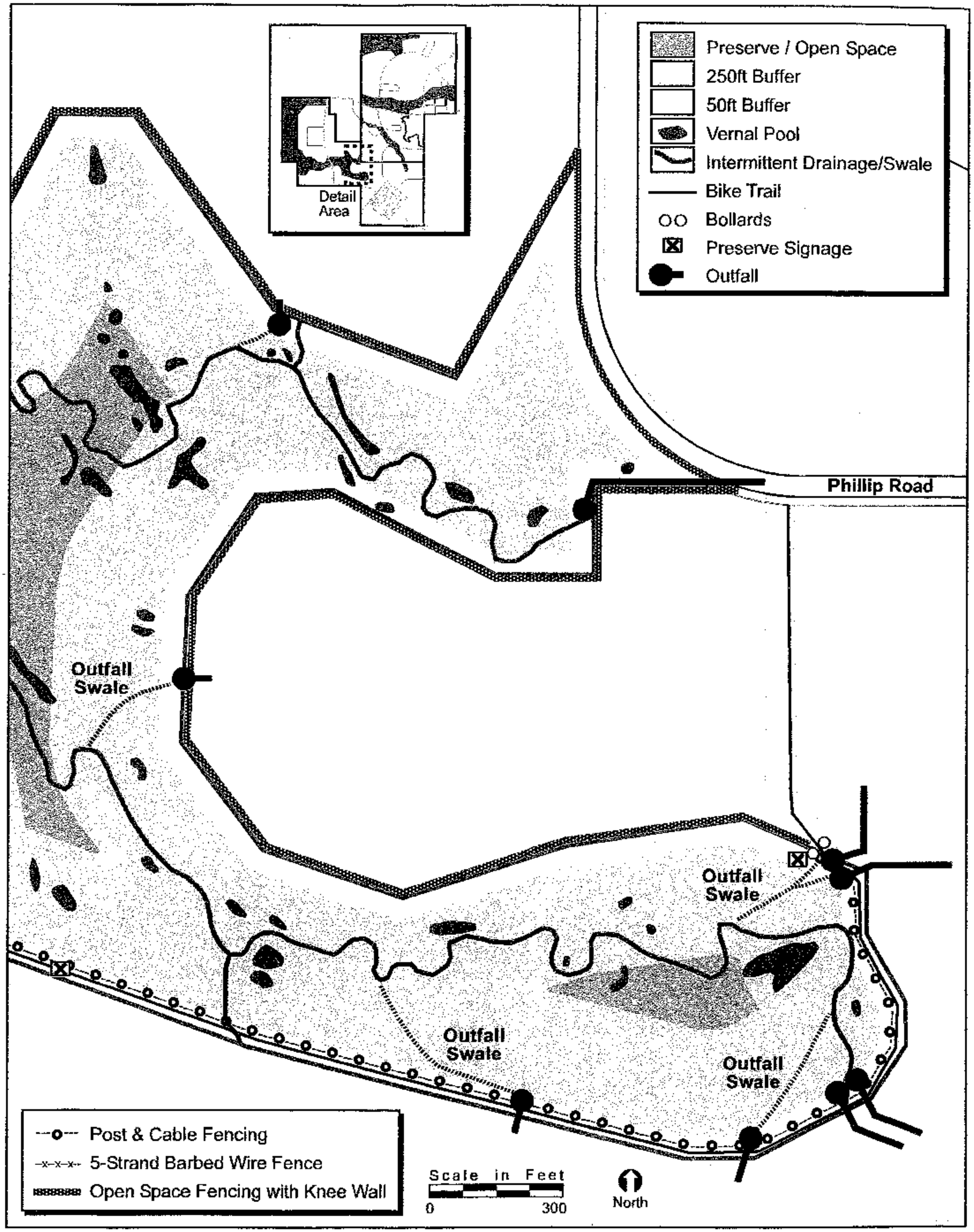

FIGURE 13. Preserve Detail: Parcels F-89 and W-83 (east)

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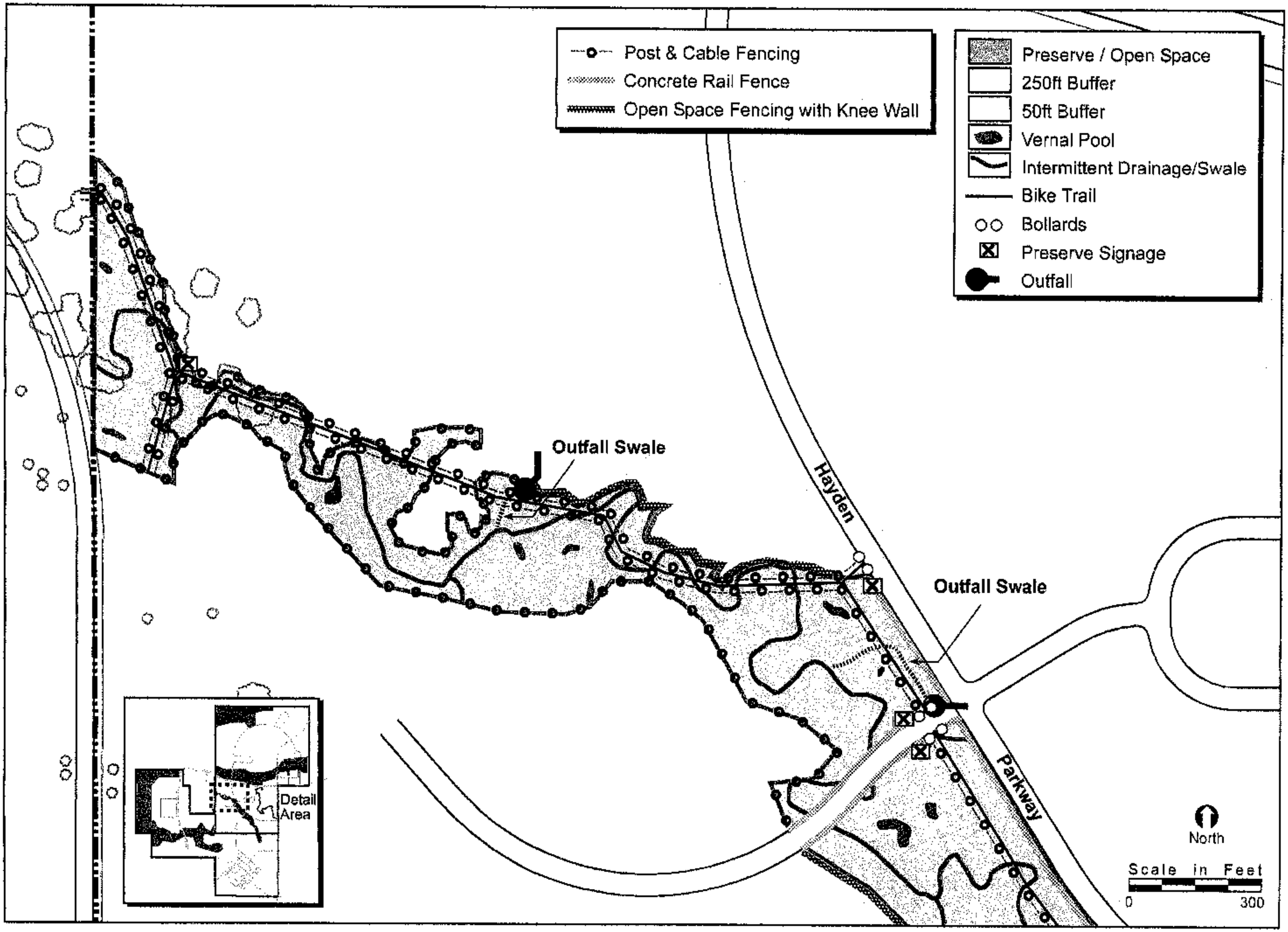

FIGURE 14. Preserve Detail: Parcels F-86

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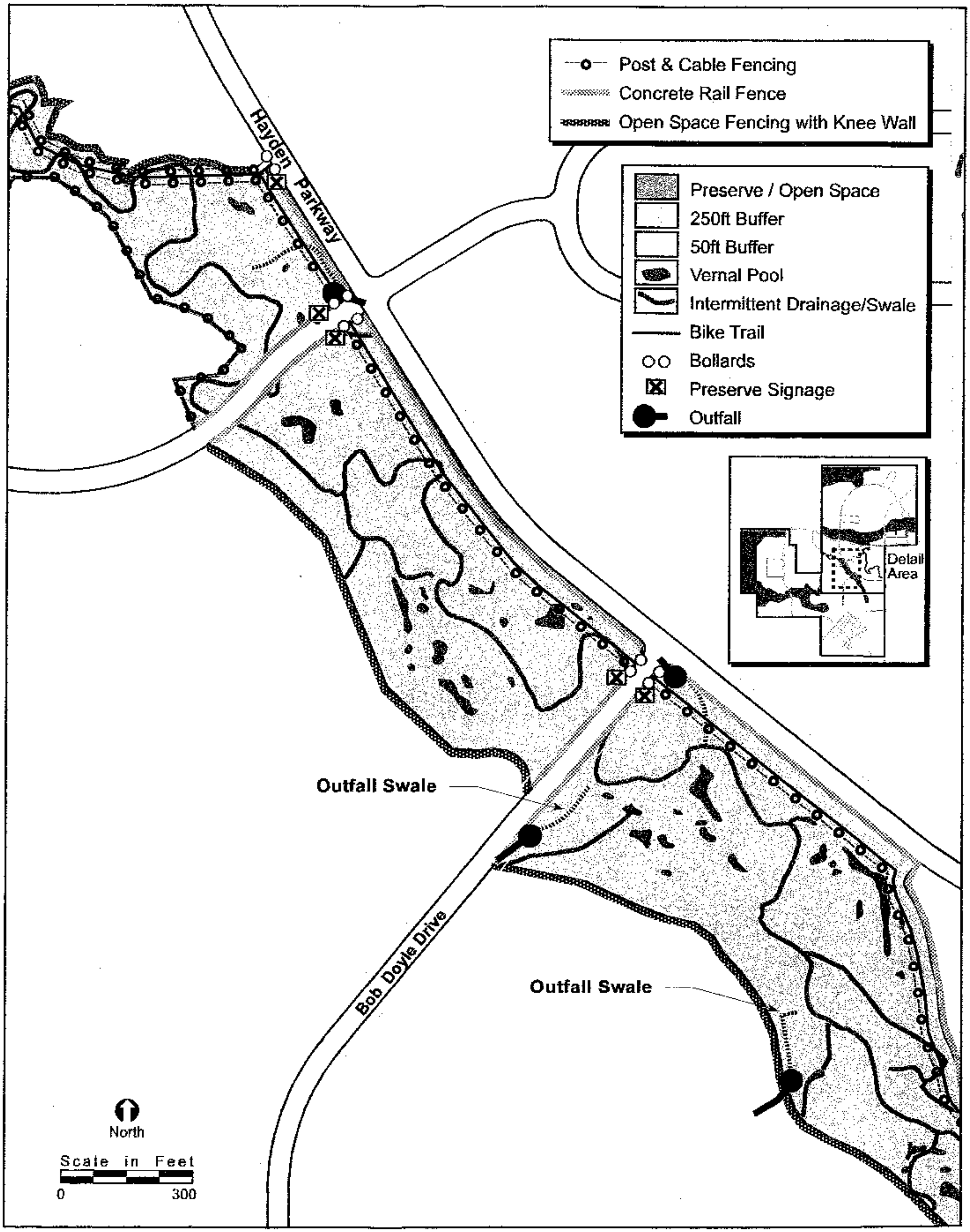

FIGURE 15. Preserve Detail: Parcel F-87

2000-169 West Roseville Specific Plan

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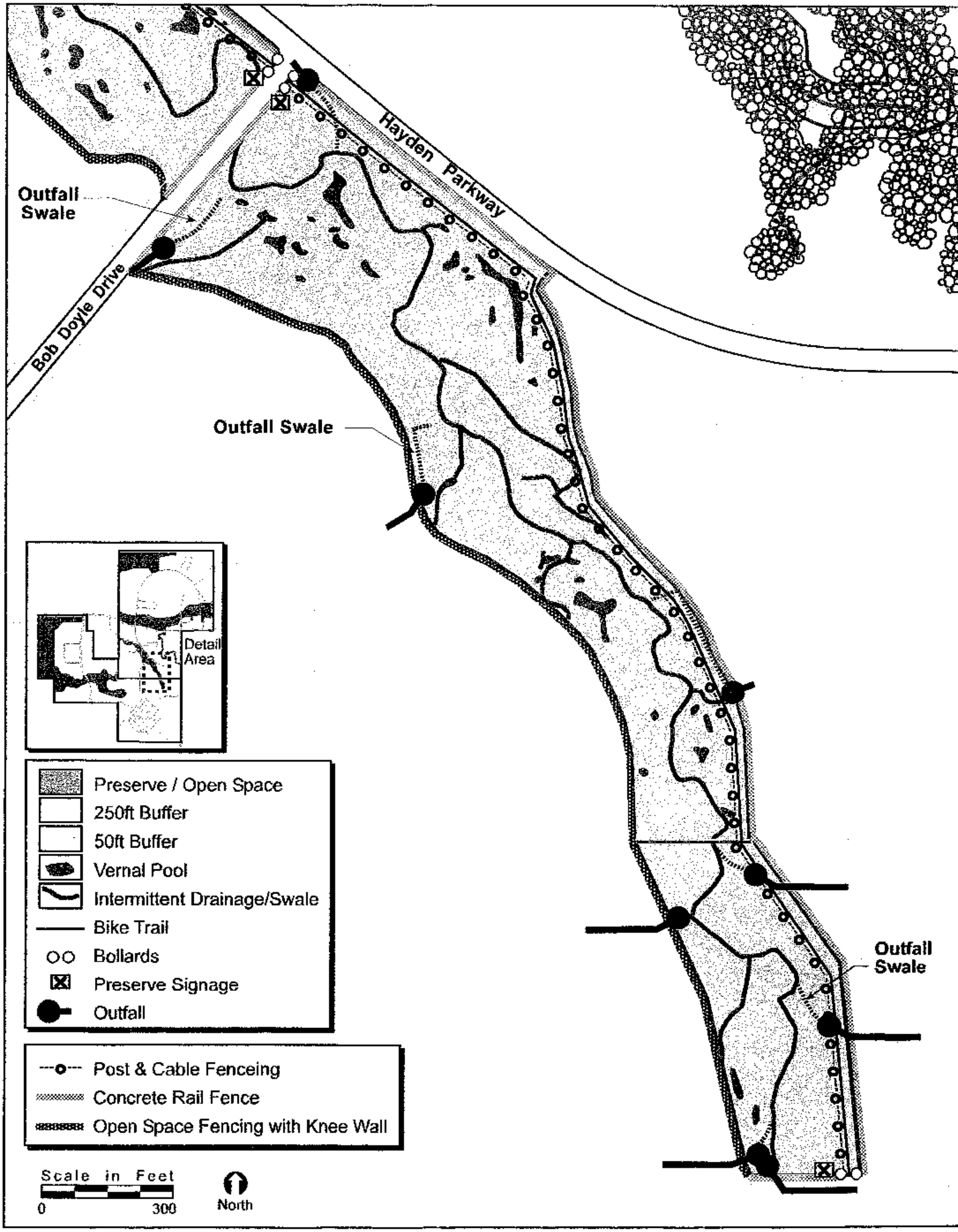

FIGURE 16. Preserve Detail: Parcels F-88 and W-82

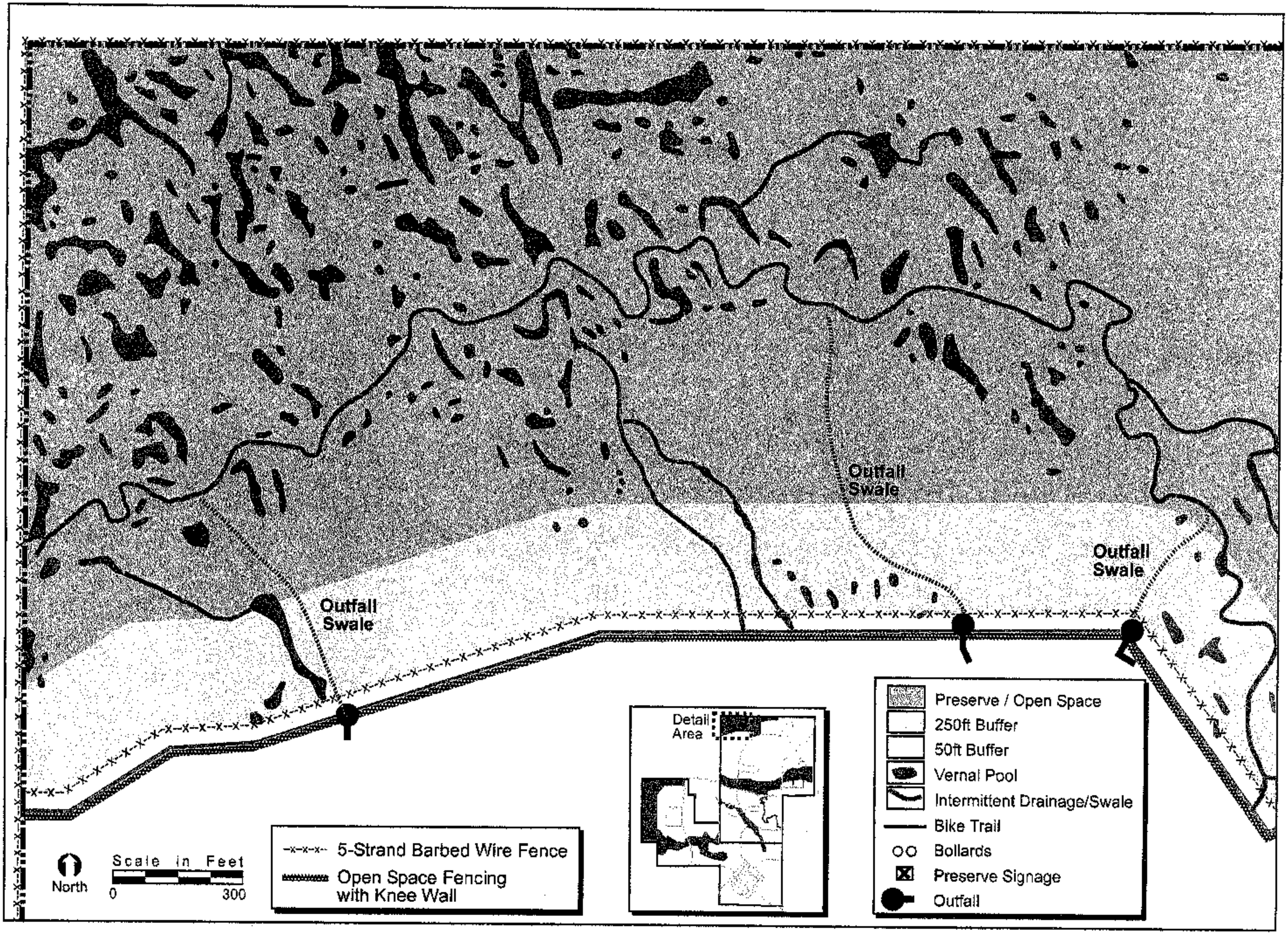

FIGURE 17. Preserve Detail: Parcel F-80 (west)

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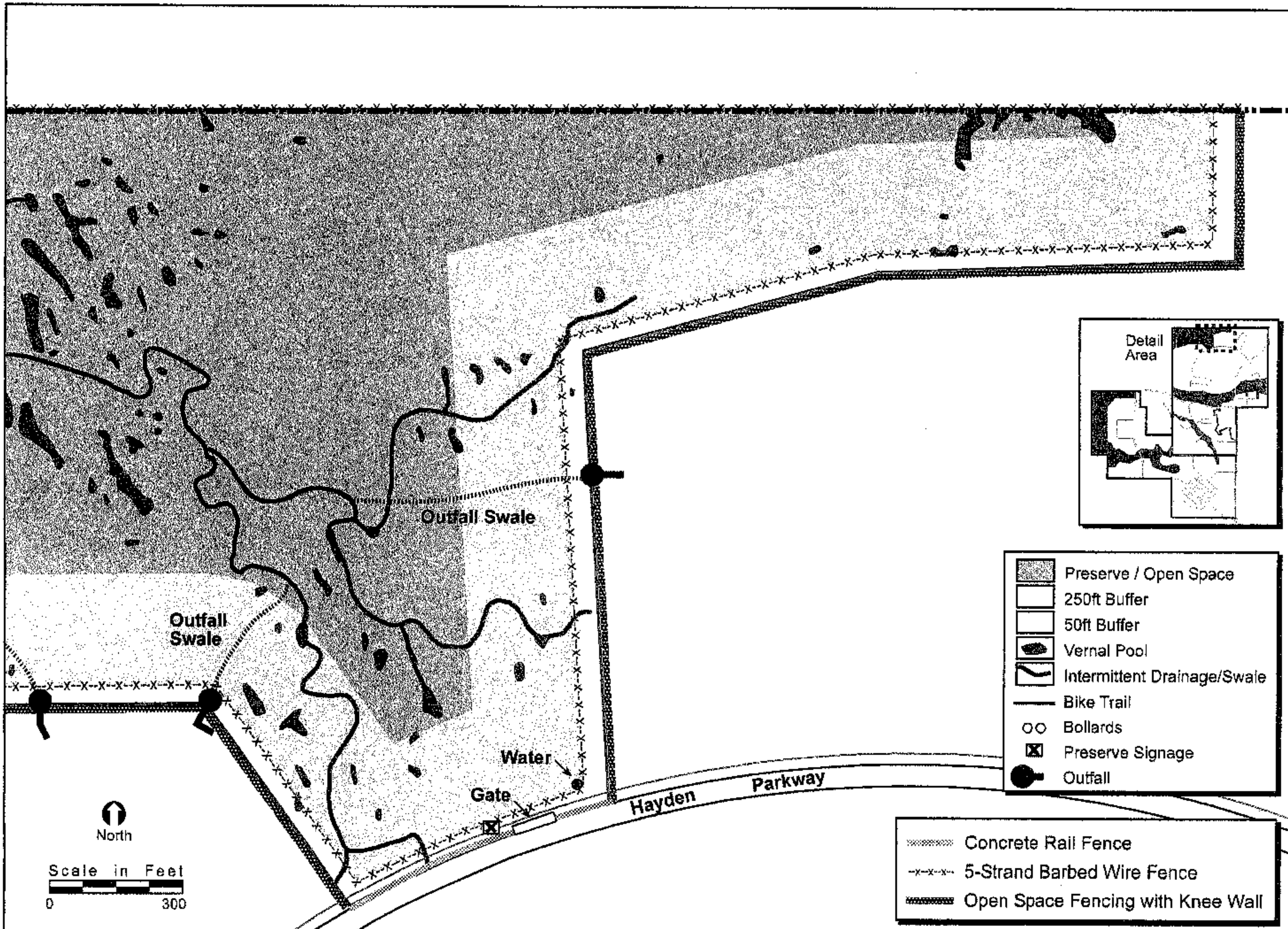

FIGURE 18. Preserve Detail: Parcel F-80 (east)

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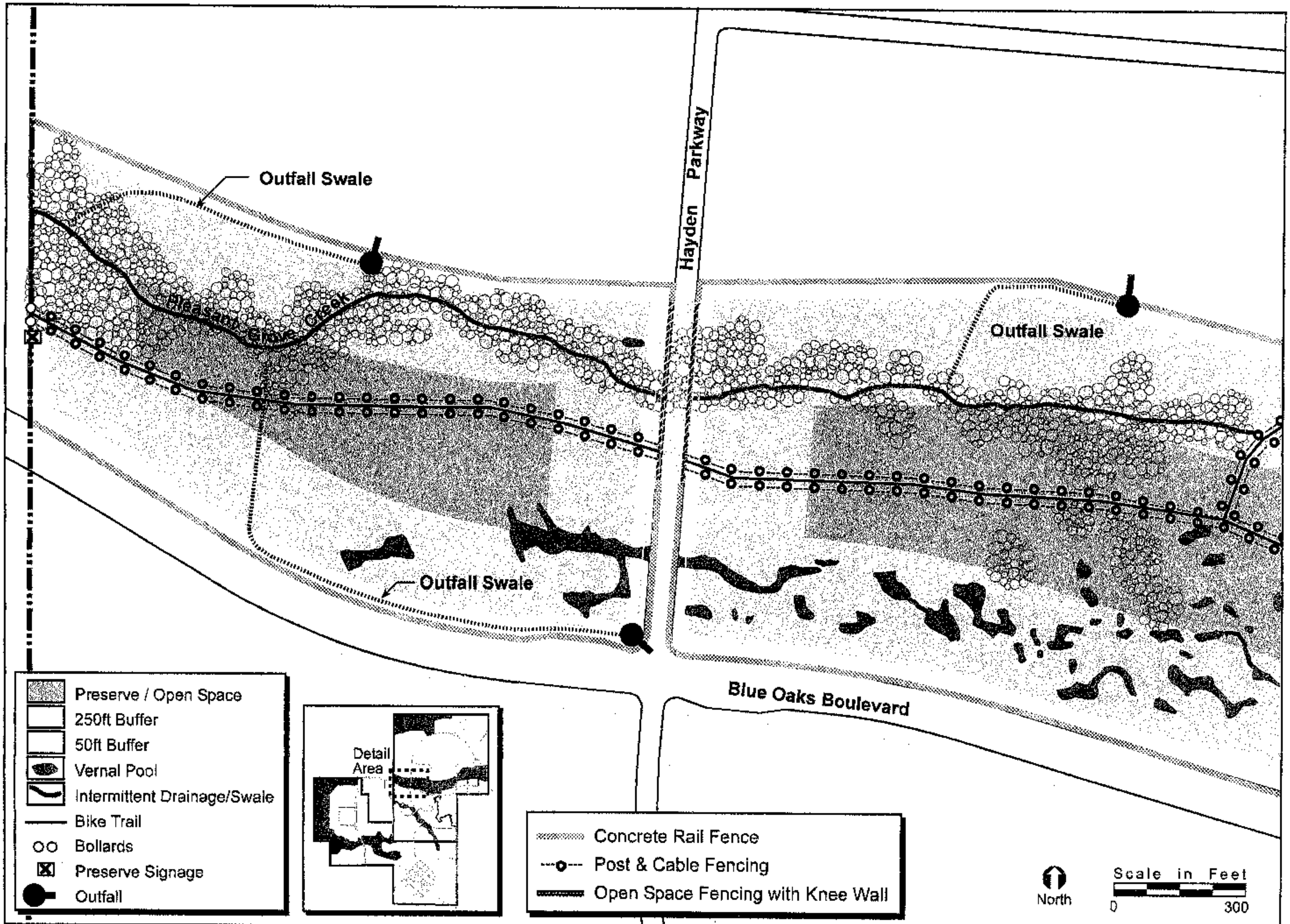

FIGURE 19. Preserve Detail: Parcels F-85 and F-84 (west)

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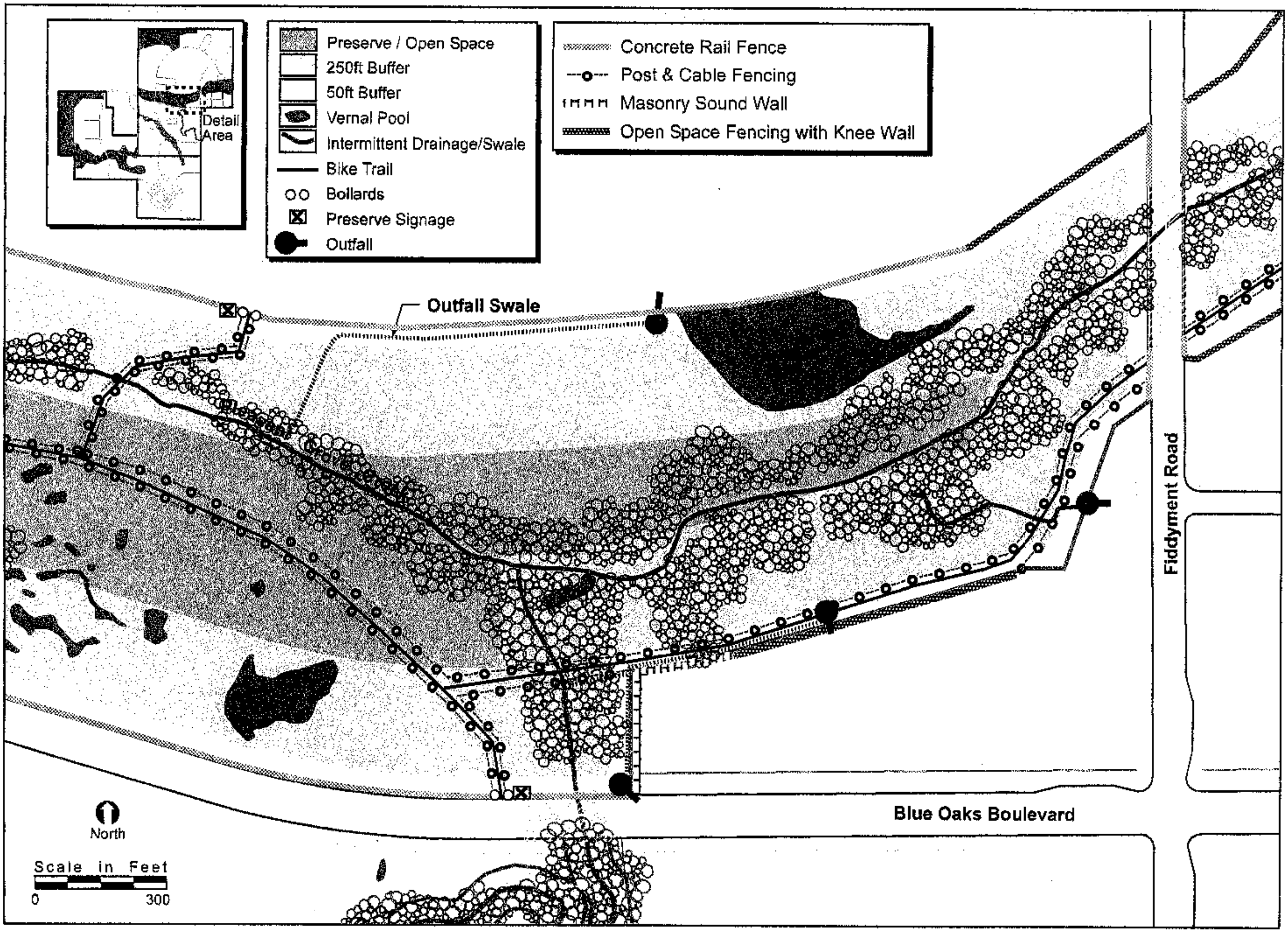

FIGURE 20. Preserve Detail: Parcel F-84 (east)

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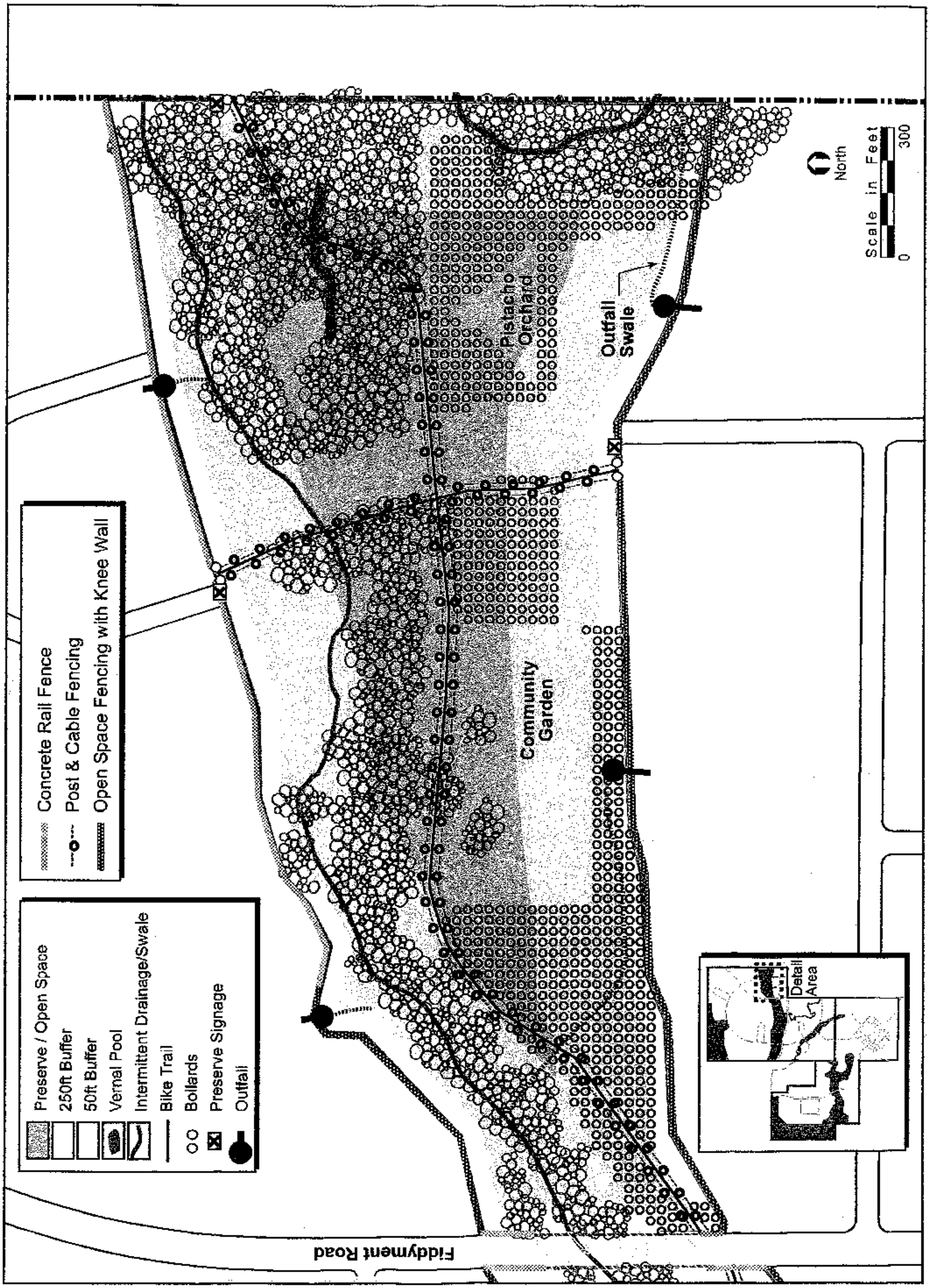

FIGURE 21. Preserve Detail: Parcel F-83

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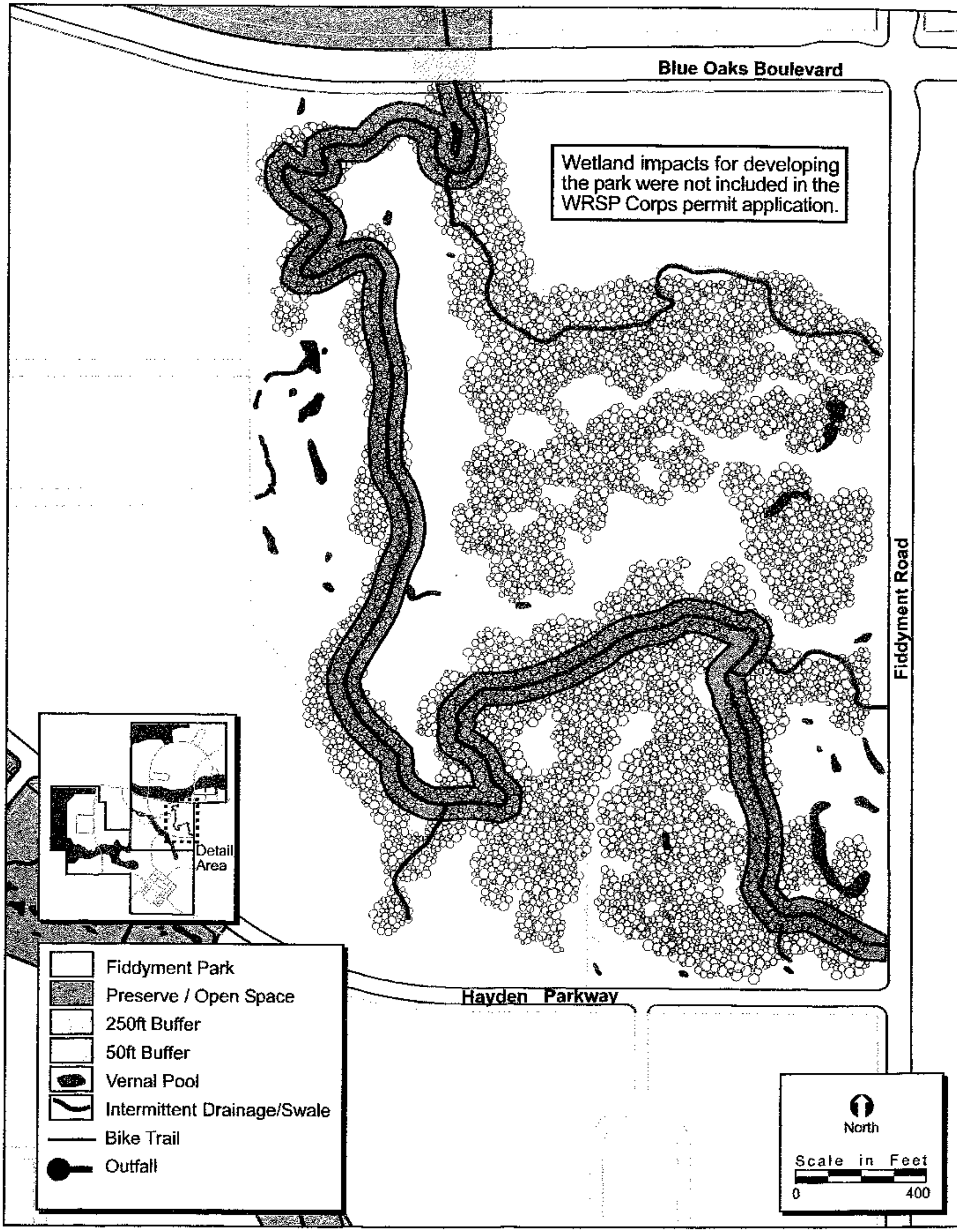

FIGURE 22. Preserve Detail: Parcel F-54

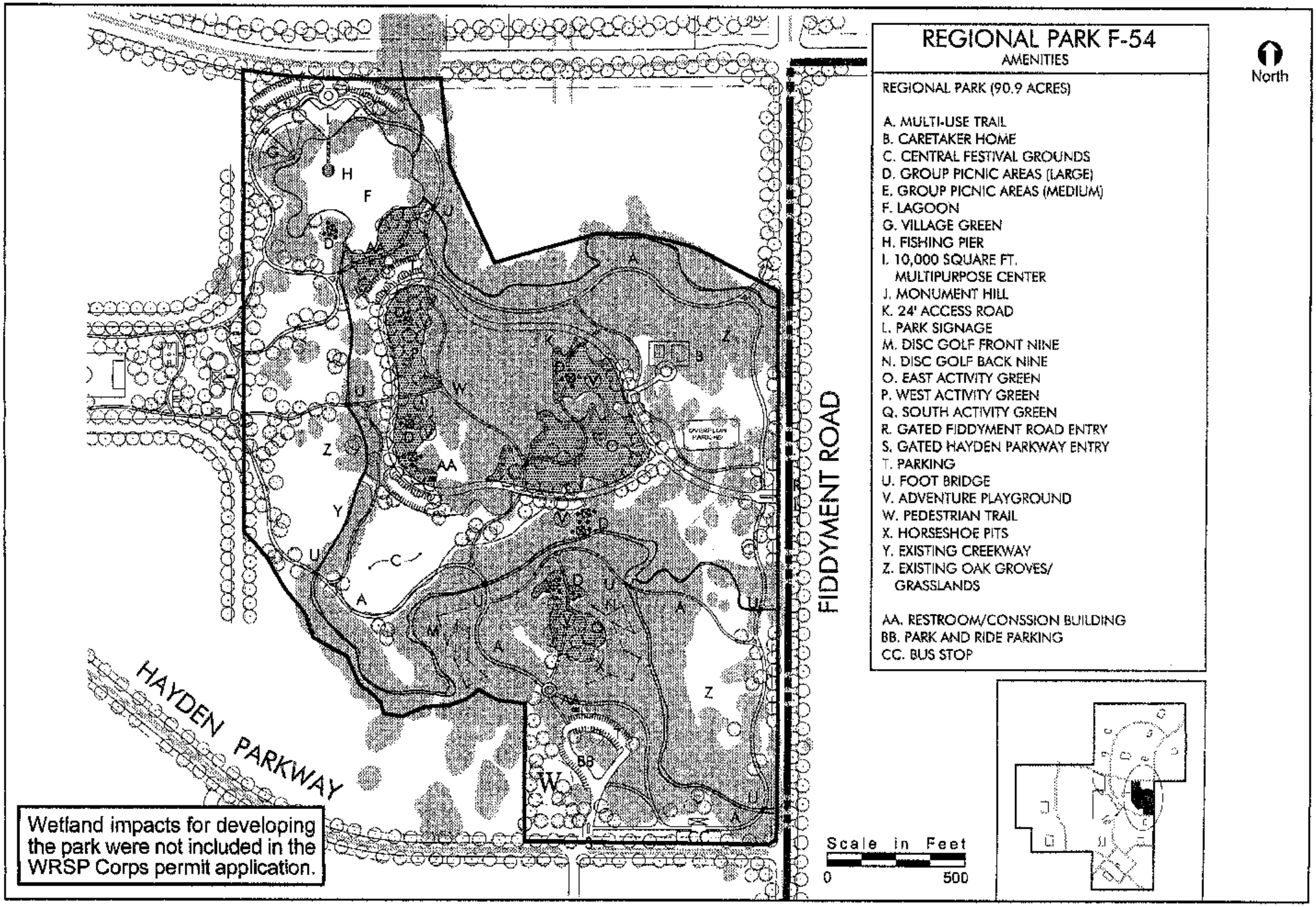

FIGURE 23. Fiddyment Park Amenities

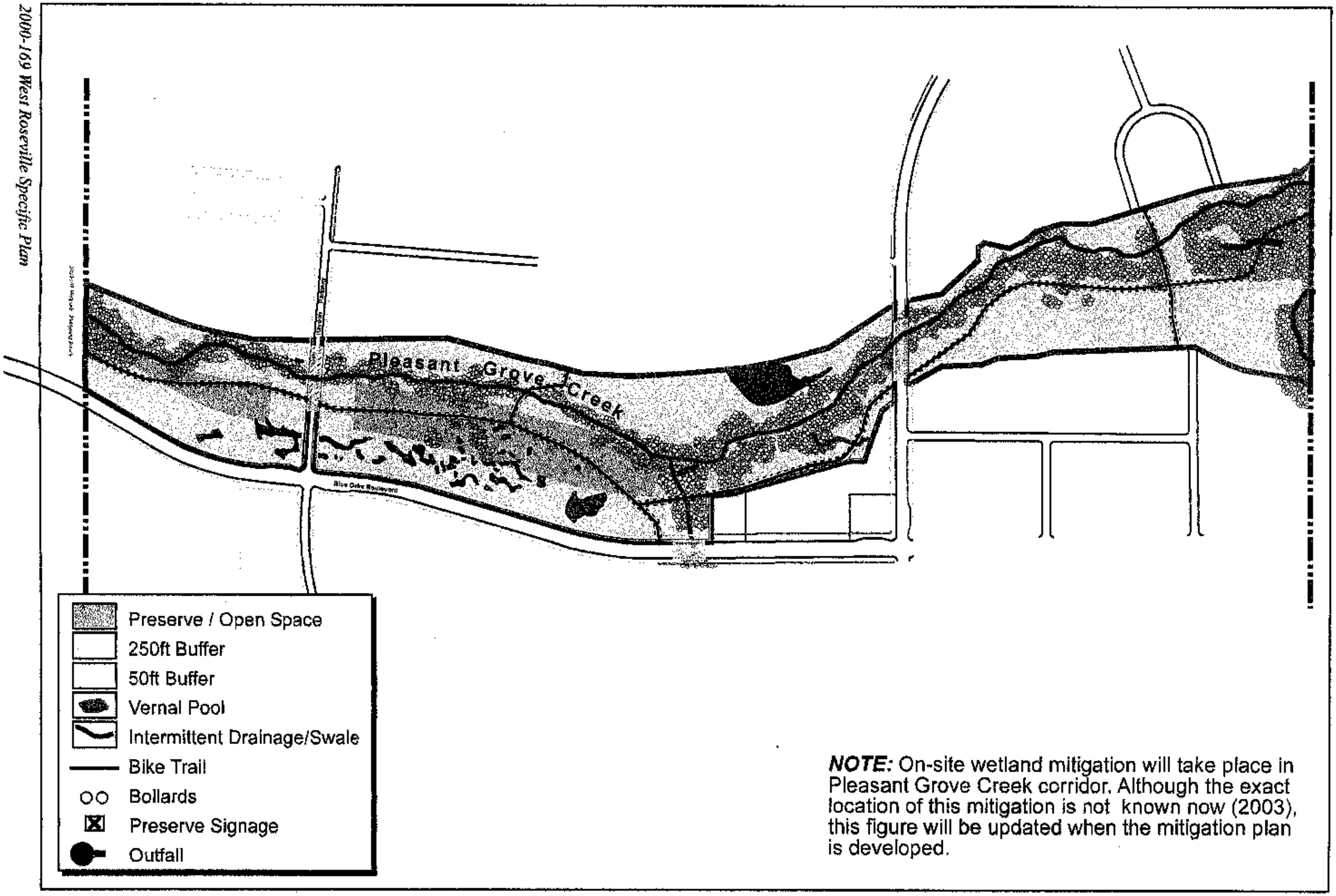

FIGURE 24. On-Site Wetland Mitigation Area

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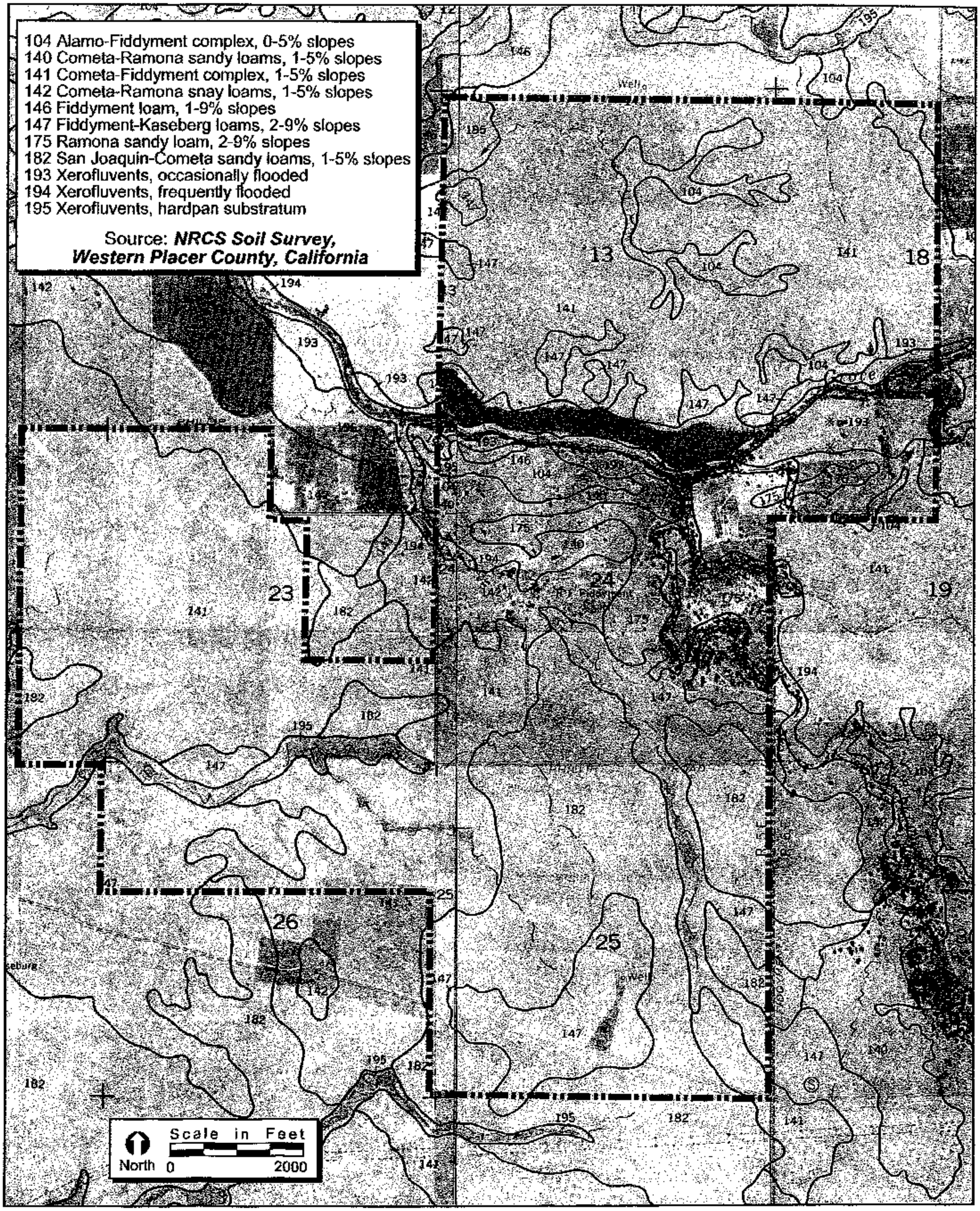

FIGURE 25. NRCS Soil Types

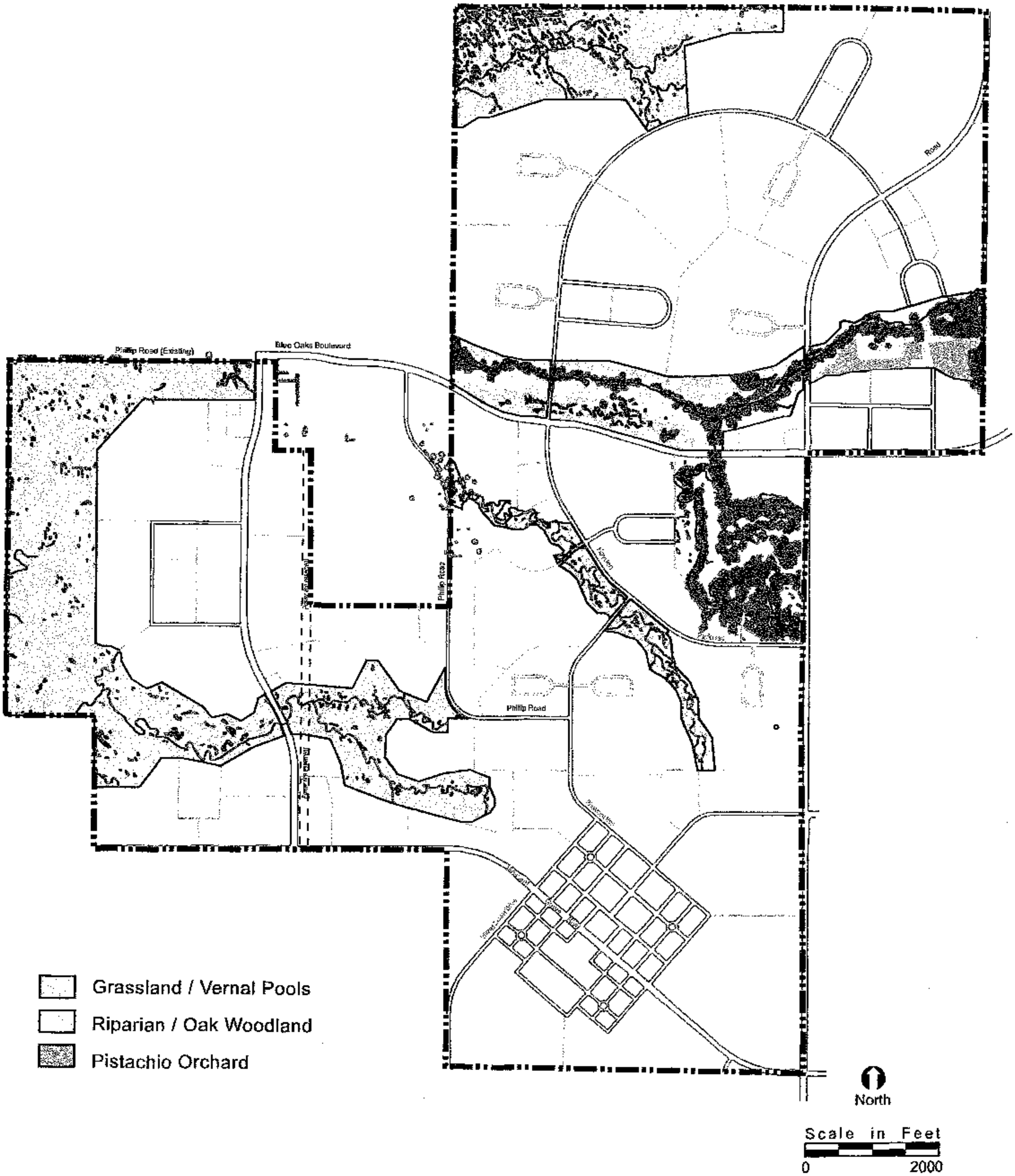

FIGURE 26. Preserve Habitat Map

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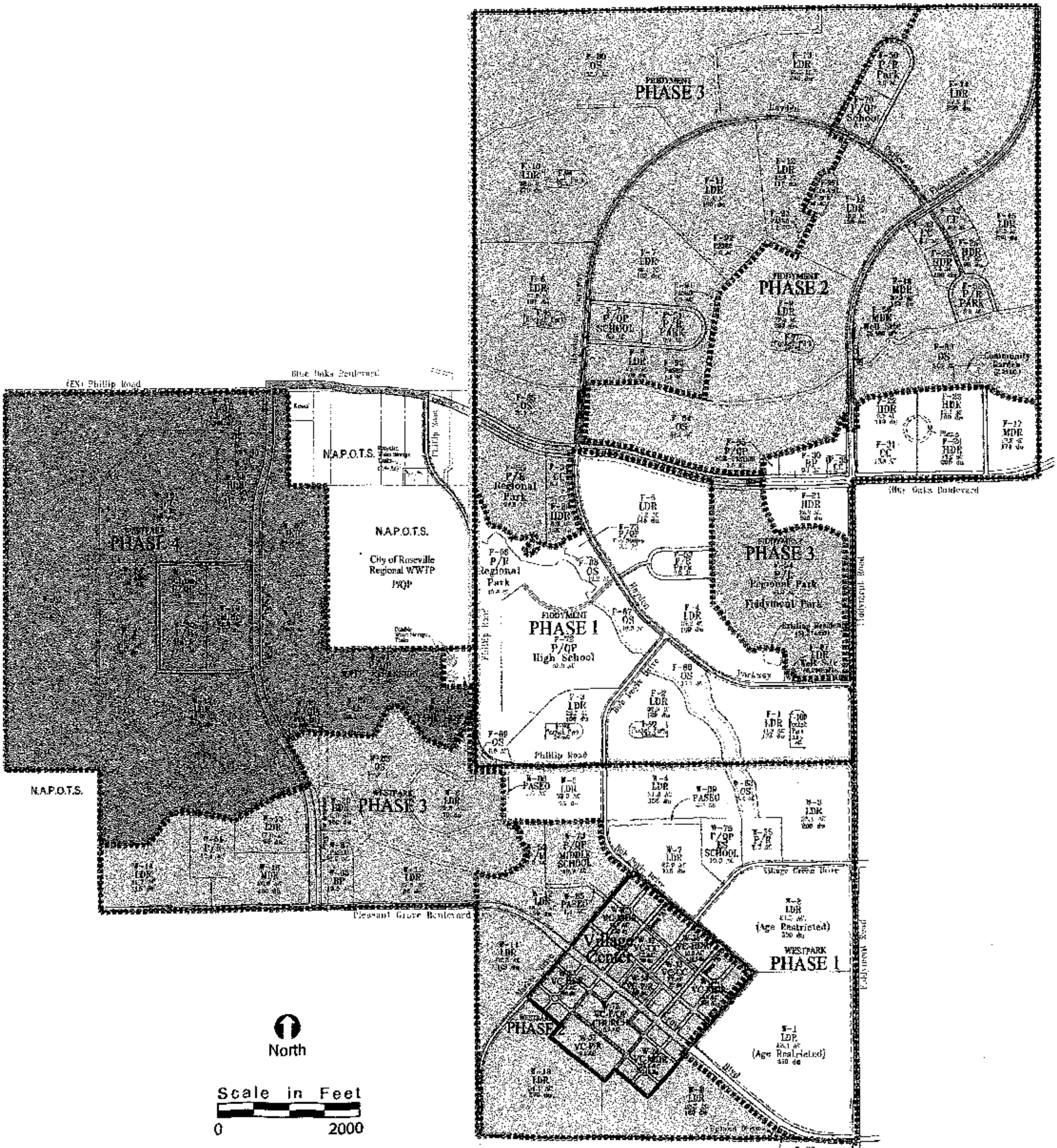

Source: *Draft EIR Land Use Plan*, Wood Rodgers, 8/29/03.

FIGURE 27. Phasing of Development

2000-169 West Roseville Specific Plan

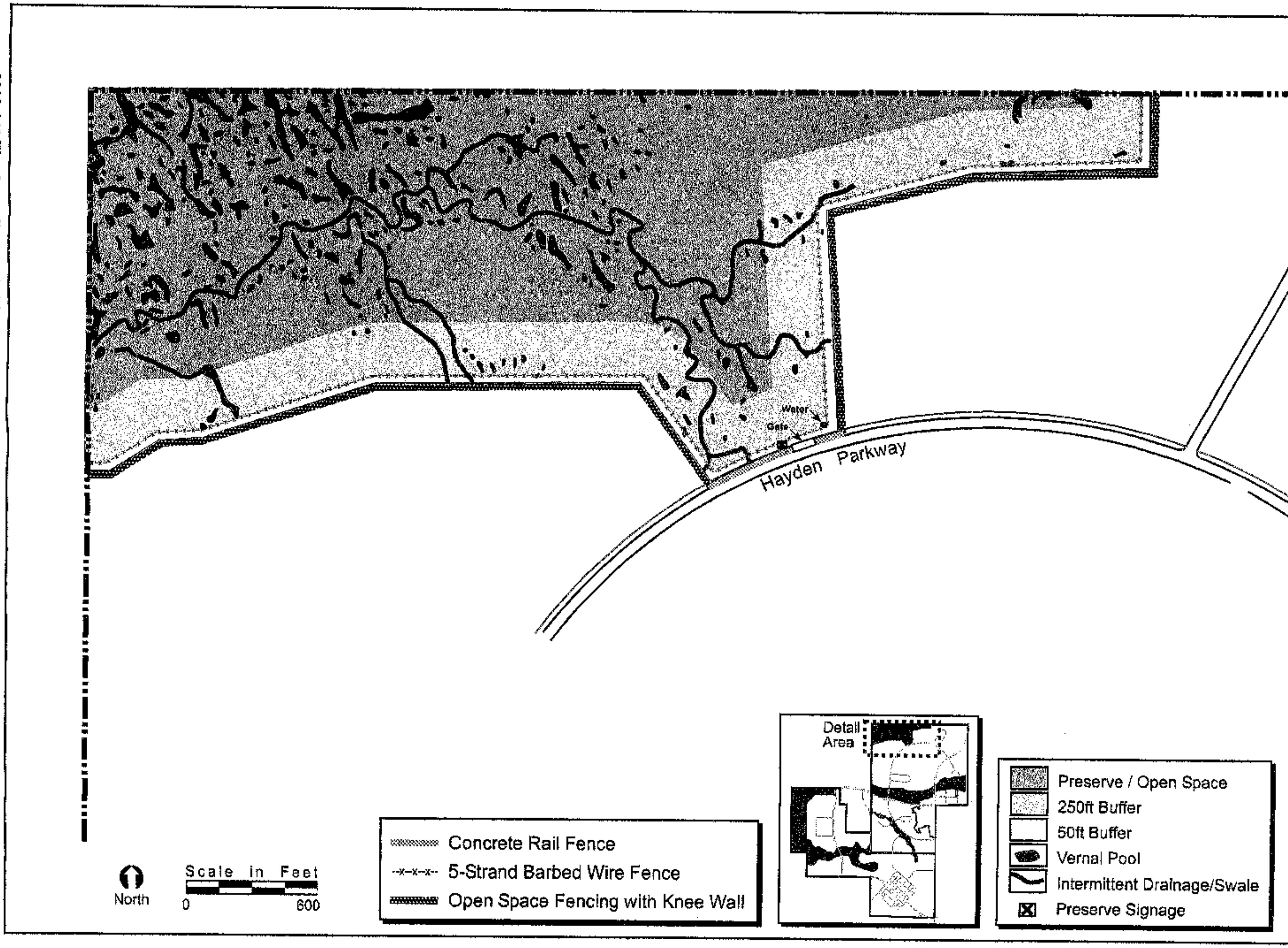

FIGURE 28. Grazing Components, Parcel F-80

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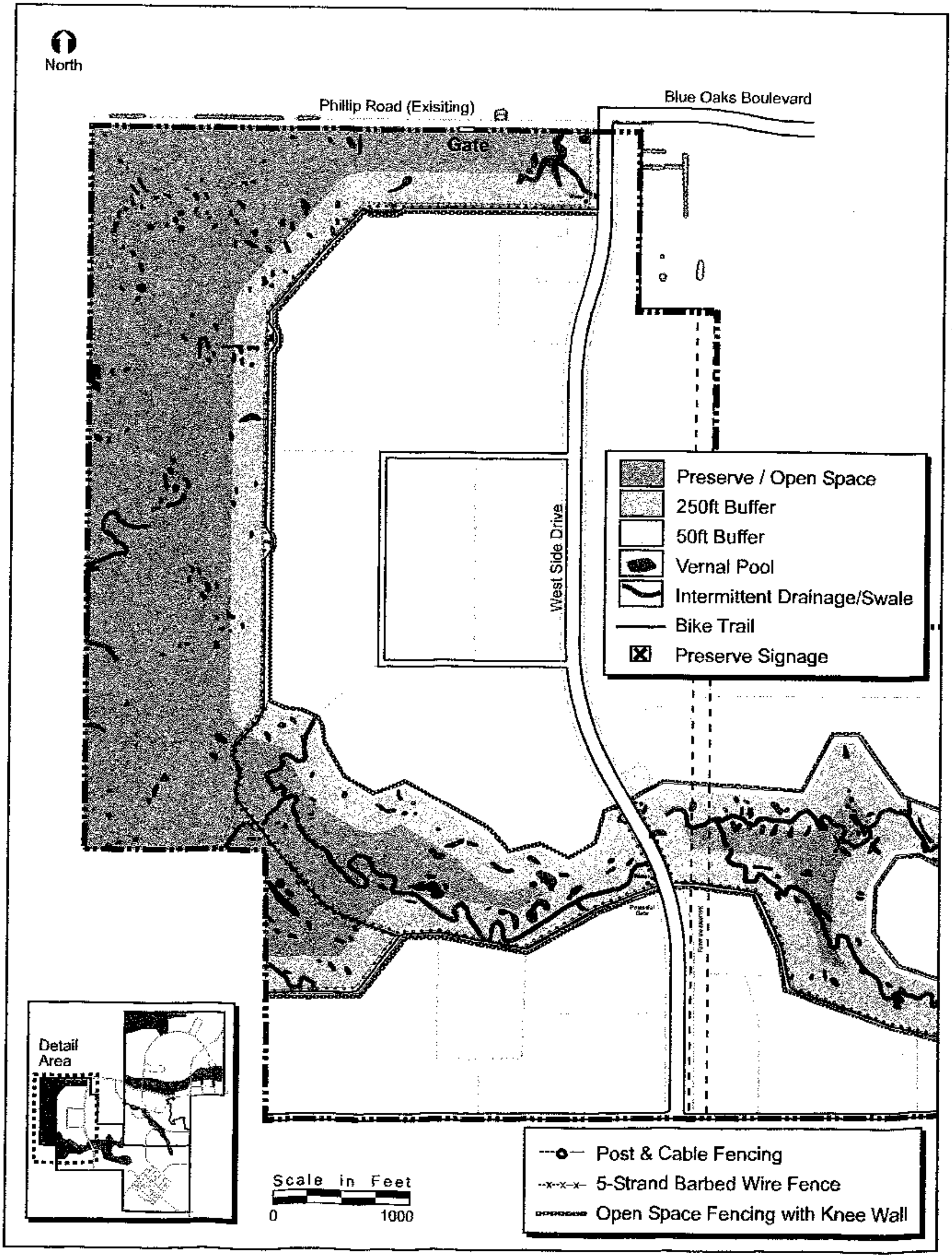

FIGURE 29. Grazing Components, Parcel W-81

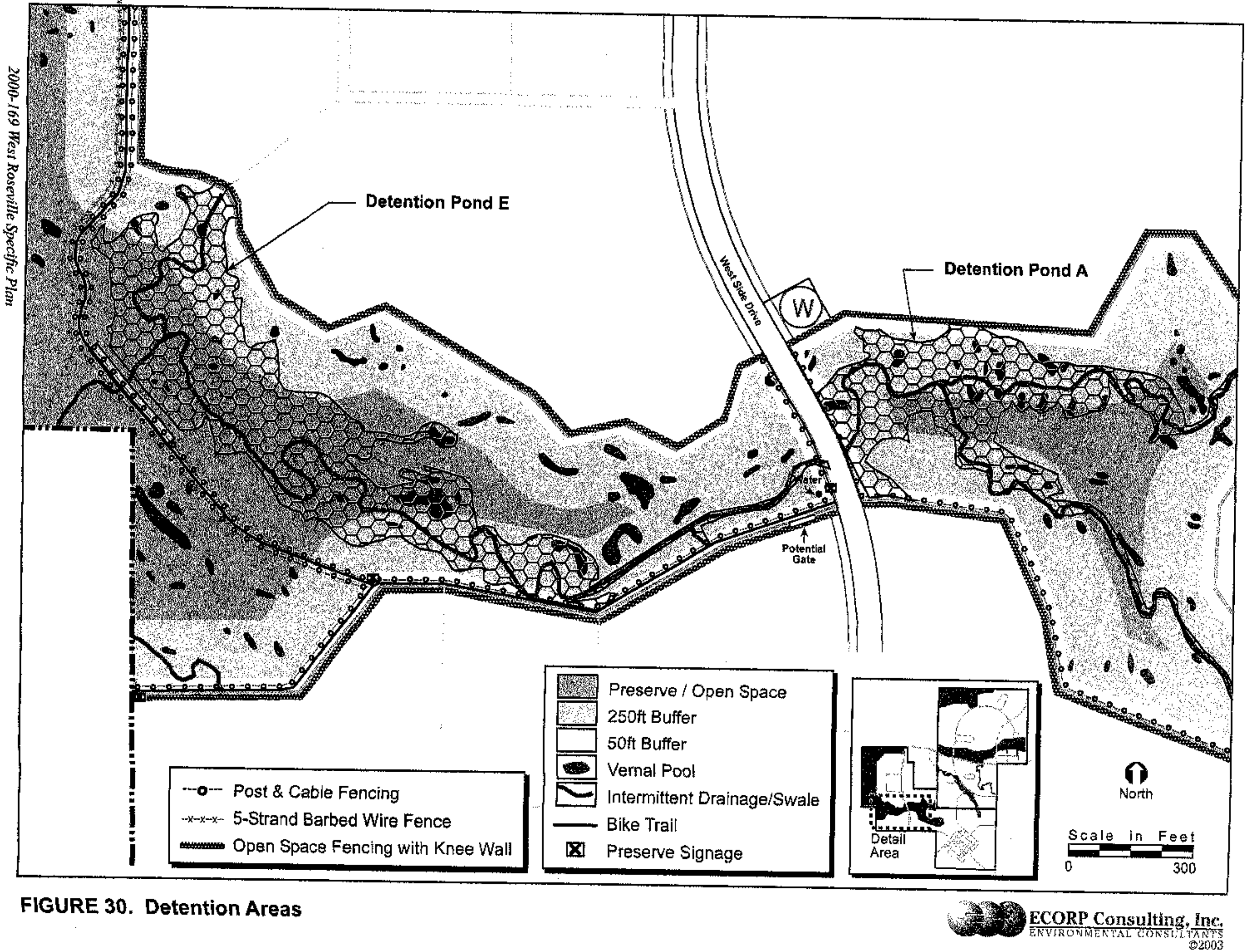

FIGURE 30. Detention Areas

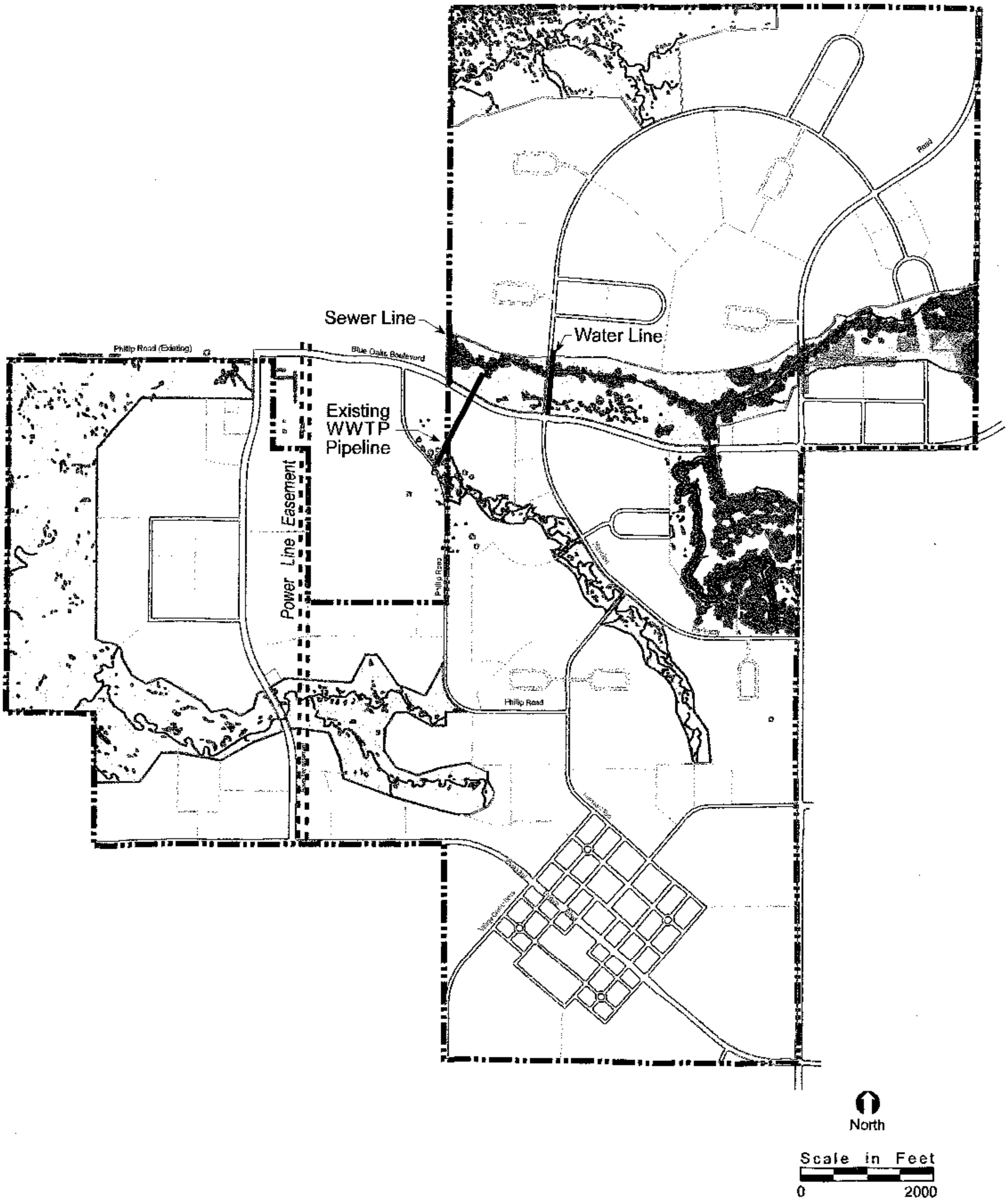

FIGURE 31. Utility Line Locations

2000-169 West Roseville Specific Plan

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS
©2003

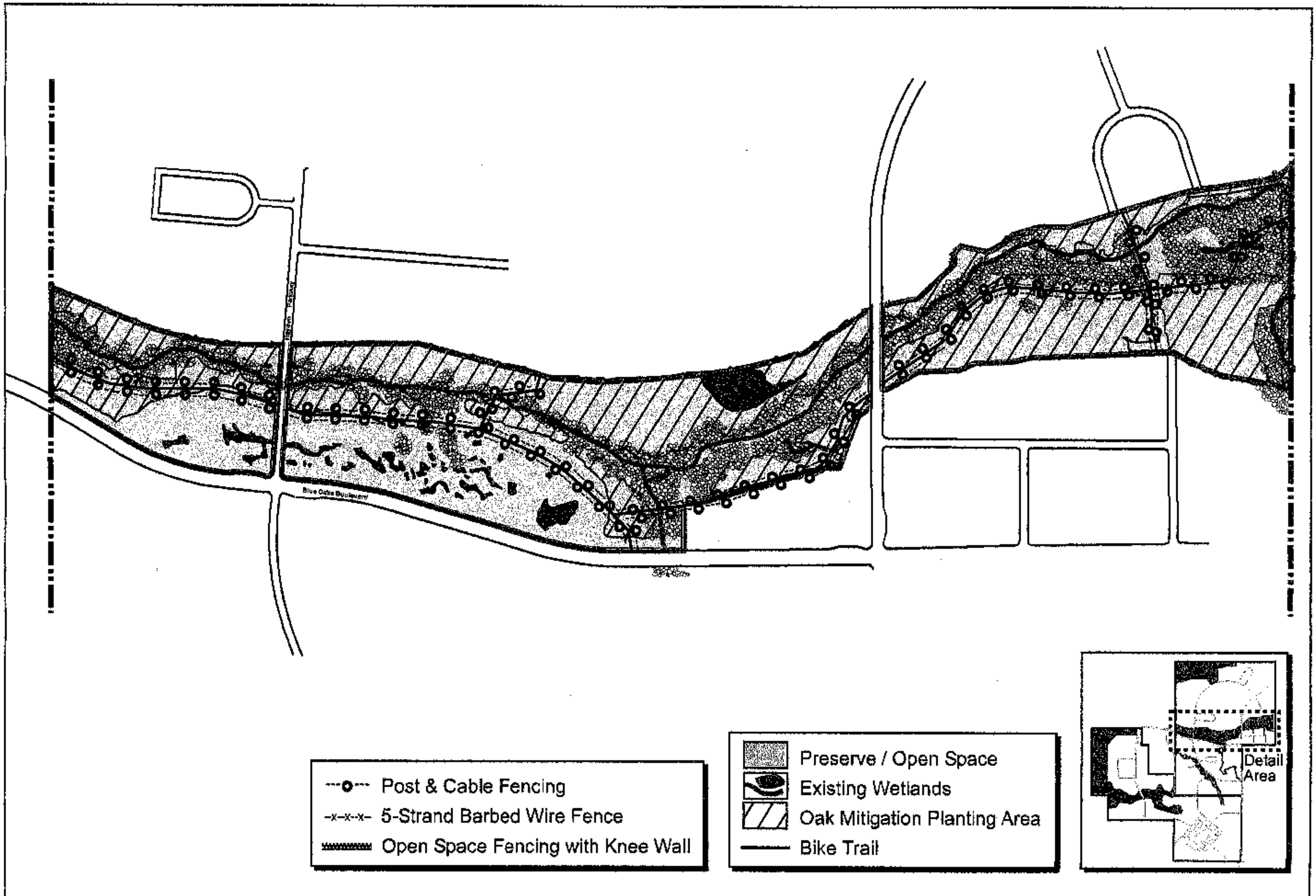

FIGURE 32. Oak Restoration / Potential Mitigation Planting Areas

LIST OF ATTACHMENTS

ATTACHMENT A

Individual Permit

To be attached when received.

ATTACHMENT B

Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

IN REPLY REFER TO:
1-1-03-F-0013

NOV 20 2003

Mr. Tom Cavanaugh
Chief, Sacramento Valley Office
U. S. Army Corps of Engineers
1325 J Street, Room 1480
Sacramento, California 95814-2922

Subject: Formal Consultation on the proposed Westpark/Fiddyment Ranch Project (File 200200666), Placer County, California

Dear Mr. Cavanaugh:

This is in response to your October 21, 2002, letter requesting initiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed Westpark/Fiddyment Ranch project, Placer County, California. Your letter was received on October 23, 2002. The Service has reviewed the biological information submitted by your office describing the effects of the proposed project on the federally endangered vernal pool tadpole shrimp (*Lepidurus packardi*) and the threatened vernal pool fairy shrimp (*Branchinecta lynchi*) and its designated critical habitat. This response is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)(Act).

The Service has determined that the proposed Westpark/Fiddyment Ranch project is not likely to adversely affect the federally threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) or the threatened giant garter snake (*Thamnophis gigas*) because the habitat requirements associated with these species are not present within the proposed project area. The Service's effects determination does not extend to State listed or species of concern such as the Swainson's Hawk (*Buteo swainsonii*) or Burrowing Owl (*Athene cunicularia*), and the applicant is encouraged to seek consultation on potential impacts to these species with the California Department of Fish and Game. The applicant is also reminded that the proposed project should incorporate measures to conserve species protected under the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755) as amended.

The findings and recommendations in this consultation are based on: (1) Information provided regarding the Notice of Preparation of an Environmental Impact Report for the West Roseville Specific Plan, dated August 16, 2002; (2) information included in the Section 404 Individual Permit Application prepared by ECORP Consulting, dated July 10, 2002; (3) a document titled Supplemental Information for Initiation of Section 7 Consultation for Westpark/Fiddyment Ranch, dated September 17, 2002; (4) a letter dated January 21, 2003, that includes the Response to Service Request for Additional Information; (5) the Wetland Delineation for the Fiddyment Property revised in November 1998, and Placer 1600 Property revised in March 1999 by Gibson and Skordal, Wetland Consultants, Sacramento, California; (6) a letter received from Westpark Associates on August 11, 2003, outlining the proposed compensation measures for the proposed project; (7) additional correspondence and meetings between the Service, ECORP and the applicants; and (8) additional information in Service Files.

Consultation History

November 20, 2001. Meeting with representatives of the City of Roseville, Consultants (ECORP), Applicants (Signature Properties and Westpark Associates (Signature/Westpark)), National Oceanic and Atmospheric Administration-Fisheries, U.S. Army Corps of Engineers, California Department of Fish and Game (CDFG), and the Service to discuss the proposed project and agency concerns. The Service and CDFG commit to developing information regarding western Placer vernal pool conservation.

February 7, 2002. Meeting to present/discuss CDFG/Service strategy for dealing section 7 projects prior to NCCP/HCP development in Western Placer County.

March 28, 2002. Reason Farms site visit. Items discussed included design of retention basins, wetland resource compensation potential for site, potential for vernal pool creation for site. Service discussed pulling back of levee design, site may provide minor restoration potential for vernal pools, on-site creation at Reason Farms not suitable compensation for Roseville Specific Plan effects.

August 16, 2002. A Notice of Preparation (NOP) for the Environmental Impact Report (EIR) for the proposed West Roseville Specific Plan was sent out to the public for comment. We received the document on August 27, 2002.

September 16, 2002. We provided comments to the City of Roseville regarding the Notice of Preparation for the Environmental Impact Report for the West Roseville Specific Plan.

October 23, 2002. We received a request for formal section 7 consultation from the U.S. Army Corps of Engineers (Corps) regarding the proposed project. Along with the request was the permit application, biological assessment and supplemental information for initiation of Section 7 consultation provided by ECORP.

November 4, 2002. Meeting regarding West Roseville Specific Plan. Attending were City of Roseville, Consultants, Applicants, U.S. Army Corps of Engineers, Department of Fish and

Game, and the Service. Discussion involved revisions to plan, update on status of Draft EIR, off-site compensation. Service requested information regarding on-site detention basin.

November 22, 2002. We sent the Corp a letter outlining our concerns regarding the project and requested additional information in order to start consultation. We requested additional information regarding a description of how the proposed action may affect any listed species, a cumulative effects analysis, and a description of the compensation plan.

January 21, 2003. We received a letter from ECORP responding to our concerns on the proposed project. The requested information was not provided in ECORP's response letter.

January 30, 2003. Meeting with applicants, applicant's attorney (Mr. George Kammerer), Department of Fish and Game, and the Service. Items discussed were site description proposed development, wetland resources on-site, compensation options on-site and off-site

April 2, 2003. We received a letter from the applicant's attorney regarding the applicant's revised project description and minimization measures including several off-site conservation areas to compensate for loss of listed species habitat as a result of the proposed project.

April 8, 2003. Meeting to discuss project design, wetland resources on-site, impact and avoidance summary, on-site and off-site compensation components.

May 5, 2003. We received correspondence from the applicant regarding approval of the East Sheridan property and the potential need to compensate outside of Placer County.

May 13, 2003. Meeting to discuss on-site avoidance, review additional information provided, off-site compensation proposal.

May 19, 2003. We received a request from Mr. George Kammerer to provide them with a Draft Biological Opinion including Service proposed "reasonable and prudent alternatives" and measures.

June 3, 2003. Meeting to discuss revised on-site plan, wetland habitat impacted, off-site compensation.

June 6, 2003. We responded to the applicant regarding providing a Draft Biological Opinion for the project, informing the applicant that the proper procedures are for the Corps to request a draft and that they should contact the Corps to make such a request.

June 6, 2003. Ms. Lori Rinek, Mr. Ken Sanchez, and Mr. Arnold Roessler of the Service, Mr. Jeff Finn of the California Department of Fish and Game, Mr. Jim Stewart and Mr. Pete Balfour of ECORP made a site visit to the proposed Yankee Slough preserve.

June 9, 2003. We received a letter from the County of Sacramento requesting the Service to not accept projects in Placer County acquire off-site compensation in Sacramento County.

June 16, 2003. Meeting to discuss compensation alternatives and the Yankee Slough parcel and Swainson Hawk mitigation.

July 8, 2003. We received a letter from the applicant outlining the revised compensation plan and notification for purchasing portions of East Sheridan and Yankee Slough properties in Placer County.

July 8, 2003. We received a facsimile from Mr. Greg Bardini of Morton & Pitalo Inc. regarding the proposed retention basin to be constructed within a proposed vernal pool preserve area on the proposed project site.

July 10, 2003. We received a facsimile from Mr. John Tallman who provided copies of the proposed agreements for purchasing portions of the Sheridan East and Yankee Slough properties.

July 11, 2003. We received a letter from Ms. Kellie Berry of Wildlands Inc. regarding the East Sheridan preservation area and the resources available to the proposed development project.

July 14, 2003. We received a letter from the applicants regarding the on-site avoidance areas and their relationship to the preservation requirements of the project. The applicant believes that the on-site "preserves" should be included as part of their compensation package.

July 14, 2003. Meeting to discuss East Sheridan and Yankee Slough parcels, on-site detention basin issues, on-site preservation credit, indirect compensation requirements.

July 16, 2003. We sent a letter (Service File # 1-1-03-TA-2485) to Mr. Bill Falik of Westpark Associates regarding the July 10, 2003, proposed agreements with Wildlands Inc. and Conservation Resources Inc. for purchasing portions of the Sheridan East and Yankee Slough properties. We also notified the applicant that the issues regarding the detention basin are still outstanding.

July 18, 2003. We received a facsimile from Mr. Bill Falik of Westpark Associates regarding the proposed compensation for the detention basin and bike path within the on-site avoidance area. A revised project description was included in the package.

August 7, 2003. We received a revised project description from the applicant memorializing the compensation acreages as outlined in the Service's July 16. 2003, letter to the applicant.

August 11, 2003. We received a letter from Mr. Bill Falik of Westpark Associates regarding the proposed compensation for the entire development project.

BIOLOGICAL OPINION

Description of the Proposed Action

The proposed Westpark/Fiddyment Ranch Project is located in western Placer County, California, west of Fiddyment Road and north of Baseline Road. Pleasant Grove and Kaseberg Creeks traverse the property. The project site lies within portions of Sections 13, 22, 23, 24, 25, 26, & 27 of Township 11 North, Range 5 East, of the 'Pleasant Grove, California' and Section 18 and 19 of Township 11 North, Range 6 East, of the 'Roseville, California' U.S.G.S. quadrangle maps. The site has been used for livestock grazing and retains its natural topography and hydrology. The applicant, proposes to construct approximately 8,430 low, medium and high density housing units, with supporting infrastructure, numerous commercial facilities, schools, and parks on a 3,142 acre parcel. At issue are the adverse effects of the proposed residential and commercial development project on the endangered vernal pool tadpole shrimp and the threatened vernal pool fairy shrimp and its designated critical habitat.

The proposed project site contains 63.89 wetted acres of wetlands, including 33.91 wetted acres vernal pools and 8.05 wetted acres drainage swales considered habitat for listed vernal pool crustaceans. The area also includes approximately 3.92 wetted acres of seasonal wetlands, 0.62 wetted acres of emergent marsh, as well as the Pleasant Grove Creek and Kaseberg seasonal creek. Approximately 0.49 wetted acre of vernal pools within the proposed project area were directly affected as a result of the Pleasant Grove Waste Water Treatment Plant project (Service File 1-1-01-F-0034), and those effects will not be addressed further in this biological opinion.

The effects on wetland resources of the proposed project are outlined in Table 1 below.

Table 1. Wetland Resources on the Westpark/Fiddyment Ranch Project Area

Classification	Existing (acres)	Preserved	Avoided[1]	Direct	Indirect
Vernal Pools	33.91[2]	19.62	11.26	13.8	8.83
Swales	8.05	4.76	1.72	3.29	0.74
Total	41.96	24.38	12.98	17.09	9.57

[1] acreage within preserve areas not indirectly affected
[2] (0.49 acres under previous Service biological opinion for Pleasant Grove Waste Water Treatment Plant, 1-1-01-F-0034)

The applicant proposes to avoid approximately 699.3 acres of vernal pool grassland habitat, in four separate areas of the proposed project (see Attachment A); an approximately 132.7 acre preserve area at the northwest portion of the Fiddyment Ranch portion of the project; an approximately 162.5 acre preserve area along Pleasant Grove Creek, protecting mostly riparian habitat; an approximately 44.4 acre preserve area along the intermittent unnamed tributary to Pleasant Grove Creek: and 100' corridor along Kaseberg Creek which totals 14.7 acres; and a 345 acre preserve area along the western portion and extending to include numerous swales and unnamed channels of the Westpark portion of the proposed development. Approximately 24.38 wetted acres of vernal pools and associated swales will be within the avoided areas. The proposed project's direct and indirect effects include 26.66 acres of vernal pool and vernal swale habitat (as outlined in letters dated July 18, 2003, and August 7, 2003, from Mr. Bill Falik). The applicant proposes to compensate for the loss or degradation of 26.66 acres of listed vernal pool crustacean habitat through the following compensation measures.

For Direct and Indirect Effects:

- The preservation component for vernal pools/swales would include preserving approximately 25.48 acres off-site at the Sheridan East property and 1.2 acres at the Yankee Slough property both in Placer County.

- The restoration component for vernal pool/swales would include restoring approximately 43.00 acres vernal pool grassland habitat at the off-site Yankee Slough property.

Additional measures include:

- No preservation credit will be given for the vernal pools/swales within the on-site avoidance areas.

- The Service shall approve the firm performing the restoration and related monitoring on the Yankee Slough property.

- Restoration can be phased to coincide with losses of habitat as a result of development phasing.

- Phase one of the restoration work is to start on the southern-most portion of the Yankee Slough property.

- Conservation Easement. Vernal pool habitat and associated upland habitat preserved on-site will be protected and managed in perpetuity through a Service-approved conservation easement, Service-approved management plan, and sufficient funds to manage and monitor the site in perpetuity in accordance with the management plan. Funding mechanisms for the maintenance and management may be phased to coincide with phased construction of the project. All maintenance and management obligations associated with this project at the off-site Sheridan East parcel and the Yankee Slough parcel shall be conducted by the respective owners as agreed through separate agreements by the applicant approved by the Service. The applicant has secured the endowment funds necessary for the maintenance and management of the Sheridan East and Yankee Slough parcels in perpetuity.

- Prior to ground-breaking, the applicant will provide the Service with verification that the necessary restoration and preservation acreages have been dedicated in a Service-approved preserve area.

Status of the Species

A final rule was published on September 19, 1994 (59 **FR** 48136), to list the vernal pool fairy shrimp as threatened and vernal pool tadpole shrimp as endangered under the Act. The final rule to designate critical habitat for 15 vernal pool species, including the vernal pool fairy shrimp and vernal pool tadpole shrimp, was published on August 6, 2003 (68 **FR** 46684). Further information on the life history and ecology of the vernal pol fairy shrimp and vernal pool tadpole shrimp may be found in the final listing rule, the final rule to designate critical habitat, Eng *et al.* (1990), Helm (1998), Simovich *et al.* (1992), and Volmar (2002). Vernal pool fairy shrimp are restricted to vernal pools, swales, and other seasonal wetlands in California and southern Oregon. Vernal pool tadpole shrimp are restricted to similar habitats in California's Central Valley and San Francisco Bay area.

Vernal pool fairy shrimp. Vernal pool fairy shrimp have delicate elongate bodies; large, stalked, compound eyes; no hard shell (i.e., no carapace); and 11 pairs of swimming legs. Typically less than 2.5 centimeters (cm) (1 inch) long, they swim or glide gracefully upside-down by means of complex, wavelike beating movements while feeding on algae, bacteria, protozoa, rotifers, and detritus. Female vernal pool fairy shrimp carry eggs in a pear-shaped, ventral brood sac until the eggs are either dropped or sink to the pool bottom with the female when she dies. Eggs which remain after pools dry are known as cysts and are able to withstand heat, cold, and prolonged desiccation. When pools refill in the same or subsequent seasons, some, but not all, of the cysts may hatch, resulting in a cyst bank in the soil that may include cysts from several breeding seasons (Donald 1983). Vernal pool fairy shrimp develop rapidly and may become sexually mature within two weeks after hatching (Gallagher 1996, Helm 1998). Such quick maturation permits fairy shrimp populations to persist in short-lived, shallow bodies of water (Simovich *et al.* 1992).

Vernal pool fairy shrimp inhabit alkaline pools, ephemeral drainages, rock outcrop pools, ditches, stream oxbows, stock ponds, vernal pools, vernal swales, and other seasonal wetlands (Helm 1998). Occupied habitats range in size from rock outcrop pools as small as one square meter to large vernal pools up to 4.5 hectares (12 acres); the potential ponding depth of occupied habitat ranges from 3 cm (1.2 inches) to 1.2 meters (48 inches). The vernal pool fairy shrimp has been collected from early December to early May.

All known occurrences of vernal pool fairy shrimp inhabit sites in California or southern Oregon. The geographic range of this species encompasses most of the Central Valley from Shasta County to Tulare County and the central coast range from northern Solano County to Santa Barbara County, California; additional disjunct occurrences have been identified in western Riverside County, California, and in Jackson County, Oregon near the city of Medford (CDFG 2000-2003, Helm 1998, Eriksen and Belk 1999, Volmar 2002, Service 1994, Service 2003).

Vernal pool fairy shrimp Critical Habitat

The proposed project lies within the Western Placer County Unit (Unit 12) for the vernal pool fairy shrimp designated on August 6, 2003 (68 **FR** 46684). This critical habitat unit is approximately 32,134 acres in size and forms one of the remaining large vernal pool complex areas in the Southeastern Sacramento Valley vernal Pool Region (Keeler-Wolf *et al.* 1998). This unit contains occurrences of the vernal pool fairy shrimp and is considered essential for the conservation of the species. The majority of the lands within the unit are privately owned. Several conservation areas set-up to protect vernal pool habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp have been established within this unit.

In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR §424.12(b)). The Service is required to list the known primary constituent elements together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

(1) space for individual and population growth, and for normal behavior;

(2) food, water, air, light, minerals, or other nutritional or physiological requirements;

(3) cover or shelter;

(4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and

(5) generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

In designating critical habitat for the vernal pool fairy shrimp, the Service identified the following primary constituent elements essential to the conservation of the species:

The first primary constituent element provides the aquatic environment required for cyst incubation and hatching, growth and maturation, reproduction, feeding, sheltering, and dispersal, and the appropriate periods of dessication for cyst dormancy and to eliminate predators such as bullfrogs, fish, and other aquatic predators that depend on year round inundation of wetland habitats to survive. We concluded that this element is essential to the conservation of vernal pool fairy shrimp because the species is ecologically dependent on seasonal fluctuations, such as absence or presence of water during specific times of the year, and duration of inundation (59 **FR** 48136).

The second primary constituent element is essential to maintain the aquatic phase of the vernal pool habitat. The entire vernal pool complex, including the pools, swales, and associated uplands, is essential to support the aquatic functions of the vernal pool habitat. Although the uplands are not actually occupied by vernal pool fairy shrimp, they nevertheless are essential to the conservation of vernal pool habitat and crustaceans because they maintain the aquatic phase of vernal pools and swales. Associated uplands are also essential to provide nutrients that form the basis of the vernal pool food chain, including a primary food source for the vernal pool crustaceans.

The areas designated as vernal pool critical habitat were based on CNDDB (2000-2003) occurrence data, vernal pool mapping, and the vernal pool regions outlined in the California Vernal Pool Assessment Preliminary Report (Keeler-Wolf *et al.* 1998). Placer County is considered within the Southeastern Sacramento Valley Vernal Pool Region. The vernal pool grasslands mapped by Holland (1998b) and Glazner (2001) were used to identify areas which contain the primary constituent elements for the species in Placer County. Site visits, species information, and aerial photography were used to further refine those areas which we consider essential to the conservation of the vernal pool fairy shrimp and to exclude those areas which no longer support the species. As a result of the mapping refinements, approximately 32,134 acres (12,854 hectares) are designated as critical habitat for the vernal pool fairy shrimp in Placer County. The critical habitat within Placer County represents approximately 4.3 percent of the total amount of critical habitat for the 15 vernal pool species in the final rule and approximately 7 percent of the critical habitat designated for the vernal pool fairy shrimp. The critical habitat in western Placer County also represents approximately 84 percent of the critical habitat designated in the Southeastern Sacramento Valley Vernal Pool Region (68 **FR** 46684).

Vernal pool tadpole shrimp. Vernal pool tadpole shrimp have large, shield-like carapaces approximately 1 inch (2.5 cm) long that covers most of their body; dorsal, compound eyes; and a pair of long cercopods, one on each side of a flat caudal plate, at the end of their last abdominal segment. Vernal pool tadpole shrimp are primarily bottom-dwelling animals that move with legs down while feeding on detritus and living organisms, including fairy shrimp and other invertebrates (Pennak 1989). Females deposit cysts (partially developed embryos encased in an egg-like structure) which settle on the pool bottom. Although some cysts may hatch quickly, others remain dormant to hatch during later rainy seasons (Ahl 1991). When winter rains refill inhabited wetlands, tadpole shrimp reestablish from dormant cysts and may become sexually mature within three to four weeks after hatching (Ahl 1991, Helm 1998). Reproductively mature adults may be present in pools until the habitats dry up in the spring (Ahl 1991, Gallagher 1996, Simovich *et al.* 1992).

Vernal pool tadpole shrimp inhabit alkaline pools, clay flats, ditches, freshwater marshes, stream oxbows, vernal lakes, vernal pools, vernal swales, and other seasonal wetlands (Helm 1998). Occupied habitats range in size from vernal pools as small as two square meters to large vernal lakes up to 36 hectares (89 acres); the potential ponding depth of occupied habitat ranges from 4 cm (1.5 inches) to 1.5 meters (59 inches). All known occurrences of vernal pool tadpole shrimp inhabit sites in California. The geographic range of this species encompasses most of (and particularly the eastern side of) the Central Valley from Shasta County to northern Tulare County and the central coast range from Solano County to Alameda County (Service 1994, CDFG 2003). Critical habitat was not designated or proposed for vernal pool tadpole shrimp in western Placer County.

The vernal pool fairy shrimp and tadpole shrimp are ecologically dependent on seasonal fluctuations in their habitat, such as absence or presence of water during specific times of the year, durations of inundation, and other environmental factors that include specific salinity, conductivity, dissolved solids, and pH levels. Water chemistry and soil parent material are two of the most important factors in determining plant and crustacean distribution in vernal pools

(Belk 1977, Holland and Dains 1990, King 1996, Simovich 1998). The genetic characteristics of vernal pool fairy shrimp and vernal pool tadpole shrimp, and the ecological conditions, such as watershed continuity, indicate that populations of these animals are defined by pool complexes rather than by individual vernal pools (Fugate 1992; Keeler-Wolf et al 1998; Service 1994, 2003). Therefore, the most accurate indication of the distribution and abundance of these species is the number of inhabited vernal pool complexes. Individual vernal pools occupied by these species are most appropriately referred to as subpopulations. The pools and, in some cases, pool complexes supporting these species are usually small. Anthropogenic and unforeseen natural catastrophic events such as long-term drought, non-native predators, off-road vehicles, pollution, berming, and urban development, threaten their extirpation at some sites.

Distribution

Vernal pool fairy shrimp. The vernal pool fairy shrimp is known from 33 occurrences extending from the Stillwater Plain in Shasta County through most of the length of the Central Valley to Pixley in Tulare County, and along the central coast range from northern Solano County to Pinnacles in San Benito County (Eng *et al.* 1990, Fugate 1992, Sugnet and Associates 1993). Five additional, disjunct populations exist: one near Soda Lake in San Luis Obispo County; one in the mountain grasslands of northern Santa Barbara County; one on the Santa Rosa Plateau in Riverside County, one near Rancho California in Riverside County, and a recently discovered population near Medford, Oregon. Three of these five isolated populations each contain only a single pool known to be occupied by the vernal pool fairy shrimp.

Vernal pool tadpole shrimp. The vernal pool tadpole shrimp is known from 19 occurrences in the Central Valley, ranging from east of Redding in Shasta County south to Fresno County, and from a single vernal pool complex located on the San Francisco Bay National Wildlife Refuge in Alameda County. It inhabits vernal pools containing clear to highly turbid water, ranging in size from 5 square meters (54 square feet) in the Mather Air Force Base area of Sacramento County, to the 36-hectare (89-acre) Olcott Lake at Jepson Prairie in Solano County.

Dispersal

The primary historic dispersal method for the vernal pool tadpole shrimp and vernal pool fairy shrimp may have been large-scale flooding resulting from winter and spring rains which allowed the animals to colonize different individual vernal pools and other vernal pool complexes. This dispersal mechanism may no longer function in some areas due to the construction of dams, levees, and other flood control measures, and widespread urbanization and agricultural conversion of lands within significant portions of the range of this species. Waterfowl and shorebirds are now considered the primary dispersal agents for vernal pool tadpole shrimp and vernal pool fairy shrimp (Simovich *et al.* 1992, Eriksen and Belk 1999). The eggs of these crustaceans are either ingested (Krapu 1974, Swanson *et al.* 1974, Driver 1981, Ahl 1991) and/or adhere to the legs and feathers where they are transported to new habitats.

Environmental Baseline

The main threat to listed vernal pool crustaceans is the loss of habitat associated with human activities, including urban/suburban development, water supply/flood control development, and conversion of natural lands to intensively farmed agricultural uses. Detrimental effects associated with these activities include the physical destruction of wetlands, adverse alteration of hydrology, introduction of toxic substances and insecticides/herbicides, introduction of non-native plants and animals, increased water run-off from residential and commercial development, and illegal dumping of residential materials. State and local laws and regulations do not protect listed vernal pool crustaceans, the other laws and regulations, including the Clean Water Act, have not effectively maintained habitat necessary to conserve and recover these species. Although developmental pressures continue, only a small fraction of vernal pool habitat is protected from the threat of destruction.

Holland (1978) estimated that about two thirds of the grasslands that once supported vernal pools in the Central Valley had been destroyed by 1973 with an associated loss of nearly 75 to over 95 percent of vernal pool habitat. In subsequent years, a substantial amount of the remaining habitat for vernal pool crustaceans has been destroyed with estimates of habitat loss ranging from two to three percent per year (Holland 1998a). Coe (1988) estimated that, between 1988 and 2008, 60 to 70 percent of the remaining vernal pools within the jurisdiction of the U.S. Army Corps of Engineers, Sacramento District would be lost to development.

Occurrences of listed vernal pool crustaceans are highly fragmented throughout their ranges due to the nature of vernal pool landscapes and the destruction of natural habitat by human activities. Such fragmentation results in small, isolated populations which may be more susceptible to extinction due to random demographic, genetic, and environmental events (Gilpin and Soule 1986; Goodman 1987 a,b; Noss *et al.* 2002). Furthermore, if localized extinctions occur in fragmented populations, the opportunity for recolonization of previously occupied habitat is reduced due to the geographic isolation of potential habitats from occupied sites (Noss *et al.* 2002).

Loss of Vernal Pool Habitat in the Southeastern Sacramento Valley Vernal Pool Region. Of the several thousand vernal pools that are located around Sacramento, Coe (1988) has suggested that perhaps 1,800 vernal pools will be impacted due to future development in western Placer County alone. Western Placer County is located in the Southeastern Sacramento Vernal Pool Region, one of 17 vernal pool regions in the State of California defined by the California Department of Fish and Game in the California Vernal Pool Assessment Preliminary Report (Keeler-Wolf *et al.* 1998). The regions were identified according to biological, geomorphological, and soils information. According to the report, "One of the primary assumptions is that these regions are ecologically distinct and that they encompass the full range of variability of vernal pools and species in the state" (Keeler-Wolf *et al.* 1998).

The Southeastern Sacramento Valley Vernal Pool Region contains almost 15% of the remaining vernal pool grasslands in the State of California, and supports 35% of the known occurrences of the vernal pool fairy shrimp documented in the California Natural Diversity Database. It is the most threatened by development of the 17 regions. Of 155 projects authorized by the Service to take vernal pool fairy shrimp and vernal pool tadpole shrimp since the species were federally listed in 1994, almost 80% (121 projects) were located within the southeastern Sacramento Vernal Pool Region. These projects resulted in the loss of more than 37,500 acres of vernal pool grasslands, out of a total of almost 56,000 acres of uplands containing vernal pool fairy shrimp and vernal pool tadpole shrimp habitat. Close to 20,000 acres of vernal pool grassland habitats have been preserved through the Act since the listing of the vernal pool fairy shrimp and vernal pool tadpole shrimp, yet only 7,000 acres are contained within the Southeastern Sacramento Vernal Pool Region.

Development projects within western Placer County, including the Highland Reserve, Highland Reserve North, Sunset West, Stanford Ranch, Twelve Bridges, Sun City Lincoln Hills, and Stoneridge Specific Plan Area, (Olympus Oaks, Cavitt Ranch projects), have reduced the number of vernal pool complexes within the area. These developments and others within the region, have resulted in both direct and indirect effects to vernal pools, and have contributed to the loss of vernal pool fairy shrimp and vernal pool tadpole shrimp occurrences. Although the reduction of federally listed vernal pool crustacean populations has not been quantified, the acreage of lost habitat continues to grow. General and Specific Plans for the western Placer County area such as the proposed Placer Vineyards, Antonio Mountain Ranch, Three-D project, Whispering Springs, Placer Parkway, and State Route 165 bypass, as well as numerous other proposed housing, industrial, infrastructure, energy facilities, universities, hospitals, and other development projects in and around the city of Lincoln, Rocklin, Roseville and in Placer County have identified significant, unavoidable impacts to biological communities, including elimination of vernal pools, intermittent drainages and other seasonal wetlands. Despite these impacts, city and county governments continue to implement development projects within the area.

Vernal Pool Fairy Shrimp Critical Habitat. Approximately 467,148 acres of critical habitat has been designated for the vernal pool fairy shrimp throughout California and southern Oregon. Portions of the vernal pool wetlands and associated uplands which contain the necessary primary constituent elements within western Placer County have been designated as critical habitat unit 12 (32,134 acres) and are essential for the conservation of vernal pool fairy shrimp. The Placer County unit 12 represents one of the last remaining large vernal pool grassland landscapes in the Southeastern Sacramento Valley and plays an important part in providing connectivity between other vernal pool habitats further to the north and south. The primary dispersal agent for vernal pool fairy shrimp and other crustaceans is transport by waterfowl and other migratory birds. The loss and further fragmentation of existing vernal pool habitats lessens the chance that migratory birds will visit such habitats and as a result, the dispersal rate, colonization, and recolonization of listed vernal pool crustaceans into viable habitats would be affected. Vernal pool fairy shrimp critical habitat will be affected by the same development activities that destroy or alter other vernal pool or ephemeral wetland habitat and/or change the hydrologic patterns within the vernal pool complexes in California and Southern Oregon.

Effects of the Proposed Action

The proposed Westpark/Fiddyment Ranch project would eliminate one of the last remaining intact vernal pool grasslands complexes in western Placer County supporting occurrences of listed vernal pool crustaceans. The proposed project would directly or indirectly affect 26.66 acres of vernal pool habitat for the listed vernal pool crustaceans as follows: 1) result in the direct mortality of all listed vernal pool crustaceans inhabiting 17.09 acres of habitat and indirectly affecting 9.57 acres of habitat within the on-site preserve for listed vernal pool crustaceans; 2) eliminate or degrade over two thousand acres of intact vernal pool grassland supporting vernal pool fairy shrimp; 3) reduce and further fragment one of the largest remaining high quality areas of listed crustacean habitat within the Western Placer area and the Southern Sacramento Vernal Pool Region; and 4) increase construction-related and other human-related disturbances to the listed vernal pool crustaceans. The direct and indirect effects of the project would result in the loss or degradation of over 66 percent of the vernal pools and swales located on the Westpark/Fiddyment Ranch project site.

Direct Effects
The construction of the proposed Westpark/Fiddyment Ranch residential development will result in the direct loss of 17.09 acres of federally listed crustacean habitat, and the death of an unknown number of vernal pool fairy shrimp and vernal pool tadpole shrimp.

Indirect effects
Approximately 9.57 acres of vernal pool tadpole shrimp and vernal pool fairy shrimp habitat avoided on the project site would be adversely affected by the indirect effects of the project. Due to non-existent or inadequate buffers, these avoided pools would be vulnerable to the effects of the surrounding development, including the effects of proposed roads, crossings, a detention basin, bike trails, paths and access roads through the project area and the commercial, residential, school, and park land uses associated with the proposed project. Indirect effects associated with the proposed Westpark/Fiddyment Ranch project include erosion, changes in hydrology, human-related disturbance, degradation of the upland areas, and introduction of pollutants.

<u>Changes in hydrology</u>. The proposed Westpark/Fiddyment Ranch project is likely to alter the hydrology of the remaining vernal pool habitats on the project site. Although vernal pools are typically filled by rain water, vernal pool hydrology can be influenced by a variety of factors. Vernal pool hydrology can be directly altered when swale systems connected to vernal pools are dammed by physical barriers, such as roads and canals or other development. The project also includes creation of an earthen berm detention basin within the swale system within one of the vernal pool preserve areas. These activities will alter vernal pool hydrology both upstream and downstream of the barrier. These components of the proposed Westpark/Fiddyment Ranch project will disturb vernal pool hydrology by altering patterns of overland and subsurface flow.

The proposed project will involve construction of storm water drains and the coverage of land surfaces with concrete, asphalt, and irrigated landscaping. These aspects of the project likely will alter the duration, volume and frequency of surface flows through increased flooding and runoff. The timing, frequency, and length of inundation of the vernal pool habitat are critical to the fairy shrimp and the vernal pool tadpole shrimp; any substantial hydrologic change in these factors will adversely affect the animals. Alterations in the water regime threaten the vernal pool crustaceans because they can result in: (1) insufficient wetting or premature pool dry-down before the life cycles of the species are completed; (2) flowing water that washes away the cyst bank; (3) altered vernal pool crustacean reproduction and longevity (Helm 1998); and (4) conversion of the vernal pool habitat to a marsh-dominated or a permanent aquatic community, leading to predation of vernal pool crustaceans from the introduction of bullfrogs and fish (Bauder 1986, 1987); and (5) altering the dry season by brief unnatural inundation which may result in premature cyst hatching or destruction.

Human-related disturbance. The proposed Westpark/Fiddyment Ranch development will increase human-related disturbance of vernal pool habitats on the project area. Waste materials from the residential development bordering the proposed on-site preserve areas would be deposited onto preserve area. Pedestrian trails are proposed to border and be within the on-site preserve areas. This access will increase impacts to the preserve from people's activities, including off-trail access, bicycle riding, pets, and trash dumping. De Weese (1998) found that the most frequently observed adverse impacts to vernal pools were human-related activities.

Pollutants. Toxic chemicals, such as petroleum products, pesticides, herbicides, fertilizers and soap, may wash into vernal pools during development of the Westpark/Fiddyment Ranch project area. Contamination of vernal pools from the Westpark/Fiddyment Ranch project area areas may injure or kill vernal pool crustaceans. Vernal pool crustaceans are highly sensitive to the chemistry of their vernal pool habitats (Belk 1977, Eng *et al.* 1990, Gonzalez *et al.* 1996). Vernal pools adjacent to existing developments may be contaminated from roadway contaminants in surface runoff (e.g., grease, oil, and heavy metals). Contamination also may result from increased discharge of contaminants such as fertilizers and pesticides into surface waters from landscaped residential areas (Petrovich 1990). Fertilizer contamination can lead to the eutrophication of vernal pools, which can kill vernal pool crustaceans by reducing the concentration of dissolved oxygen (Rogers 1998).

Habitat fragmentation. In addition to the direct and indirect loss of vernal pool crustacean habitat in this region, the Westpark/Fiddyment Ranch project will contribute to extensive habitat fragmentation of remaining vernal pool habitats in the local area. The proposed Westpark/Fiddyment Ranch project will increase the distance between areas of remaining habitat, thereby reducing the opportunity for recolonization and dispersal between populations of vernal pools crustaceans. Successful colonization may be fairly rare for vernal pool crustaceans (Simovich 1998). The effects of fragmentation in the Southeastern Sacramento Vernal Pool Region have been significant. Extant populations of vernal pool fairy shrimp are increasingly isolated and vulnerable to extirpation from chance events.

As stated earlier, individual vernal pools are unique micro-habitats (Belk 1977, Eng *et al.* 1990, Gonzalez *et al.* 1996, Holland and Griggs 1979, Holland and Dains 1990) based on water chemistry and soil parent material. The conservation of different vernal pool types maintains habitat diversity that promotes genetic diversity (Fugate 1992, King 1996, Fugate 1998, Noss *et* *al.* 2002), and reduces the chance of losing disjunct populations of vernal pool fairy shrimp that are important for their genetic uniqueness (Simovich 1998, Platenkamp 1998). Loss of genetic diversity can have significant effects on a population's ability to respond to environmental

change over time (Frankel and Soule 1981). Species that are protected across their ranges have lower chances of extinction (e.g., Soule and Simberloff 1986, Noss *et al.* 1997, Noss *et al.* 1999).

Effects of the Proposed Minimization Measures

The project would maintain approximately 699.3 acres of open space on-site, in four separate preserve areas on the proposed project site; a 132.7 preserve area at the northwest portion of the Fiddyment Ranch portion of the project; a 162.5 preserve area along Pleasant Grove Creek, protecting mostly riparian habitat; a 44.4 acre preserve area along the intermittent unnamed tributary to Pleasant Grove Creek; a 100' corridor along Kaseberg Creek which totals 14.7 acres; and a 345 acre preserve area along the western portion and extending to include numerous swales and un-named channels of the Westpark portion of the proposed development. The four areas support approximately 19.62 acres of wetted vernal pools and 4.76 acres of vernal swales considered habitat for listed crustaceans. These on-site preserve areas would be fragmented from each other and be fragmented and isolated from other vernal pool habitats within the county. This fragmentation and isolation further disrupts and may preclude the long-term viability of the habitat on-site. As a result no reduction in compensation requirements will be granted by establishing these on-site preserve areas. A conservation easement will be recorded on the four preserve areas.

Preservation component. To minimize the loss of 26.66 acres of directly and indirectly affected vernal pools and swales, the applicant is preserving 25.48 acres of wetted vernal pool acres off-site on the Sheridan East parcel in Placer County. An additional 1.2 acres will be preserved at the Yankee Slough parcel in Placer County due to effects associated with the on-site detention basin.

Restoration component. To minimize the loss of 26.66 acres of directly and indirectly affected vernal pools and swales the applicant is restoring a total of 43.0 acres on the southern portion of Yankee Slough parcel in Placer County. The combination of on-site preserves and off-site preserves and restoration will assist in off-setting the loss of vernal pool crustacean habitat on-site and limit the indirect effects of the proposed Westpark/Fiddyment project.

Effects to Vernal Pool Fairy Shrimp Critical Habitat

Issuance of a permit for the proposed Westpark/Fiddyment project will result in loss of approximately 2,436 acres of the designated critical habitat unit 12 for vernal pool fairy shrimp. The loss represents 7.5 percent of the designated critical habitat unit 12 and approximately 0.5 percent of the total critical habitat designated for vernal pool fairy shrimp. The proposed project will preserve on-site approximately 706 gross acres of designated vernal pool fairy shrimp critical habitat. This represents approximately 22 percent of the critical habitat on-site. Since the publication of the proposed critical habitat rule on September 24, 2002 (67 **FR** 59884), and final critical habitat rule on August 6, 2003 (68 **FR** 46684), we have received additional information regarding occurrences of vernal pool fairy shrimp in the Sheridan area in north western Placer County. The Sheridan area has been found to contain numerous occurrences of vernal pool fairy shrimp and the vernal pool grassland habitats within the Sheridan area has been less subject to development pressure and is less fragmented than habitats near Lincoln, Rocklin and Roseville. The off-site preservation components at Sheridan East and Yankee Slough assist in preserving large parcels of vernal pool habitat in this northwestern portion of Placer County and would off-set the loss of habitat on the proposed Westpark/Fiddyment site.

Cumulative Effects

Cumulative effects are those impacts of future State, Tribal, county, local agency, and private actions that are reasonably certain to occur. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The proposed Westpark/Fiddyment Ranch project site is located in a region where future destruction of vernal pool habitat is anticipated. The Cities of Roseville, Rocklin, and Lincoln and the County of Placer continue to develop Specific and General Plan which do not adequately compensate for the loss of endangered species habitat. Such development will result in increased direct loss of federally listed vernal pool crustacean habitat. It will also contribute to the imperilment of existing vernal pools and seasonal wetlands throughout the area through alterations to local watersheds and disruption of natural flooding regimes.

The Service is currently working with local jurisdictions to establish a more comprehensive vernal pool conservation strategy for the Southeastern Sacramento Vernal Pool Region. These efforts include the Placer County HCP, several city wide planning efforts, and the South Sacramento County HCP. These planning efforts are collectively aimed at establishing a regional preserve system that is configured and managed to provide for the long-term survival of a diversity of special status species including vernal pool crustacean species. However, projects impacting vernal pools continue to move forward prior to the development and adoption of these regional conservation plans, potentially precluding the ability for the regional plans to meet their conservation goals. The loss of the vernal pools on the proposed Westpark/Fiddyment Ranch project area would make it more difficult for vernal pool species to be adequately conserved under regional plans in western Placer County.

Because the vernal pool fairy shrimp and vernal pool tadpole shrimp are endemic to vernal pools in the Central Valley, coast ranges, and a limited number of sites in the transverse range and Santa Rosa plateau of California and southern Oregon, the Service anticipates that a wide range of activities will be determined to affect this species. Such activities include, but are not limited to: (1) urban development, (2) water projects, (3) flood control projects , (4) highway projects, (5) utility projects, (6) chemical contaminants, and, (7) conversion of vernal pools to agricultural use. Projects occurring adjacent to vernal pool complexes will indirectly affect vernal pool complexes and their associated upland areas.

Conclusion

After reviewing the current status of the vernal pool fairy shrimp and vernal pool tadpole shrimp, the environmental baseline for the area covered by this biological opinion, the effects of the proposed action, the effects of the minimization measures, and the cumulative effects, it is the Service's biological opinion that the adverse effects on the vernal pool fairy shrimp and vernal pool tadpole shrimp inhabiting the proposed Westpark/Fiddyment Ranch project site, as proposed, is not likely to jeopardize the continued existence of the vernal pool fairy shrimp and vernal pool tadpole shrimp. As stated above, the proposed project would affect approximately 26.66 wetted acres of vernal pool tadpole shrimp and vernal pool fairy shrimp habitat and 2,436 gross acres of vernal pool critical habitat. Due to the amount of on-site and off-site compensation within the vernal pool ecosystem within Placer County proposed for the project, we have determined that this project, although significant, would not represent an adverse modification of critical habitat for the species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined by the Service as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or to attempt to engage in any such conduct. The Service defines "harass" as an intentional or negligent act or omission that creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding and sheltering. The Service defines harm to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, and sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be prohibited take provided such take complies with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary and must be implemented by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service anticipates that implementation of the proposed action could result in incidental take of listed vernal pool crustaceans. The Service expects that direct take of individuals would be difficult to detect or quantify, because specimens are not easily seen, due to their small body size. Due to the difficulty in quantifying the number of individuals that will be taken as a result of the proposed action, the Service is quantifying take incidental to the proposed action as the amount of habitat that will become unsuitable for listed vernal pool crustaceans as a result of the action. Therefore, the Service estimates that 17.09 acres of habitat for listed vernal pool crustaceans will be lost through direct habitat loss resulting from the proposed action. An additional 9.57 acres of habitat for listed vernal pool crustaceans will become degraded through indirect habitat loss resulting from the proposed action.

The Service has developed this Incidental Take Statement based on the premise that the reasonable and prudent measures will be implemented. Upon implementation of the following reasonable and prudent measures, incidental take associated with the construction of the proposed action on 17.09 acres of habitat directly affected and 9.57 acres of habitat indirectly affected for listed vernal pool crustaceans will become exempt from the prohibitions described under section 9 of the Act for direct and indirect impacts.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the vernal pool fairy shrimp, or vernal pool tadpole shrimp or result in adverse modification of critical habitat for the vernal pool fairy shrimp. Vernal pool tadpole shrimp critical habitat does not occur within the project area so no adverse modification is likely to occur as a result of this project.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to conserve listed vernal pool crustaceans:

1. Minimize the impacts to federally listed vernal pool crustaceans resulting from habitat modification and habitat loss.

2. Vernal pool crustacean habitat will be managed and protected from adverse effects in perpetuity.

3. Minimize direct and indirect effects from project construction to federally listed vernal pool crustaceans.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following terms and conditions. These measures are Terms and Conditions which implement the reasonable and prudent measures described above for the protection of listed vernal pool crustaceans. These terms and conditions are non-discretionary.

1. The following terms and conditions implement reasonable and prudent measure one (1):

   a. The applicant, its assigns, or successor shall obtain 26.68 wetted acres of vernal pool habitat for preservation (as outlined on page 6 above and in the August 7, 2003 letter

      from the applicant) from a Service-approved area in Placer County for effects to 26.66 acres of vernal pools and vernal pool swales.

   b. The applicant, its assigns, or successor shall restore approximately 43.00 acres of vernal pool and swale habitats for restoration from a Service-approved area in Placer County for effects to 26.66 acres of vernal pools and vernal pool swales. A Service-approved restoration plan shall be developed to restore the approximately 43.00 wetted acres of vernal pool crustacean habitat on the Yankee Slough parcel. The restoration efforts shall be focused on the southwestern portion of the property bordering Brock Road, Nader Road, State Route 65, and Yankee Slough. The plan will provide information on location, size, and density of vernal pool/swales proposed for the site. A post-construction compliance report prepared by the monitoring biologists shall be forwarded to the Sacramento Fish and Wildlife Office within 60 calendar days of the completion of construction activity.

   c. The applicant, its assigns, or successor shall preserve approximately 699.3 acres on-site within four designated preserve areas as outlined above (see page 4 above and Attachment A).

   d. Reasonable access to the preserves shall be allowed with a 24-hour notice by the Service, Corps, or California Department of Fish and Game, and/or other appropriate agencies or Service-approved personnel.

2. The following terms and conditions implement reasonable and prudent measure two (2):

   a. Off-site Preserves: Prior to ground breaking, the applicant, its assigns, or successor shall place a Service-approved conservation easement on the proposed off-site preservation and restoration sites to designate the areas as wetland preserves and for them to be managed in perpetuity as wetland and vernal pool preserves and for the protection of any listed species.

   b. On-site Preserves: Prior to ground breaking on each phase of the project, the applicant, its assigns, or successors shall place a Service-approved conservation easement on the proposed on-site preservation and restoration sites to designate the areas as wetland preserves and for them to be managed in perpetuity as wetland and vernal pool preserves and for the protection of any listed species.

   c. The conservation easements will be recorded with the appropriate county agency and run with the land (See Attachment B Draft Conservation Easement). All such habitat preserved for listed species shall be protected in perpetuity by the conservation easement. All such vernal pool acres shall be protected from adverse effects and managed in perpetuity or until the Corps and the Service agree on a process to exchange such areas for credits within a Service-approved conservation banking system. The conservation easement shall be reviewed and approved by the Service prior to recording in the appropriate County Recorders Office(s). The conservation easement for off-site preserves shall be recorded within 120 days of the date of the issuance of the permit from the Corps. The conservation easement for the on-site preserves shall be recorded prior to ground breaking of each phase. A true copy of the recorded easement(s) shall be provided to the Service within 30 days after recordation. The easements shall include, but not be limited to, provisions and responsibilities of the permittee(s) for protection of the vernal pool preserves, including any anticipated future transfers of the easement or fee interest. The conservation easements shall specify the purposes for which they were established (i.e., to maintain in perpetuity the suitability of the vernal pool and swale ecosystem and associated watersheds and uplands within the preserves for federally listed vernal pool crustaceans). The easement shall be held by a third party approved by the Service. The documents shall include a list of prohibited activities inconsistent with the maintenance of the preserves and the suitability of the remaining federally listed vernal pool crustacean habitat and associated watershed.

d. The applicant shall transfer the on-site and off-site preserve and restoration areas to a Service-approved third party for perpetual management at the time of recording of the conservation easement.

e. The applicant shall establish a Service approved non-wasting funding mechanism to fully fund the maintenance, management and monitoring of the on-site and off-site preserve and restoration areas. Establishment of the fund may be phased to coincide with the development of the property and establishment of the preserves. The principal in the fund must generate sufficient revenue to cover the costs of activities including but not limited to alien plant species removal, maintenance of fencing, monitoring of vernal pools, and remediation of indirect effects in perpetuity. This endowment shall be made to a Service-approved entity prior to any groundbreaking. Specific actions covered under the endowment shall be addressed in the Management and Monitoring Plan (further described below). All maintenance and management obligations associated with this project at the off-site Sheridan East parcel and the Yankee Slough parcel shall be conducted by the respective owners as agreed through separate agreements by the applicant approved by the Service. The applicant has secured the endowment funds necessary for the maintenance and management of the Sheridan East and Yankee Slough parcels in perpetuity.

f. Prior to groundbreaking, a management and monitoring plan shall be formulated for the on-site and off-site preserve areas. The plan shall be approved by the Service, and shall include but not be limited to the following components: discussions of the management and maintenance in perpetuity of the wetland habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp within the on-site and off-site preserve and restoration areas; discussions of runoff control and maintenance of hydrology of the aquatic habitat; provisions for management and maintenance in perpetuity of upland habitat within the on-site and off-site preserve and restoration areas; discussion of grazing strategies, alien species control, sedimentation, erosion, and controlled burning; provisions for creating a position for a preserve manager that would undertake the duties of implementing the management plan; provisions for a monitoring program to be set up and implemented by the preserve manager, with a monitoring report that addresses the ecological functions of the preserve including whether the preserves are adversely affected by adjacent development, and if the maintenance/management plans are successful.

3. The following terms and conditions implement reasonable and prudent measure three (3):

   a. A Worker Environmental Awareness Training Program for construction personnel shall be conducted before and during construction. The program shall provide workers with information on their responsibilities with regard to listed species and an overview of the life-history of the species and description of the preserve areas. Written documentation of the training shall be transmitted to the Sacramento Fish and Wildlife Office within 30 days of completion of training.

   b. Adequate high visibility fencing shall be placed around the on-site preserve areas to prevent encroachment of construction equipment and personnel into wetland preserves during project work activities. Such fencing shall be inspected and maintained daily until completion of the project.

   c. Runoff from dust control, and hazardous materials during construction activities shall be retained in the construction site and prevented from flowing into the on-site wetland preserves or permanent waterways. To control erosion during and after project implementation, the applicant shall implement best management practices, as identified by the appropriate Regional Water Quality Control Board. Erosion control measures and best management practices (BMP's) that prevent soil or sediment from entering the river shall be placed, monitored for effectiveness, and maintained throughout the construction operations. Construction adjacent to the preserve areas (within 250 feet) shall be limited generally to the periods within the dry season (May-September). Construction may occur outside this work window as long soil moisture levels allow access to the areas and the extended forecasts preclude the likelihood of precipitation.

   d. The Service-approved biologist shall have the authority to halt any action that might result in impacts to the preserve areas. If work is stopped due to construction activities within or affecting the preserve areas, the Service shall be notified immediately.

   e. All fueling and maintenance of vehicles and other equipment and staging areas shall occur at least 250 feet from any riparian habitat or water body or preserve area. The applicant shall ensure contamination of habitat does not occur during such operations. All workers shall be informed of the importance of preventing spills and appropriate measures to take should a spill occur.

f. The number of access routes, number and size of staging areas, and the total area of the activity shall be limited to the minimum necessary to achieve the project goal. Routes and boundaries shall be clearly demarcated, and these areas shall be outside of riparian and wetland areas.

g. Stockpiling of construction materials, portable equipment, vehicles and supplies, including chemicals, shall be restricted to the designated construction staging areas and exclusive of the riparian and wetlands avoidance areas. Refueling of construction equipment and vehicles within the floodplain shall occur only within designated areas not affecting the preserves. Any spills of hazardous materials shall be cleaned up immediately. Such spills shall be reported in the post-construction compliance reports.

h. Opportunity shall be given to third party individuals conducting vernal pool restoration efforts to collect innoculum from the vernal pools prior to fill and destruction. At least 90 days notice prior to the beginning of the wet season shall be given to the Service and appropriate wetland restoration contractors (Wildlands, ECORP, etc...). Construction activities shall not begin prior to opportunities to collect innoculum from vernal pools.

i. The Covenants, Conditions and Restrictions for the Westpark/Fiddyment Ranch Project residential development shall at a minimum include a description of the importance of protecting the listed species and habitats preserved at the project site and within the watershed; and a list of prohibited activities that are inconsistent with the maintenance of the suitability of the remaining vernal pool habitat and associated watershed, including, but not limited to: (i) a restriction that no vehicles (including but not limited to passenger vehicles, motorcycles, bicycles, and off-road recreational vehicles) shall be allowed or operated on the preserves by owners, renters, or lessees of any of the lots within the residential development, or by their family members or their guests, (ii) alteration of existing topography or any other alteration or uses for any purposes, including the exploration for, or development of mineral extraction; (iii) placement of any structures on any of the vernal pool preserves, (iv) dumping and/or burning of rubbish, garbage, or any other wastes or fill materials; (v) building of any roads or trails; (vi) killing, removal, alteration, or replacement of any existing native vegetation; (vii) placement of storm water drains or other diversion or alteration of water that would disturb the existing hydrologic characteristics of the preserves and associated watersheds; (viii) fire protection activities not required to protect existing structures; (ix) use of pesticides and herbicides within the preserves; and (x) actions that would degrade the quality of runoff from the project site.

j. Should any phasing of construction occur for the proposed project, those construction activities and disturbances shall not affect vernal pool crustacean habitat on the Westpark/Fiddyment project site.

k. Should the applicant not initiate the first phase of the construction outlined in the project description within 5 years of the date of this biological opinion, or not implement any subsequent phases within 3 years of the completion of any one phase, the terms and conditions of this biological opinion expire and the applicant and the Corps would need to reinitiate consultation regarding the remainder of the proposed project.

l. The applicant shall implement measures to conserve species covered under the Migratory Bird Treaty Act of 1918 as amended. Such measures include but are not limited to bird safe utility poles to reduce the likelihood of electrocution.

m. The applicant shall comply with the reporting requirements outlined below.

Reporting Requirements

The Service's Sacramento Fish and Wildlife Office shall be notified immediately by phone or fax and within three working days in writing of the finding of any dead listed species or any unanticipated harm to the species addressed in this biological opinion. The Service contact person for this is the Chief, Endangered Species Division at (916) 414-6600. The Service-approved biologist shall notify the Service immediately if listed vernal pool crustaceans are found on site and shall submit a report including date(s), location(s), habitat description, and any corrective measures taken to protect the listed species found. The Service-approved biologist shall submit locality information to the California Department of Fish & Game (CDFG), using completed California Native Species Field Survey Forms or their equivalent, no more than 90 calendar days after completing the last field visit of the project site. Each form shall have an accompanying scale map of the site such as a photocopy of a portion of the appropriate 7.5 minute U.S. Geological Survey map and shall provide at least the following information: township, range, and quarter section; name of the 7.5' or 15' quadrangle; dates (day, month, year) of field work; number of individuals and life stage (where appropriate) encountered; and a description of the habitat by community-vegetation type. Global Positioning System coordinates (Universal Transverse Mercator, North American Datum, Zone 10, meters) shall also be provided with any reporting requirements.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases.

1. The Corps should require the applicant to further avoid and minimize wetland and riparian impacts on the project site.

2. As recovery plans for listed crustacean species are developed, the Corps should assist the Service in their implementation.

3. The Corps should work with the Service to ensure that its wetland delineation techniques fully assess the impacts of proposed projects on listed crustacean species.

4. The Corps should conduct a study of cumulative loss of wetlands habitat, including habitat of listed crustaceans in western Placer County.

5. The Corps should incorporate into bidding documents any conservation measures outlined for vernal pools and vernal pool crustaceans when appropriate.

6. The Corps and the applicant should coordinate with the California Department of Fish and Game Officials on implementation of measures to minimize impacts to state listed species.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation with the Corps on the proposed Westpark/Fiddyment Ranch project. As provided for in 50 CFR Section 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law), and if (1) the amount or extent of incidental take is exceeded, as previously described, or the requirements under the Incidental Take section are not implemented; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent that was not considered in this opinion; (3) the proposed action is subsequently modified in a manner that causes an effect to listed species that was not considered in this opinion; and/or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Please contact Arnold Roessler or Elizabeth Warne at (916) 414-6645, if you have any questions.

Sincerely,

Kenneth D. Sanchez
Acting Field Supervisor

cc:
ARD (ES), Portland, Oregon
Environmental Protection Agency, San Francisco, CA (Attn: Ms. Kathy Dadey)
CDFG, Region 2, Rancho Cordova, CA (Attn: Mr. Jeff Finn)
Westpark Associates, Roseville, CA (Attn: Mr. Bill Falik, John Murray)
Signature Properties, (Attn: Mr. Jim McKeehan)
ECORP Roseville, CA (Attn: Jim Stewart)
Hefner, Stark & Marios, Sacramento, CA (Attn: Mr. George Kammerer)

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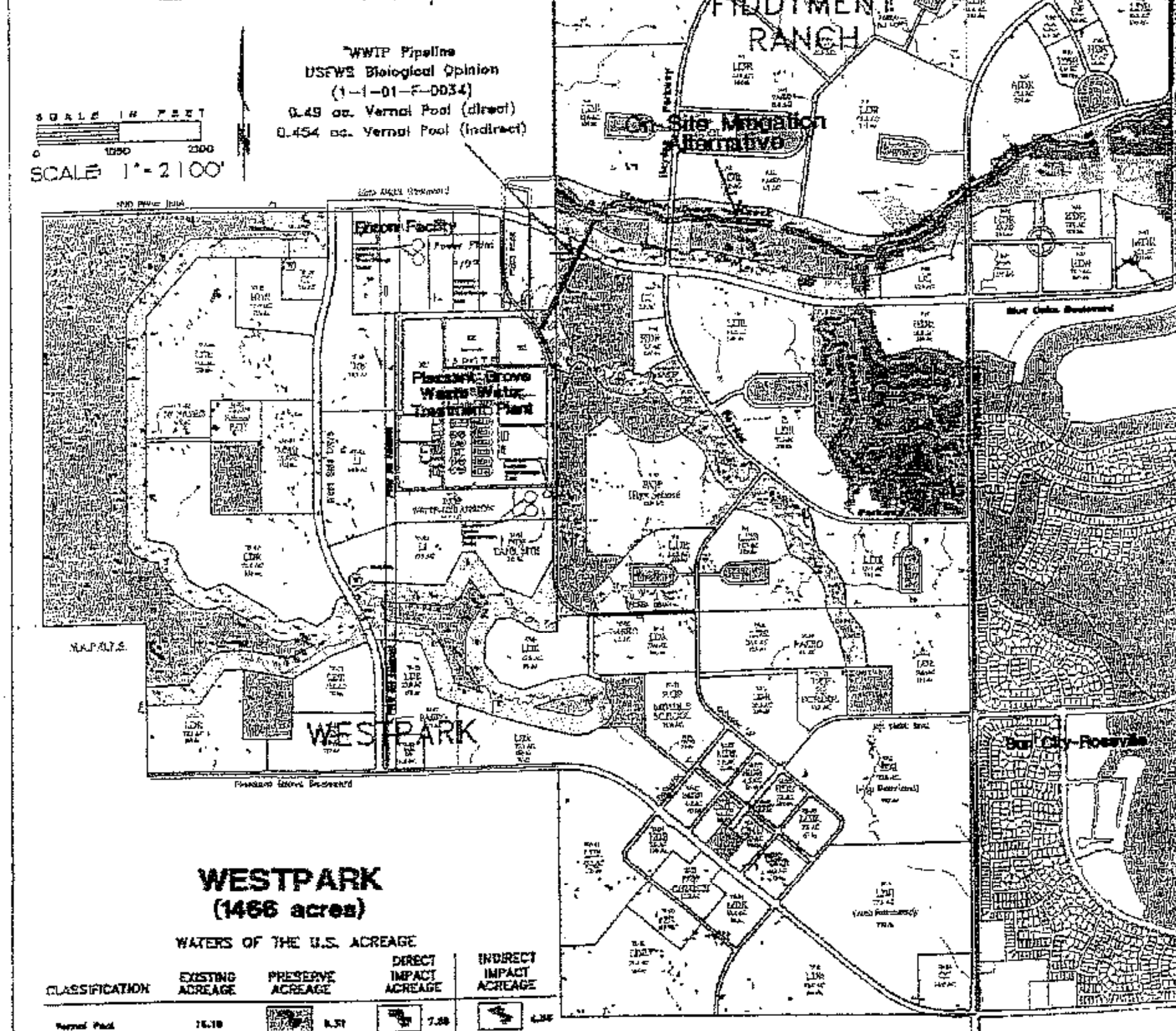
Attachment A: Proposed Westpark/Fiddyment Project

FIDDYMENT RANCH
(1676 acres)

WATERS OF THE U.S. ACREAGE

CLASSIFICATION	EXISTING ACREAGE	PRESERVE ACREAGE	DIRECT IMPACT ACREAGE	INDIRECT IMPACT ACREAGE
Vernal Pool	17.72	11.31	5.11 6.92	(4.45)4.00
Seasonal Wetland	4.92	0.40	3.82	N/A —
Emergent Marsh	0.22	N/A —	0.82	N/A —
Wet Swales/Channels	21.57	15.65	3.82	N/A —
Totals	43.83	27.36	(13.47) 15.16	(4.43)4.00



WESTPARK
(1466 acres)

WATERS OF THE U.S. ACREAGE

CLASSIFICATION	EXISTING ACREAGE	PRESERVE ACREAGE	DIRECT IMPACT ACREAGE	INDIRECT IMPACT ACREAGE
Vernal Pool	15.19	8.31	7.88	4.36
Wet Swales/Channels	5.87	2.79	1.08	N/A —
Totals	20.06	11.10	8.96	4.36

FILENAME: -DWGS\2000-167\wp-presaxl1.dwg 01/29/03

Wetland Preserve and Impact Plan

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS

Attachment B: Sample Conservation Easement

RECORDING REQUESTED BY:)
)
)
)
MAIL TO:)
)
)
)
)

TEMPLATE

PERPETUAL CONSERVATION EASEMENT GRANT

THIS PERPETUAL CONSERVATION EASEMENT GRANT (this "**EASEMENT**") is made this _____ day of ____________, by [name who the grantor is and include applicable category: e.g, a corporation, a partnership, a limited partnership, husband and wife] ("**GRANTOR**"), in favor of the [name of the entity; must be one that is recognized by § 815 of the California Civil Code] ("**GRANTEE**").

RECITALS

A. GRANTOR is [describe Grantor; is it a corporation, a partnership, limited partnership, Federal agency] and is the sole owner in fee simple of certain real property located in the County of [name county(s)], State of California, more particularly depicted on the map attached as Exhibit A hereto (the "**Protected Property**") (this map shows land subject to EASEMENT and separately shows land not subject to EASEMENT. The execution copy of the EASEMENT also shall have legal descriptions attached as Exhibit B); [the map and the legal description must match and portray the actual easement area] and

B. GRANTEE is a non-profit entity formed under the laws of the [State of California, District of Columbia, etc.] and is authorized to hold conservation easements under California Civil Code § 815 et seq.; and

C. SERVICE is the United States Fish and Wildlife Service within the United States Department of the Interior, which is authorized by Federal law to administer the Federal Endangered Species Act and other laws and regulations; and

D. The Protected Property possesses significant ecological and habitat values that benefit endangered, threatened, and other rare species (Collectively, "**Conservation Values**"). These species and their habitats are of aesthetic, ecological, educational, historical, recreational, and scientific value to the people of California and the people of the United States. These values include [list habitats and plant and animal species; include both listed species, and those that are of special significance], and are of great importance to both GRANTOR and GRANTEE; and

E. Significant portions of the Property, consisting of approximately [##] acres, have been presently identified as being occupied by species of native plants and wildlife which GRANTOR and GRANTEE desire to conserve and protect; [if applicable: restore and/or enhance] [if applicable: pursuant to a Management Plan titled XXXXXXX, a memorandum of which is attached to this EASEMENT as Exhibit C, or record entire Management Plan if possible.]; and

F. GRANTOR intends to convey to GRANTEE the right to conserve and protect [if applicable: restore and/or enhance] the conservation values of the property in perpetuity; and

G. GRANTEE agrees by accepting this grant to honor the intentions of GRANTOR stated herein and to conserve and protect [if applicable: restore and/or enhance] in perpetuity the conservation values of the Protected Property in accordance with the terms of this EASEMENT [if applicable: and the Management Plan prepared for it]; and

H. This EASEMENT provides mitigation for certain impacts located in City of [XXX], County of [XXX], State of California, described in a [date of Biological Opinion/Habitat Conservation Plan] Federal Endangered Species Act [Biological Opinion/Habitat Conservation Plan] for [project name].

Covenants, Terms, Conditions, and Restrictions

In consideration of the above and the mutual covenants, terms, conditions, and restrictions contained herein, and pursuant to the laws of California and California Civil Code section 815 et seq., GRANTOR hereby voluntarily grants and conveys to GRANTEE a perpetual conservation easement over the Protected Property of the nature and character and to the extent hereinafter set forth.

1. <u>PURPOSE</u>

It is the purpose of this EASEMENT to assure that the Protected Property will be retained forever in a natural and open space condition and to prevent any use of the Protected Property that will impair or interfere with the Conservation Values of the Protected Property. GRANTOR intends that this EASEMENT (i) will assure that the Protected Property will be used for such activities as are consistent with the conservation purposes of this EASEMENT, and if applicable: (ii) shall be implemented consistently with the Management Plan.

2. <u>RIGHTS OF GRANTEE</u>

To accomplish the purpose of this EASEMENT, the following rights are conveyed to GRANTEE by this EASEMENT:

(a) To conserve and protect, [if applicable: restore and enhance] the Protected Property.

[if applicable: in a manner consistent with the Management Plan].

(b) To enter upon and traverse all portions of the Property at all times in order to have access to the Protected Property and to monitor GRANTOR's compliance with and otherwise enforce the terms of this EASEMENT [if applicable: and to fulfill duties identified in the Management Plan]; provided that such entry shall not unreasonably impair or interfere with GRANTOR's use and quiet enjoyment of the Property or unreasonably disturb natural resources on the Property; and

(c) To prevent any activity on or use of the Protected Property that is inconsistent with the conservation purposes of this EASEMENT and to require the restoration of such areas or features of the Protected Property that may be damaged by any inconsistent activity or use.

(d) To conserve and protect all mineral, air, water rights, and ground water required to protect and to sustain the biological resources of the Protected Property [describe more specific types of water rights, use of wells, et al.].

3. PROHIBITED USES

Subject to the provisions of Paragraph 4 herein, any activity on or use of the Protected Property inconsistent with the conservation purposes of this EASEMENT is prohibited [if applicable: except as stated in the management plan]. Without limiting the generality of the foregoing, GRANTOR, its personal representative, heirs, assigns, agents, and potential future lessees are expressly prohibited from doing any of the following on Protected Property:

(a) Erecting of any building, billboard, or sign;

2. Grazing (except grazing provided for in the Management Plan) or use of off-road vehicles;

3. Planting, introduction or dispersal of non-native or exotic plant or animal species;

(d) Unseasonal watering, use of herbicides, rodenticides, mosquito abatement activities, or weed abatement activities, incompatible fire protection activities and any and all other uses which may adversely affect the purposes of this EASEMENT;

(e) Depositing of soil, trash, ashes, garbage, waste, bio-solids or any other material;

(f) Excavating, dredging or removing of loam, gravel, soil, rock, sand or other material;

(g) Otherwise altering the general topography of the Protected Property.

(h) Removing, destroying, or cutting of trees, shrubs, or other vegetation, except as required for [list exceptions:
(1) fire breaks, (2) maintenance of existing foot trails or roads, or (3) prevention or treatment of disease, others?]

(i) Granting use of the land to any third party for off-road vehicle use;

(j) Legally subdividing the Conservation Property, recording of a subdivision plan, partition, or any other division of the Conservation Property into two or more parcels;

(k) Paving or otherwise covering of the conservation Property with concrete, asphalt, or any other impervious paving material;

(l) Transferring any appurtenant water right required to maintain and restore the biological resources of the Conservation Property;

(m) Granting surface entry for the exploration or extraction of minerals without approval by the SERVICE; and

(n) [Others? All prohibited actions should be listed-- examples: pumping water, diverting water, extracting oil, mining].

4. GRANTOR'S DUTIES

_______GRANTOR shall undertake all reasonable actions to prevent the unlawful entry and trespass by persons whose activities may degrade or harm the conservation values of the Protected Property. In addition, GRANTOR shall undertake all necessary actions to perfect GRANTEE's rights under section 2 of this EASEMENT, including, but not limited to, GRANTEE's water rights.

5. RESERVED RIGHTS

GRANTOR reserves to itself, and to its personal representative, heirs, successors, assigns, agents and present and potential future lessees, including, but not limited to, all rights accruing from its ownership of the Property, including the right to engage in or permit or invite others to engage in all uses of the Protected Property that are not expressly prohibited herein and are not inconsistent with the conservation purposes of this EASEMENT.

[Add this paragraph if applicable] This EASEMENT includes Waters consisting of (i) any riparian water rights appurtenant to the Protected Property, (ii) any appropriative water rights held by GRANTOR to the extent those rights are appurtenant to the Protected Property, (iii) any waters, the rights to which are secured under contract between the GRANTOR and any irrigation or water district, to the extent such waters are customarily applied to the Protected Property, and (iv) any water from wells that are in existence or may be constructed in the future on the Protected Property or on those lands described as excepted from the Protected Property in the legal description and that were historically used, by the GRANTOR to maintain the Protected Property in a flooded condition (Collectively, **"Easement Waters"**. The Easement Waters are limited to the amount of GRANTOR's water reasonably required to maintain the Conservation Values of the Protected Property.

6. REMEDIES

If GRANTEE, SERVICE or other interested parties determines that there is a violation of the terms of this EASEMENT or that a violation is threatened, such party shall give written notice to the other parties of such violation and demand corrective action sufficient to cure the violation and, where the violation involved injury to the Property resulting from any use or activity inconsistent with the purpose of this EASEMENT, to restore [if applicable: in accordance with the Management Plan] the portion of the Protected Property so injured. In any instance, measures to cure the violation shall be reviewed and approved by the SERVICE. If a party fails to cure a violation within sixty (60) days after receipt of notice thereof from the other party, or under circumstances where the violation cannot reasonably be cured within a sixty (60) day period, or fails to continue diligently to cure such violation until finally cured, the aggrieved party may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this EASEMENT, to enjoin the violation, ex parte as necessary, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of the terms of this EASEMENT or injury to any conservation values protected by this EASEMENT, including damages for the loss of aesthetic, ecological, educational, historical, recreational or scientific values, and to require the restoration [if applicable: pursuant to the Management Plan] of the Protected Property to the condition that existed prior to any such injury. If a party, in its good faith and reasonable discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the Conservation Values of the Protected Property, such party may pursue its remedies under this paragraph without prior notice to the other party or without waiting for the period provided for the cure to expire. Each party's rights under this paragraph apply equally in the event of either actual or threatened violations of the terms of this EASEMENT, and each party agrees that the other party's remedies at law for any violation of the terms of this EASEMENT are inadequate and that such party shall be entitled to the injunctive relief described in this paragraph, both prohibitive and mandatory, in addition to such other relief to which such party may be entitled, including specific performance of the terms of this EASEMENT, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Each party's remedies described in this paragraph shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity. Furthermore, the provisions of California Civil Code section 815 et seq., are incorporated herein by this reference and this EASEMENT is made subject to all of the rights and remedies set forth therein. If at any time in the future GRANTOR or GRANTEE or any subsequent transferee or assignee uses or threatens to use such lands for purposes not in conformance with the provisions of this EASEMENT, or releases or abandons this EASEMENT in whole or in part, notwithstanding California Civil Code § 815 et seq., the California Attorney General, the United States through the SERVICE, or any entities organized for conservation purposes shall have standing as interested parties, and as third party beneficiaries in any proceeding affecting this EASEMENT.

(a) Costs of Enforcement. Reasonable costs incurred by any party enforcing the terms of this EASEMENT, including without limitation, costs of suit and attorneys fees, and any costs of restoration necessitated by a violation of the terms of this EASEMENT shall be borne by the breaching party. If a party prevails in any action to enforce the terms of this EASEMENT, such party's costs of suit including, without limitation, attorneys fees, shall be borne by the other party.

(b) GRANTEE's Discretion. Enforcement of the terms of this EASEMENT shall be at the discretion of GRANTEE, and any forbearance by GRANTEE to exercise its rights under this EASEMENT shall not be deemed or construed to be a waiver by GRANTEE of such term or of any subsequent breach of the same or any other term of this EASEMENT or of any of GRANTEE's rights under this EASEMENT. No delay or omission by GRANTEE in the exercise of any right or remedy upon any breach by GRANTOR shall impair such right or remedy or be construed as a waiver.

(c) Acts Beyond GRANTOR's Control. Nothing contained in this EASEMENT shall be construed to entitle GRANTEE to bring any action against GRANTOR for any injury to or change in the Property resulting from causes beyond GRANTOR's control, including, without limitation, fire, drought, flood, storm, and earth movement caused by an earthquake.

7. COSTS AND LIABILITIES

Except as set forth in this EASEMENT, or as otherwise agreed in writing between the parties hereto, GRANTOR retains all responsibilities related to the ownership, operation, upkeep, and maintenance of the Property.

(a) Taxes: GRANTOR shall pay before delinquency all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Protected Property by competent authority, including any taxes imposed upon, or incurred as a result of, this EASEMENT, and shall furnish GRANTEE with satisfactory evidence of payment upon request.

(b) Hold Harmless: [this provision varies upon needs of grantee] GRANTOR or its successor shall hold harmless, indemnify, and defend GRANTEE and its members, directors, officers, employees, agents and contractors and the heirs, personal representatives, successors, and assigns of each of them (collectively "Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expense, causes of action, claims, demands, or judgments, including without limitation, reasonable attorney's fees, arising from or in any way connected with: (1) injury to or the death of any person, or physical damages to any property, resulting from any act, omission, condition or other matter occurring on the Protected Property, unless caused by the acts or omissions of any of the Indemnified Parties; and (2) the existence or administration of this EASEMENT.

8. ASSIGNMENT

This EASEMENT is transferable, but GRANTEE shall give GRANTOR and the SERVICE [anyone else] at least thirty (30) days prior written notice of the transfer. GRANTEE may assign its rights and obligations under this EASEMENT only to an organization that is 1) approved by the SERVICE [anyone else]; and, 2) a public agency or a qualified organization at the time of transfer under section 170(h) of the Internal Revenue Code of 1954, as amended (or any successor provision then applicable), and the applicable regulations promulgated thereunder; and, 3) authorized to acquire and hold conservation easements under California Civil Code section 815 et seq. (or any successor provision then applicable). As a condition of such assignment or transfer, the Assignee or Transferee shall agree in writing that the conservation purposes that this grant is intended to advance shall continue to be fulfilled [if applicable: and that the Management Plan will be followed] and notice of such restrictions shall be recorded in the county where the property is located. In the event of the termination of GRANTEE's existence, the rights and obligations of GRANTEE hereunder shall, by that fact itself, and without any further action on the part of any entity, be deemed assigned to [Identify Entity; not the SERVICE].

9. SUBSEQUENT TRANSFERS

GRANTOR agrees to incorporate the terms of this EASEMENT in any deed or other legal instrument by which GRANTOR divests itself of any interest in all or a portion of the Property, including, without limitation, a leasehold interest. GRANTOR further agrees to give written notice to GRANTEE and the SERVICE at least fifteen (15) days prior to the date of any property transfer. The failure of GRANTOR to perform any act required by this paragraph shall not impair the validity of this EASEMENT or limit its enforceability in any way.

10. ESTOPPEL CERTIFICATES

Upon request by GRANTOR, GRANTEE shall within fifteen (15) days execute and deliver to GRANTOR any document, including an estoppel certificate, which certifies GRANTOR's compliance with any obligation of GRANTOR contained in this EASEMENT and otherwise evidences the status of this EASEMENT as may be requested by GRANTOR.

11. NOTICES

Any notice, demand, request, consent, approval, or communication that the parties desire or is required to give to the others shall be in writing and either served personally or sent by first class mail, postage prepaid, addressed as follows:

To Grantor:

To Grantee:

To Service:

United States Fish and Wildlife Service
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846
Attn: Field Supervisor

or to such other address or the attention of such other officer from time to time shall designate by written notice to the other.

12. RECORDATION

GRANTOR shall submit an original, signed and notarized Conservation Easement Grant to GRANTEE and GRANTEE shall promptly record this instrument [if applicable: in accordance with instructions for recordation contained in the biological opinion or HCP] in the official records of [County(s) where property is located], California and may re-record it at any time as may be required to preserve its rights in this EASEMENT.

13. FUNDING

______GRANTOR has provided [describe funding mechanism for maintenance of easement in perpetuity and include as exhibits all agreements, e.g., declaration of trust] to GRANTEE [others that will be managing the easement] for the purposes of fulfilling all of GRANTOR's obligations long-term operations and maintenance of the EASEMENT [under the Management Plan/Habitat Conservation Plan/Biological Opinion]. Funding shall be transferred to the appropriate transferee or assignee if the EASEMENT is assigned or transferred.

14. ADDITIONAL EASEMENTS

______GRANTOR shall not grant any additional easements, rights-of-way, or other interests in the Protected Property, other than a fee or leasehold interest, undivided interest or security interest (mortgage or deed of trust), or grant or otherwise transfer to any other person or entity or to other lands or otherwise abandon or relinquish any Waters associated with the Protected Property without the prior written authorization of GRANTEE given through the SERVICE. Such authorization will be given unless the SERVICE, among other things, determines that the proposed interest or transfer will interfere with the use of the Protected Property as habitat suitable for federally listed species or other federally protected species. This paragraph shall not prohibit the transfer of a fee title or leasehold interest in the Protected Property that is subject to the terms of this EASEMENT. This paragraph shall also not prohibit the granting of future compatible utility easements, as authorized by the SERVICE.

15. GENERAL PROVISIONS

(a) Controlling Law. The interpretation and performance of this EASEMENT shall be governed by the laws of the State of California, the Federal Endangered Species Act, and other applicable Federal laws.

(b) Construction. Any general rule of construction to the contrary notwithstanding, this EASEMENT shall be construed in favor of the grant to effect the Conservation Purpose of this EASEMENT and the policy and purpose of California Civil Code section 815 et seq. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the purposes of this EASEMENT that would render the provision valid shall be favored over any interpretation that would render it invalid.

(c) Severability. If any provision of this EASEMENT, or the application thereof to any person or circumstances, is found to be invalid, the remainder of the provisions of this EASEMENT, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

(d) Entire Agreement. This instrument sets forth the entire agreement of the parties with respect to the EASEMENT and all exhibits and supersedes all prior discussions, negotiations, understandings, or agreements relating to the EASEMENT.

(e) No Forfeiture. Nothing contained herein will result in a forfeiture or reversion of GRANTOR's title in any respect.

(f) Successors. The covenants, terms, conditions, and restrictions of this EASEMENT shall be binding upon, and inure to the benefit of, the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as servitude running in perpetuity with the Property.

(g) Captions. The captions in this EASEMENT have been inserted solely for convenience of reference and are not a part of this EASEMENT and shall have no effect upon construction of interpretation.

(h) Counterparts. The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

(i) Third-Party Beneficiary: GRANTOR and GRANTEE acknowledge that the SERVICE is a third party beneficiary of this EASEMENT with the right of access to the EASEMENT property and the right to enforce all of the provisions of this EASEMENT.

IN WITNESS WHEREOF, GRANTOR and GRANTEE have entered into this EASEMENT the day and year first above written.

Grantor:____________________

Entity

By:________________________

Name

____

Title

Grantee:______________________

Entity

By: __________________________

Name

____

Title

APPROVED AS TO FORM: [necessary when there are modifications made to the template]

____

XXXX, Assistant Regional Solicitor
United States Department of the Interior
for U.S. Fish and Wildlife Service

Exhibit A
Conservation Easement Area

Exhibit B
Legal Description of Conservation Easement Area

Exhibit C
Management Plan

Exhibit D
Declaration of Trust

CC Addresses

California Department of Fish and Game
Attn: Jeff Finn
1701 Nimbus Road
Rancho Cordova, CA 95670

Environmental Protection Agency
Attn: Ms. Kathey Dadey
75 Hawthorne Street (WTR-3)
San Francisco, CA 94105

Westpark Associates
Attn: Mr. Bill Falik
2130 Professional Drive, Suite 240
Roseville, CA 95661

Westpark Associates
Attn: Mr. John Murray
2130 Professional Drive, Suite 240
Roseville, CA 95661

Signature Properties
Attn: Mr. Jim McKeehan
4670 Willow Road, Suite 200
Pleasanton, CA 94588

ECORP Inc.
Attn: Jim Stewart
2260 Douglas Blvd, Suite 160
Roseville, CA 95661

Hefner, Stark & Marios, Sacramento, CA
Attn: Mr. George Kammerer
2150 River Plaza Drive, Suite 450
Sacramento, CA 95833

Filename: 03F0013 Westpark_Fiddyment_VP.wpd

ATTACHMENT C

Declaration of Restrictions

Attachment B: Sample Conservation Easement

RECORDING REQUESTED BY:)
)
)
)
MAIL TO:)
)
)
)
)

TEMPLATE

PERPETUAL CONSERVATION EASEMENT GRANT

THIS PERPETUAL CONSERVATION EASEMENT GRANT (this "**EASEMENT**") is made this _____ day of ___________, by [name who the grantor is and include applicable category: e.g, a corporation, a partnership, a limited partnership, husband and wife] ("**GRANTOR**"), in favor of the [name of the entity; must be one that is recognized by § 815 of the California Civil Code] ("**GRANTEE**").

RECITALS

A. GRANTOR is [describe Grantor; is it a corporation, a partnership, limited partnership, Federal agency] and is the sole owner in fee simple of certain real property located in the County of [name county(s)], State of California, more particularly depicted on the map attached as Exhibit A hereto (the "**Protected Property**") (this map shows land subject to EASEMENT and separately shows land not subject to EASEMENT. The execution copy of the EASEMENT also shall have legal descriptions attached as Exhibit B); [the map and the legal description must match and portray the actual easement area] and

B. GRANTEE is a non-profit entity formed under the laws of the [State of California, District of Columbia, etc.] and is authorized to hold conservation easements under California Civil Code § 815 et seq.; and

C. SERVICE is the United States Fish and Wildlife Service within the United States Department of the Interior, which is authorized by Federal law to administer the Federal Endangered Species Act and other laws and regulations; and

D. The Protected Property possesses significant ecological and habitat values that benefit endangered, threatened, and other rare species (Collectively, "**Conservation Values**"). These species and their habitats are of aesthetic, ecological, educational, historical, recreational, and scientific value to the people of California and the people of the United States. These values include [list habitats and plant and animal species; include both listed species, and those that are of special significance], and are of great importance to both GRANTOR and GRANTEE; and

E. Significant portions of the Property, consisting of approximately [##] acres, have been presently identified as being occupied by species of native plants and wildlife which GRANTOR and GRANTEE desire to conserve and protect; [if applicable: restore and/or enhance] [if applicable: pursuant to a Management Plan titled XXXXXXX, a memorandum of which is attached to this EASEMENT as Exhibit C, or record entire Management Plan if possible.]; and

F. GRANTOR intends to convey to GRANTEE the right to conserve and protect [if applicable: restore and/or enhance] the conservation values of the property in perpetuity; and

G. GRANTEE agrees by accepting this grant to honor the intentions of GRANTOR stated herein and to conserve and protect [if applicable: restore and/or enhance] in perpetuity the conservation values of the Protected Property in accordance with the terms of this EASEMENT [if applicable: and the Management Plan prepared for it]; and

H. This EASEMENT provides mitigation for certain impacts located in City of [XXX], County of [XXX], State of California, described in a [date of Biological Opinion/Habitat Conservation Plan] Federal Endangered Species Act [Biological Opinion/Habitat Conservation Plan] for [project name].

Covenants, Terms, Conditions, and Restrictions

In consideration of the above and the mutual covenants, terms, conditions, and restrictions contained herein, and pursuant to the laws of California and California Civil Code section 815 et seq., GRANTOR hereby voluntarily grants and conveys to GRANTEE a perpetual conservation easement over the Protected Property of the nature and character and to the extent hereinafter set forth.

1. PURPOSE

It is the purpose of this EASEMENT to assure that the Protected Property will be retained forever in a natural and open space condition and to prevent any use of the Protected Property that will impair or interfere with the Conservation Values of the Protected Property. GRANTOR intends that this EASEMENT (i) will assure that the Protected Property will be used for such activities as are consistent with the conservation purposes of this EASEMENT, and if applicable: (ii) shall be implemented consistently with the Management Plan.

2. RIGHTS OF GRANTEE

To accomplish the purpose of this EASEMENT, the following rights are conveyed to GRANTEE by this EASEMENT:

(a) To conserve and protect, [if applicable: restore and enhance] the Protected Property.

[if applicable: in a manner consistent with the Management Plan].

(b) To enter upon and traverse all portions of the Property at all times in order to have access to the Protected Property and to monitor GRANTOR's compliance with and otherwise enforce the terms of this EASEMENT [if applicable: and to fulfill duties identified in the Management Plan]; provided that such entry shall not unreasonably impair or interfere with GRANTOR's use and quiet enjoyment of the Property or unreasonably disturb natural resources on the Property; and

(c) To prevent any activity on or use of the Protected Property that is inconsistent with the conservation purposes of this EASEMENT and to require the restoration of such areas or features of the Protected Property that may be damaged by any inconsistent activity or use.

(d) To conserve and protect all mineral, air, water rights, and ground water required to protect and to sustain the biological resources of the Protected Property [describe more specific types of water rights, use of wells, et al.].

3. PROHIBITED USES

Subject to the provisions of Paragraph 4 herein, any activity on or use of the Protected Property inconsistent with the conservation purposes of this EASEMENT is prohibited [if applicable: except as stated in the management plan]. Without limiting the generality of the foregoing, GRANTOR, its personal representative, heirs, assigns, agents, and potential future lessees are expressly prohibited from doing any of the following on Protected Property:

(a) Erecting of any building, billboard, or sign;

2. Grazing (except grazing provided for in the Management Plan) or use of off-road vehicles;

3. Planting, introduction or dispersal of non-native or exotic plant or animal species;

(d) Unseasonal watering, use of herbicides, rodenticides, mosquito abatement activities, or weed abatement activities, incompatible fire protection activities and any and all other uses which may adversely affect the purposes of this EASEMENT;

(e) Depositing of soil, trash, ashes, garbage, waste, bio-solids or any other material;

(f) Excavating, dredging or removing of loam, gravel, soil, rock, sand or other material;

(g) Otherwise altering the general topography of the Protected Property.

(h) Removing, destroying, or cutting of trees, shrubs, or other vegetation, except as required for [list exceptions:
(1) fire breaks, (2) maintenance of existing foot trails or roads, or (3) prevention or treatment of disease, others?]

(i) Granting use of the land to any third party for off-road vehicle use;

(j) Legally subdividing the Conservation Property, recording of a subdivision plan, partition, or any other division of the Conservation Property into two or more parcels;

(k) Paving or otherwise covering of the conservation Property with concrete, asphalt, or any other impervious paving material;

(l) Transferring any appurtenant water right required to maintain and restore the biological resources of the Conservation Property;

(m) Granting surface entry for the exploration or extraction of minerals without approval by the SERVICE; and

(n) [Others? All prohibited actions should be listed-- examples: pumping water, diverting water, extracting oil, mining].

4. GRANTOR'S DUTIES

______GRANTOR shall undertake all reasonable actions to prevent the unlawful entry and trespass by persons whose activities may degrade or harm the conservation values of the Protected Property. In addition, GRANTOR shall undertake all necessary actions to perfect GRANTEE's rights under section 2 of this EASEMENT, including, but not limited to, GRANTEE's water rights.

5. RESERVED RIGHTS

GRANTOR reserves to itself, and to its personal representative, heirs, successors, assigns, agents and present and potential future lessees, including, but not limited to, all rights accruing from its ownership of the Property, including the right to engage in or permit or invite others to engage in all uses of the Protected Property that are not expressly prohibited herein and are not inconsistent with the conservation purposes of this EASEMENT.

[Add this paragraph if applicable] This EASEMENT includes Waters consisting of (i) any riparian water rights appurtenant to the Protected Property, (ii) any appropriative water rights held by GRANTOR to the extent those rights are appurtenant to the Protected Property, (iii) any waters, the rights to which are secured under contract between the GRANTOR and any irrigation or water district, to the extent such waters are customarily applied to the Protected Property, and (iv) any water from wells that are in existence or may be constructed in the future on the Protected Property or on those lands described as excepted from the Protected Property in the legal description and that were historically used, by the GRANTOR to maintain the Protected Property in a flooded condition (Collectively, "**Easement Waters**". The Easement Waters are limited to the amount of GRANTOR's water reasonably required to maintain the Conservation Values of the Protected Property.

6. REMEDIES

If GRANTEE, SERVICE or other interested parties determines that there is a violation of the terms of this EASEMENT or that a violation is threatened, such party shall give written notice to the other parties of such violation and demand corrective action sufficient to cure the violation and, where the violation involved injury to the Property resulting from any use or activity inconsistent with the purpose of this EASEMENT, to restore [if applicable: in accordance with the Management Plan] the portion of the Protected Property so injured. In any instance, measures to cure the violation shall be reviewed and approved by the SERVICE. If a party fails to cure a violation within sixty (60) days after receipt of notice thereof from the other party, or under circumstances where the violation cannot reasonably be cured within a sixty (60) day period, or fails to continue diligently to cure such violation until finally cured, the aggrieved party may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this EASEMENT, to enjoin the violation, ex parte as necessary, by temporary or permanent injunction, to recover any damages to which it may be entitled for violation of the terms of this EASEMENT or injury to any conservation values protected by this EASEMENT, including damages for the loss of aesthetic, ecological, educational, historical, recreational or scientific values, and to require the restoration [if applicable: pursuant to the Management Plan] of the Protected Property to the condition that existed prior to any such injury. If a party, in its good faith and reasonable discretion, determines that circumstances require immediate action to prevent or mitigate significant damage to the Conservation Values of the Protected Property, such party may pursue its remedies under this paragraph without prior notice to the other party or without waiting for the period provided for the cure to expire. Each party's rights under this paragraph apply equally in the event of either actual or threatened violations of the terms of this EASEMENT, and each party agrees that the other party's remedies at law for any violation of the terms of this EASEMENT are inadequate and that such party shall be entitled to the injunctive relief described in this paragraph, both prohibitive and mandatory, in addition to such other relief to which such party may be entitled, including specific performance of the terms of this EASEMENT, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. Each party's remedies described in this paragraph shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity. Furthermore, the provisions of California Civil Code section 815 et seq., are incorporated herein by this reference and this EASEMENT is made subject to all of the rights and remedies set forth therein. If at any time in the future GRANTOR or GRANTEE or any subsequent transferee or assignee uses or threatens to use such lands for purposes not in conformance with the provisions of this EASEMENT, or releases or abandons this EASEMENT in whole or in part, notwithstanding California Civil Code § 815 et seq., the California Attorney General, the United States through the SERVICE, or any entities organized for conservation purposes shall have standing as interested parties, and as third party beneficiaries in any proceeding affecting this EASEMENT.

(a) Costs of Enforcement. Reasonable costs incurred by any party enforcing the terms of this EASEMENT, including without limitation, costs of suit and attorneys fees, and any costs of restoration necessitated by a violation of the terms of this EASEMENT shall be borne by the breaching party. If a party prevails in any action to enforce the terms of this EASEMENT, such party's costs of suit including, without limitation, attorneys fees, shall be borne by the other party.

(b) GRANTEE's Discretion. Enforcement of the terms of this EASEMENT shall be at the discretion of GRANTEE, and any forbearance by GRANTEE to exercise its rights under this EASEMENT shall not be deemed or construed to be a waiver by GRANTEE of such term or of any subsequent breach of the same or any other term of this EASEMENT or of any of GRANTEE's rights under this EASEMENT. No delay or omission by GRANTEE in the exercise of any right or remedy upon any breach by GRANTOR shall impair such right or remedy or be construed as a waiver.

(c) Acts Beyond GRANTOR's Control. Nothing contained in this EASEMENT shall be construed to entitle GRANTEE to bring any action against GRANTOR for any injury to or change in the Property resulting from causes beyond GRANTOR's control, including, without limitation, fire, drought, flood, storm, and earth movement caused by an earthquake.

7. COSTS AND LIABILITIES

Except as set forth in this EASEMENT, or as otherwise agreed in writing between the parties hereto, GRANTOR retains all responsibilities related to the ownership, operation, upkeep, and maintenance of the Property.

(a) Taxes: GRANTOR shall pay before delinquency all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Protected Property by competent authority, including any taxes imposed upon, or incurred as a result of, this EASEMENT, and shall furnish GRANTEE with satisfactory evidence of payment upon request.

(b) Hold Harmless: [this provision varies upon needs of grantee] GRANTOR or its successor shall hold harmless, indemnify, and defend GRANTEE and its members, directors, officers, employees, agents and contractors and the heirs, personal representatives, successors, and assigns of each of them (collectively "Indemnified Parties") from and against all liabilities, penalties, costs, losses, damages, expense, causes of action, claims, demands, or judgments, including without limitation, reasonable attorney's fees, arising from or in any way connected with: (1) injury to or the death of any person, or physical damages to any property, resulting from any act, omission, condition or other matter occurring on the Protected Property, unless caused by the acts or omissions of any of the Indemnified Parties; and (2) the existence or administration of this EASEMENT.

8. ASSIGNMENT

This EASEMENT is transferable, but GRANTEE shall give GRANTOR and the SERVICE [anyone else] at least thirty (30) days prior written notice of the transfer. GRANTEE may assign its rights and obligations under this EASEMENT only to an organization that is 1) approved by the SERVICE [anyone else]; and, 2) a public agency or a qualified organization at the time of transfer under section 170(h) of the Internal Revenue Code of 1954, as amended (or any successor provision then applicable), and the applicable regulations promulgated thereunder; and, 3) authorized to acquire and hold conservation easements under California Civil Code section 815 et seq. (or any successor provision then applicable). As a condition of such assignment or transfer, the Assignee or Transferee shall agree in writing that the conservation purposes that this grant is intended to advance shall continue to be fulfilled [if applicable: and that the Management Plan will be followed] and notice of such restrictions shall be recorded in the county where the property is located. In the event of the termination of GRANTEE's existence, the rights and obligations of GRANTEE hereunder shall, by that fact itself, and without any further action on the part of any entity, be deemed assigned to [Identify Entity; not the SERVICE].

9. SUBSEQUENT TRANSFERS

GRANTOR agrees to incorporate the terms of this EASEMENT in any deed or other legal instrument by which GRANTOR divests itself of any interest in all or a portion of the Property, including, without limitation, a leasehold interest. GRANTOR further agrees to give written notice to GRANTEE and the SERVICE at least fifteen (15) days prior to the date of any property transfer. The failure of GRANTOR to perform any act required by this paragraph shall not impair the validity of this EASEMENT or limit its enforceability in any way.

10. ESTOPPEL CERTIFICATES

Upon request by GRANTOR, GRANTEE shall within fifteen (15) days execute and deliver to GRANTOR any document, including an estoppel certificate, which certifies GRANTOR's compliance with any obligation of GRANTOR contained in this EASEMENT and otherwise evidences the status of this EASEMENT as may be requested by GRANTOR.

11. <u>NOTICES</u>

Any notice, demand, request, consent, approval, or communication that the parties desire or is required to give to the others shall be in writing and either served personally or sent by first class mail, postage prepaid, addressed as follows:

To Grantor:

To Grantee:

To Service:

United States Fish and Wildlife Service
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846
Attn: Field Supervisor

or to such other address or the attention of such other officer from time to time shall designate by written notice to the other.

12. <u>RECORDATION</u>

GRANTOR shall submit an original, signed and notarized Conservation Easement Grant to GRANTEE and GRANTEE shall promptly record this instrument [if applicable: in accordance with instructions for recordation contained in the biological opinion or HCP] in the official records of [County(s) where property is located], California and may re-record it at any time as may be required to preserve its rights in this EASEMENT.

13. <u>FUNDING</u>

______GRANTOR has provided [describe funding mechanism for maintenance of easement in perpetuity and include as exhibits all agreements, e.g., declaration of trust] to GRANTEE [others that will be managing the easement] for the purposes of fulfilling all of GRANTOR's obligations long-term operations and maintenance of the EASEMENT [under the Management Plan/Habitat Conservation Plan/Biological Opinion]. Funding shall be transferred to the appropriate transferee or assignee if the EASEMENT is assigned or transferred.

14. <u>ADDITIONAL EASEMENTS</u>

______GRANTOR shall not grant any additional easements, rights-of-way, or other interests in the Protected Property, other than a fee or leasehold interest, undivided interest or security interest (mortgage or deed of trust), or grant or otherwise transfer to any other person or entity or to other lands or otherwise abandon or relinquish any Waters associated with the Protected Property without the prior written authorization of GRANTEE given through the SERVICE. Such authorization will be given unless the SERVICE, among other things, determines that the proposed interest or transfer will interfere with the use of the Protected Property as habitat suitable for federally listed species or other federally protected species. This paragraph shall not prohibit the transfer of a fee title or leasehold interest in the Protected Property that is subject to the terms of this EASEMENT. This paragraph shall also not prohibit the granting of future compatible utility easements, as authorized by the SERVICE.

15. GENERAL PROVISIONS

(a) Controlling Law. The interpretation and performance of this EASEMENT shall be governed by the laws of the State of California, the Federal Endangered Species Act, and other applicable Federal laws.

(b) Construction. Any general rule of construction to the contrary notwithstanding, this EASEMENT shall be construed in favor of the grant to effect the Conservation Purpose of this EASEMENT and the policy and purpose of California Civil Code section 815 et seq. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the purposes of this EASEMENT that would render the provision valid shall be favored over any interpretation that would render it invalid.

(c) Severability. If any provision of this EASEMENT, or the application thereof to any person or circumstances, is found to be invalid, the remainder of the provisions of this EASEMENT, or the application of such provision to persons or circumstances other than those as to which it is found to be invalid, as the case may be, shall not be affected thereby.

(d) Entire Agreement. This instrument sets forth the entire agreement of the parties with respect to the EASEMENT and all exhibits and supersedes all prior discussions, negotiations, understandings, or agreements relating to the EASEMENT.

(e) No Forfeiture. Nothing contained herein will result in a forfeiture or reversion of GRANTOR's title in any respect.

(f) Successors. The covenants, terms, conditions, and restrictions of this EASEMENT shall be binding upon, and inure to the benefit of, the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall continue as servitude running in perpetuity with the Property.

(g) Captions. The captions in this EASEMENT have been inserted solely for convenience of reference and are not a part of this EASEMENT and shall have no effect upon construction of interpretation.

(h) Counterparts. The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by both parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

(i) Third-Party Beneficiary: GRANTOR and GRANTEE acknowledge that the SERVICE is a third party beneficiary of this EASEMENT with the right of access to the EASEMENT property and the right to enforce all of the provisions of this EASEMENT.

IN WITNESS WHEREOF, GRANTOR and GRANTEE have entered into this EASEMENT the day and year first above written.

Grantor:____________________
Entity

By:______________________

Name

____
Title

Grantee:______________________
Entity

By: __________________________
Name

____
Title

APPROVED AS TO FORM: [necessary when there are modifications made to the template]

____
XXXX, Assistant Regional Solicitor
United States Department of the Interior
for U.S. Fish and Wildlife Service

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Conservation Easement Area

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Legal Description of Conservation Easement Area

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CC Addresses

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Attn: Mr. George Kammerer
2150 River Plaza Drive, Suite 450
Sacramento, CA 95833

Filename: 03F0013 Westpark_Fiddyment_VP.wpd

ATTACHMENT D

Guidelines for Native Grass Seed Mixes, Application, and Suppliers

SEED MIX - UPLAND

FOR UPLAND AREAS DOWN TO 3' ABOVE SWALE BOTTOM

SPECIES	PLS LBS./ACRE	MIN. GERM. %
NASELLA PULCHRA (PURPLE NEEDLEGRASS)	9.0	60
MELICA CALIFORNICA (ONIONGRASS)	7.0	60
FESTUCA IDAHOENSIS (IDAHO FESCUE)	6.0	60
POA SECUNDA (NATIVE PINE BLUEGRASS)	5.0	50
VULPIA MICROSTACHYS (THREE WEEKS FESCUE)	6.0	60
ELYMUS GLAUCUS (BLUE WILDRYE)	6.0	80
ELYMUS MULTISETUS (SQUIRRELTAIL)	4.0	50
ELYMUS X TRITICUM (REGREEN)	20.0	80
TOTAL	63 PLS LBS	

SEED MIX - SWALE

FOR ALL SWALE AREAS TO 3' UPSLOPE ABOVE WATER SURFACE LEVEL.

SPECIES	PLS LBS./ACRE	MIN. GERM. %
CAREX BARBARAE (BARBARA SEDGE)	1.0	35
DESCHAMPSIA CAESPITOSA (TUFTED HAIRGRASS)	4.0	40
ELYMUS TRACHYCAULUS (SLENDER WHEATGRASS)	9.0	45
HORDEUM BRACHYANTHERUM (MEADOW BARLEY)	9.0	45
LEYMUS TRICTICOIDES 'YOLO' (CREEPING WILDRYE)	4.0	40
TRIFOLIUM OBTUSIFLORUM (CREEK CLOVER)	3.0	40
ELYMUS X TRICTICUM (REGREEN)	20.0	80
TOTAL	50 PLS LBS	

FERTILIZER COMPONENT	INGREDIENT %
NITROGEN	7
PHOSPHORUS	2
POTASSIUM	3

FERTILIZER SHALL BE NATURAL & SLOW RELEASE.

ADD MYCORRHIZAL INNOCULANT AT 60 LBS/ACRE

3-STEP SEED APPLICATION PROCESS

USE 3-STEP APPLICATION PROCESS IN AREAS RECEIVING HYDROSEED ONLY.

STEP 1: APPLY FIBER, SEED, FERTILIZER, & INNOCULANT AS SPECIFIED BELOW:

CELLULOSE WOOD FIBER	600 LBS./ACRE
SEED	AS SPECIFIED
FERTILIZER	1000 LBS/ACRE (ORGANIC 7-2-3)
MYCORRHIZAL INOCULATE	60 LBS./ACRE

STEP 2: APPLY STRAW MULCH — 4,000 lbs. /acre
WEED FREE RICE, NATIVE,
OR APPROVED SUBSTITUTE

STEP 3: APPLY FIBER & BINDER

CELLULOSE WOOD FIBER	500 LBS./ACRE
ORGANIC BINDER	100 LBS./ACRE

2-STEP SEED APPLICATION PROCESS

USE 2-STEP APPLICATION PROCESS IN AREAS RECEIVING HYDROSEED UNDER TURF REINFORCEMENT MAT (TRM) OR EROSION CONTROL BLANKET (ECB).

STEP 1: APPLY FIBER, SEED, FERTILIZER, BINDER & INNOCULANT AS SPECIFIED BELOW:

CELLULOSE WOOD FIBER	600 LBS./ACRE
SEED	AS SPECIFIED
FERTILIZER	1000 LBS/ACRE (ORGANIC 7-2-3)
MYCORRHIZAL INOCULATE	60 LBS./ACRE
ORGANIC BINDER	100 LBS/ACRE

STEP 2: APPLY TURF REINFORCEMENT MAT OR EROSON CONTROL BLANKET AS SPECIFIED IN PLANS. ALL AREAS RECEIVING BOTH HYDROSEED AND TURF REINFORCEMETNT MAT OR EROSION CONTROL BLANKET SHALL RECEIVE HYDROSEED BEFORE FABRIC.

NATIVE SEED SUPPLERS

Hedgerow Farms
21740 County Road 88
Winters, CA 95694
Phone: (530) 662-4570
Fax: (530) 668-8369
Web: www.hedgerowfarms.com

Pacific Coast Seed, Inc.
6144-A Industrial Way
Livermore, CA 94551-9749
Phone: (925) 373-4417
Fax: (925) 373-6855
Email: pcseed@attglobal.net

S&S Seeds
P.O. Box 1275
Carpenteria, CA 93014-1275
Phone: (805) 684-0436
Fax: (805) 684-2798
Web: www.ssseeds.com

For more information on native seed providers contact the California Native Grass Association P.O. Box 72405, Davis, CA, 95617-6405, Phone: (530) 759-8458; admin@cnga.org.

ATTACHMENT E

PAR Printouts

Section 9 - Ongoing Tasks and Costs

Property Title: Fiddyment Dataset: CA004 PAR ID: 2000169A 12/09/2003

Budget: PAR

Task list	Specificaton	Unit	Number of Units	Cost / Unit	Annual Cost	Divide Years	Total Cost
SITE CONSTRUCTION/MAINT.							
Fence, 4' X 6' X 6'	Post & 3/4" Cable	Lin. Ft.	23,411.00	10.00	234,110.00	20	11,705.50
Fence - Installed	5 Strand Barbed Wire	Lin. Ft.	6,653.00	8.00	53,224.00	30	1,774.13
Fence - Installed	5 Strand Barbed Wire - Cattle	Lin. Ft.	6,688.00	8.00	53,504.00	30	1,783.47
Fence - Installed	Concrete Rail Fence	Lin. Ft.	14,774.00	35.00	517,090.00	40	12,927.25
Fence - Installed	Masonry Block Wall	Lin. Ft.	470.00	55.00	25,850.00	80	323.13
Gate	Gate	Item	3.00	500.00	1,500.00	50	30.00
Lock	Padlock	Item	11.00	19.00	209.00	2	104.50
Vehicle Barrier	Metal Bollard	Item	8.00	100.00	800.00	35	22.86
Sub-Total							28,670.84
BIOTIC SURVEYS							
Wetland Specialist	1st Hydro/Shrimp Svy.	L. Hours	20.00	75.00	1,500.00	1	1,500.00
Wetland Specialist	2nd Floristic Svy.	L. Hours	12.00	75.00	900.00	1	900.00
Wetland Specialist	3rd Field Svy.	L. Hours	12.00	75.00	900.00	1	900.00
Ornithologist	Grnd. Nesting Bird Svy.	L. Hours	4.00	75.00	300.00	1	300.00
Other	General Inspection	L. Hours	16.00	60.00	960.00	1	960.00
Other	Agency Liaison	L. Hours	8.00	75.00	600.00	1	600.00
Sub-Total							5,160.00
HABITAT MAINTENANCE							
Erosion Control	Labor	L. Hours	24.00	60.00	1,440.00	2	720.00
Exotic Plant Control	Hand Removal, Labor	L. Hours	25.00	60.00	1,500.00	1	1,500.00
Exotic Plant Control	Exotic Plant/Thatch Mowing	L. Hours	20.00	80.00	1,600.00	1	1,600.00
Exotic Animal Control	Beaver Management	L. Hours	32.00	60.00	1,920.00	1	1,920.00
Other	Grazing coordination	L. Hours	10.00	85.00	850.00	1	850.00
Sub-Total							6,590.00
PUBLIC SERVICES							
Sign	Preserve	Item	15.00	70.00	1,050.00	7	150.00
Sign, Redwood	Interpretive	Item	12.00	300.00	3,600.00	7	514.29
Community Outreach	Homeowner Liaison	L. Hours	36.00	60.00	2,160.00	1	2,160.00
Sub-Total							2,824.29

Task list	Specificaton	Unit	Number of Units	Cost / Unit	Annual Cost	Divide Years	Total Cost
GENERAL MAINTENANCE							
Sanitation Control	Collection and disposal	L. Hours	24.00	60.00	1,440.00	1	1,440.00
Sub-Total							1,440.00
REPORTING							
Photo Materials	Film/Process	Roll	2.00	13.00	26.00	1	26.00
Agency Report	Draft Annual Report	L. Hours	16.00	75.00	1,200.00	1	1,200.00
Agency Report	City Review Annual Report	L. Hours	4.00	60.00	240.00	1	240.00
Monitoring Reports	General Inspection Memo	L. Hours	4.00	60.00	240.00	1	240.00
Other	Agency Liaison	L.Hours	20.00	75.00	1,500.00	1	1,500.00
Sub-Total							3,206.00
CONTINGENCY & ADMINISTRATION							
Contingency							4,789.11
Administration							2,634.01
Sub-Total							7,423.12
Total							55,314.25

Section 9 - Ongoing Tasks and Costs

Property Title: Westpark | Dataset: CA004 | PAR ID: 2000167B | 12/09/2003

Budget: PAR

Task list	Specificaton	Unit	Number of Units	Cost / Unit	Annual Cost	Divide Years	Total Cost
SITE CONSTRUCTION/MAINT.							
Fence, 4' X 6' X 6'	Post & 3/4" Cable	Lin. Ft.	16,634.00	10.00	166,340.00	20	8,317.00
Fence - Installed	5 Strand Barbed Wire	Lin. Ft.	12,176.00	8.00	97,408.00	30	3,246.93
Fence - Installed	5 Strand Barbed Wire - Cattle	Lin. Ft.	6,631.00	8.00	53,048.00	30	1,768.27
Fence - Installed	Concrete Rail Fence	Lin. Ft.	1,647.00	35.00	57,645.00	40	1,441.13
Gate	Gate	Item	2.00	500.00	1,000.00	50	20.00
Lock	Padlock	Item	6.00	19.00	114.00	2	57.00
Vehicle Barrier	Metal Bollard	Item	4.00	100.00	400.00	35	11.43
Sub-Total							14,861.76
BIOTIC SURVEYS							
Wetland Specialist	1st Hydro/Shrimp Svy.	L. Hours	20.00	75.00	1,500.00	1	1,500.00
Wetland Specialist	2nd Floristic Svy.	L. Hours	12.00	75.00	900.00	1	900.00
Wetland Specialist	3rd Field Svy.	L. Hours	12.00	75.00	900.00	1	900.00
Ornithologist	Grnd. Nesting Bird Svy.	L. Hours	4.00	75.00	300.00	1	300.00
Other	General Inspection	L. Hours	16.00	60.00	960.00	1	960.00
Other	Agency Liaison	L. Hours	8.00	75.00	600.00	1	600.00
Sub-Total							5,160.00
HABITAT MAINTENANCE							
Erosion Control	Labor	L. Hours	18.00	60.00	1,080.00	2	540.00
Exotic Plant Control	Hand Removal, Labor	L. Hours	15.00	60.00	900.00	1	900.00
Exotic Plant Control	Exotic Plant/Thatch Mowing	L. Hours	40.00	80.00	3,200.00	1	3,200.00
Other	Grazing coordination	L. Hour	10.00	85.00	850.00	1	850.00
Sub-Total							5,490.00
PUBLIC SERVICES							
Sign	Preserve	Item	15.00	70.00	1,050.00	7	150.00
Community Outreach	Homeowner Liaison	L. Hours	36.00	60.00	2,160.00	1	2,160.00
Sub-Total							2,310.00
GENERAL MAINTENANCE							
Sanitation Control	Collection and disposal	L. Hours	24.00	60.00	1,440.00	1	1,440.00
Sub-Total							1,440.00

Task list	Specificaton	Unit	Number of Units	Cost / Unit	Annual Cost	Divide Years	Total Cost
REPORTING							
Photo Materials	Film/Process	Roll	1.00	13.00	13.00	1	13.00
Agency Report	Draft Annual Report	L. Hours	16.00	75.00	1,200.00	1	1,200.00
Agency Report	City Review Annual Report	L. Hours	4.00	60.00	240.00	1	240.00
Monitoring Reports	General Inspection Memo	L. Hours	4.00	60.00	240.00	1	240.00
Other	Agency Liaison	L. Hours	20.00	75.00	1,500.00	1	1,500.00
Sub-Total							3,193.00
CONTINGENCY & ADMINISTRATION							
Contingency							3,245.48
Administration							1,785.01
Sub-Total							5,030.49
Total							37,485.25

ATTACHMENT F

Monitoring Timeline

ANNUAL LONG-TERM MONITORING TIMELINE
West Roseville Specific Plan Open Space Preserve

January	February	March	April	May	June
Biological Inspection* First Survey – 5% of preserved vernal pools will be dip-netted. Also can take place in December or February. See Section 5.3.2.1.	General Inspection** Although February is suggested, this General Inspection can happen at any time of year. See Section 5.2.		Biological Inspection* Survey – 5% of preserved vernal pools will be surveyed for dominant plant species. Also can take place in May or June. See Section 5.3.2.2.	Preserve Manager to schedule ground nesting bird survey prior to mowing of firebreaks. See Section 9.7.	Preserve Manager to discuss coming year's grazing with grazing contractor. Take care of paperwork and contract.

July	August	September	October	November	December
General Inspection** Although July is suggested, this General Inspection can happen at any time of year. See Section 5.2.	Preserve Manager/Monitoring Biologist – Submit Annual Letter Report to U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers by August 15^{th}. See Section 5.5.	Biological Inspection* Third Survey – Assess problem areas, restoration efforts, remediation activities, and grazing regime. See Section 5.3.2.3 and 8.2.3.4.			

*Biological Inspection Tasks: evaluate habitat function, thatch accumulation, newly introduced non-native plant species, and overall Preserve function.

**General Inspection Tasks: evaluate erosion and sedimentation, fire hazard reduction, fencing, gates, bollards, signage, trash accumulation, unauthorized motor vehicle use.

ATTACHMENT G

Preserve Data Sheets

PRESERVE INSPECTION SHEET
West Roseville Specific Plan Open Space Preserve

DATE:____________________ **CITY PERSONNEL:**______________________________

Preserve Condition	Actions Taken (date and by whom)
Trash Accumulation?	
Fire Hazards?	
Unauthorized Construction/Fill?	
Fencing/Gates/Bollards/Signage?	
Unauthorized Motor Vehicle Use?	
Erosion/Sedimentation?	
Preserve Condition?	
Other Notes:	

Page ____ of ____

FIELD DATA SHEET
Vernal Pool Hydrology / Aquatic Invertebrates
West Roseville Specific Plan Open Space Preserve

DATE:____________________ **BILOGIST:**_________________________

Vernal Pool Number/Location	Photo Number	*Branchinecta lynchi*	*Linderiella occidentalis*	Other Aquatic Invertebrates	General Pool Notes:

General Preserve Notes: (i.e. hydrologic condition, erosion, off-road vehicle use, mosquitos, vandalism, overgrazing, trampling, unauthorized fill, exotic weeds etc.)

FIELD DATA SHEET
Vernal Pool Flora
West Roseville Specific Plan Open Space Preserve

DATE:____________________ **BIOLOGIST:**____________________

Vernal Pool Number/Location	Photo Number	% Vegetation Cover	Dominant Species	VPA/UPI? Category	General Pool Notes

General Preserve Notes: (i.e. hydrologic condition off-road vehicle use, plant collection, erosion mosquitos, vandalism, overgrazing, trampling, unauthorized fill, exotic weeds, etc.)

Page ____ of ____

FIELD DATA SHEET
Residual Dry Matter
West Roseville Specific Plan Open Space Preserve

DATE:________________ **BIOLOGIST:**____________________

Sample Number (a)	Estimate of Vegetation Utilization (b)	Dry Weight of Sample	RDM (c)	Photo Taken?	Notes:
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

General Preserve Notes: (i.e. hydrologic condition, erosion, mosquitoes, vandalism, overgrazing, trampling, exotic weeds, etc.)

(a) Identify each sample location on the site map and attach to data sheet.
(b) Use standard vegetation use classes:
- 1 = None 0-15%, Little or no use of surveyed vegetation.
- 2 = Light 16-35%, Less than 1/3 of surveyed vegetation shows evidence of being grazed. Trampling damage is minimal.
- 3 = Moderate 36-65%, Grazing is spotty, but evident (over 1/3 of the surveyed vegetation shows evidence of being grazed). Trampling damage may be evident.
- 4 = Heavy 66-80%, Surveyed vegetation is closely cropped. Trampling damage may be evident.
- 5 = Severe >80%, Surveyed vegetation grubbed. Trampling damage should be evident.

(c) RDM (Residual Dry Matter) = Dry Weight of Sample (grams) X 100lbs/acre.

ATTACHMENT H

RDM Determination Methods

METHODOLOGY FOR UTILIZATION/RESIDUAL DRY MATTER DETERMINATION OF VEGETATION

1. Residual Dry Matter (RDM)

Residual dry matter is the amount of above ground plant material. It should be measured after the grazing season and growing season. In regards to population surveys of a specific plant species, it is more appropriate to collect RDM data within the survey area (a similar ecotype) than over the entire grazing unit. To estimate RDM, collect 5 circular plant samples (0.96 sq. ft.) within the specific survey area. Locate sample site by random selection. Toss the sample hoop in a random direction of collect a sample every 5 or 10 paces. A 0.96 sq. ft. sample hoop can be constructed from a wire cable or other material 41.66 inches long. Each gram of RDM inside a 0.96 sq. ft. hoop represents 100 lb./acre. Use hand shears to clip the above ground plant material very close to the ground about ¼ to ½ inch stubble height. Clip all rooted plant material within the hoop. Try to avoid picking up dirt, rocks and other non-plant material. Place the sample in a paper bag. The sample should be dried before it is weighted. Weigh the sample in grams. Remember to subtract the weight of the bag containing the sample.

Estimate of RDM

Samples	Dried Weight (gr.)		Lb./Acre
1	___________	X	100=___________
2	___________	X	100=___________
3	___________	X	100=___________
4	___________	X	100=___________
5	___________	X	100=___________

Note: If the standard deviation of these estimates is one half or larger than the average, more samples should be collected and added to the average.

Source: Sheila Barry. *Recording Grazing Utilization.* University of California Cooperative

2. Estimate of Total Vegetation Utilization. Visual Utilization Estimate

Degree of utilization should be estimated for the total vegetation in addition to RDM. The estimate should be based on use classes 1 to 5 as described in the table below. Record use class every time the vegetation is surveyed. It is also appropriate to record use class at the end of the grazing season. It is recommended to estimate use class at 50 points from a random dog-legged walk of the surveyed area covering the range of conditions on the site. Method used should be noted.

Use Class	**Degree of Use**	**Description**
1 – None	0 – 15%	Little or no use of surveyed vegetation
2 – Light	16 – 35%	Less than one-third of the surveyed vegetation shows evidence of being grazed. Trampling damage is minimal.
3 – Moderate	36 – 65%	Grazing is spotty, but evident (over one-third of the surveyed vegetation shows evidence of being grazed). Trampling damage may be evident.
4 – Heavy	66 – 80%	Surveyed vegetation is closely cropped. Trampling damage may be evident.
5 – Severe	Over 80%	Surveyed vegetation grubbed. Trampling damage should be evident.

If the surveyed vegetation has a low-forage value, trampling damage may be evident before the plants appear grazed. These observations should be recorded.

ATTACHMENT I

CalEPPC list

The CalEPPC List:

Exotic Pest Plants of Greatest Ecological Concern in California

October, 1999

The CalEPPC list is based on information submitted by our members and by land managers, botanists and researchers throughout the state, and on published sources. The list highlights non-native plants that are serious problems **in wildlands** (natural areas that support native ecosystems, including national, state and local parks, ecological reserves, wildlife areas, national forests, BLM lands, etc.).

List categories include:

List A: Most Invasive Wildland Pest Plants; documented as aggressive invaders that displace natives and disrupt natural habitats. Includes two sub-lists; List A-1: Widespread pests that are invasive in more than 3 Jepson regions (see page 3), and List A-2: Regional pests invasive in 3 or fewer Jepson regions.

List B: Wildland Pest Plants of Lesser Invasiveness; invasive pest plants that spread less rapidly and cause a lesser degree of habitat disruption; may be widespread or regional.

Red Alert: Pest plants with potential to spread explosively; infestations currently small or localized. If found, alert CalEPPC, County Agricultural Commissioner or California Department of Food and Agriculture.

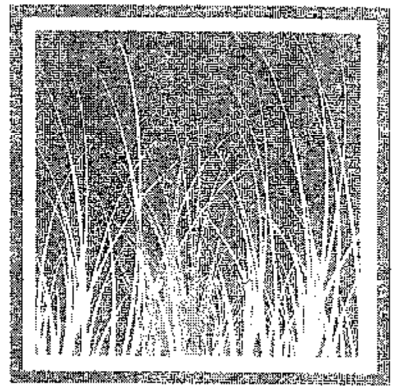
Need More Information: Plants for which current information does not adequately describe nature of threat to wildlands, distribution or invasiveness. Further information is requested from knowledgeable observers.

Annual Grasses: New in this edition; a preliminary list of annual grasses, abundant and widespread in California, that pose significant threats to wildlands. Information is requested to support further definition of this category in next List edition.

Considered But Not Listed: Plants that, after review of status, do not appear to pose a significant threat to wildlands.

Plants that fall into the following categories are not included in the List:

- Plants found mainly or solely in disturbed areas, such as roadsides and agricultural fields.
- Plants that are established only sparingly, with minimal impact on natural habitats.



1999 List Review Committee:

Dr. Lars W.J. Anderson, Research Leader
U.S. Dept of Agriculture-ARS
Aquatic Weed Research Lab.

Dr. Joe DiTomaso, Extension Weed Ecologist
Weed Science Program
Department of Vegetable Crops
University of California, Davis

Dr. G. Fred Hrusa, Senior Plant Systematist
Plant Pest Diagnostics Center
California Department of Food & Agriculture

Dr. Marcel Rejmánek, Professor of Plant Ecology
Section of Evolution and Ecology
University of California, Davis

CalEPPC List Committee:

Ann Howald, Instructor
Santa Rosa Junior College

Dr. John Randall, Invasive Weed Specialist
The Nature Conservancy

Jake Sigg, President
California Native Plant Society

Ellie Wagner, Botanist
California Dept. of Transportation

Peter Warner, Restoration Coordinator
Golden Gate National Parks Association

The CalEPPC list is updated regularly. Please use the form provided to send comments, suggestions or new information to: **Peter Warner, 555 Magnolia Avenue, Petaluma, CA, 94952-2080**, or via email at **peterjwarner@earthlink.net**

Thanks to all those who submitted comments for the 1999 list.

List A-1: Most Invasive Wildland Pest Plants; Widespread

Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Ammophila arenaria	European beach grass	Coastal dunes	SCo,CCo,NCo
Arundo donax	giant reed, arundo	Riparian areas	cSNF,CCo,SCo,SnGo,D,GV
Bromus tectorum	cheat grass, downy brome	Sagebrush, pinyon-juniper, other desert communities; increases fire frequency	GB,D
Carpobrotus edulis	iceplant, sea fig	Many coastal communities, esp. dunes	SCo,CCo,NCo,SnFrB
Centaurea solstitialis[C]	yellow starthistle	Grasslands	CA-FP (uncommon in SoCal)
Cortaderia jubata	Andean pampas grass, jubatagrass	Horticultural; many coastal habitats, esp. disturbed or exposed sites incl. logged areas	NCo,NCoRO,SnFrB, CCo,WTR,SCo
Cortaderia selloana	pampas grass	Horticultural; coastal dunes, coastal scrub, Monterey pine forest, riparian, grasslands; wetlands in ScV; also on serpentine	SnFrB,SCo,CCo,ScV
Cynara cardunculus[B]	artichoke thistle	Coastal grasslands	CA-FP, esp. CCo,SCo
Cytisus scoparius[C]	Scotch broom	Horticultural; coastal scrub, oak woodlands, Sierra foothills	NW,CaRF,SNF,GV, SCo,CW
Eucalyptus globulus	Tasmanian blue gum	Riparian areas, grasslands, moist slopes	NCoRO,GV,SnFrB, CCo,SCoRO,SCo,nChI
Foeniculum vulgare	wild fennel	Grasslands; esp. SoCal, Channel Is.; the cultivated garden herb is not invasive	CA-FP
Genista monspessulana[C]	French broom	Horticultural; coastal scrub, oak woodlands, grasslands	NCoRO,NCoRI,SnFrB, CCo,SCoRO,sChI,WTR,PR
Lepidium latifolium[B]	perennial pepperweed, tall whitetop	Coastal, inland marshes, riparian areas, wetlands, grasslands; potential to invade montane wetlands	CA (except KR,D)
Myriophyllum spicatum	Eurasian watermilfoil	Horticultural; lakes, ponds, streams, aquaculture	SnFrB,SnJV,SNH(?), prob. CA
Pennisetum setaceum	fountain grass	Horticultural; grasslands, dunes, desert canyons; roadsides	Deltaic GV,CCo,SCo, SnFrB
Rubus discolor	Himalayan blackberry	Riparian areas, marshes, oak woodlands	CA-FP
Senecio mikanioides (=*Delairea odorata*)	Cape ivy, German ivy	Coastal, riparian areas, also SoCal (south side San Gabriel Mtns.)	SCo,CCo,NCo,SnFrB,SW
Taeniatherum caput-medusae[C]	medusa-head	Grasslands, particularly alkaline and poorly drained areas	NCoR,CaR,SNF,GV,SCo
Tamarix chinensis, *T. gallica*, *T. parviflora* & *T. ramosissima*	tamarisk, salt cedar	Desert washes, riparian areas, seeps and springs	SCo,D,SnFrB,GV,sNCoR, sSNF,Teh,SCoRI,SNE, WTR
Ulex europaeus[B]	gorse	North, central coastal scrub, grasslands	NCo,NCoRO,CaRF, n&cSNF,SnFrB,CCo

[1]Noxious Weed Ratings

F: Federal Noxious Weed, as designated by the USDA; targeted for federally-funded prevention, eradication or containment efforts.

A: CA Dept. of Food & Agriculture, on "A" list of Noxious Weeds; agency policies call for eradication, containment or entry refusal.

B: CA Dept. of Food & Agriculture, on "B" list of Noxious Weeds; includes species that are more widespread, and therefore more difficult to contain; agency allows county Agricultural Commissioners to decide if local eradication or containment is warranted.

C: CA Dept. of Food & Agriculture, on "C" list of Noxious Weeds; includes weeds that are so widespread that the agency does not endorse state or county-funded eradication or containment efforts except in nurseries or seed lots.

Q: CA Dept. of Food & Agriculture's designation for temporary "A" rating pending determination of a permanent rating.

For most species nomenclature follows *The Jepson Manual: Higher Plants of California* (Hickman, J., Ed., 1993).

Exotic Pest Plants of Greatest Ecological Concern in California

List A-2: Most Invasive Wildland Pest Plants; Regional

Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Ailanthus altissima	tree of heaven	Riparian areas, grasslands, oak woodlands, esp. GV, SCo	CA-FP
Atriplex semibaccata	Australian saltbush	SoCal, coastal grasslands, scrub, "high marsh" of coastal salt marshes	CA (except CaR,c&sSN)
Brassica tournefortii	Moroccan or African mustard	Washes, alkaline flats, disturbed areas in Sonoran Desert	SW,D
Bromus madritensis ssp. *rubens*	red brome	Widespread; contributing to SoCal scrub, desert scrub type conversions; increases fire frequency	CA
Cardaria draba[B]	white-top, hoary cress	Riparian areas, marshes of central coast; also ag. lands, disturbed areas	Problem only in CCo
Conicosia pugioniformis	narrow-leaved iceplant, roundleaf iceplant	Coastal dunes, sandy soils near coast; best documented in San Luis Obispo and Santa Barbara cos.	CCo
Cotoneaster pannosus, *C. lacteus*	cotoneaster	Horticultural; many coastal communities; esp. North Coast, Big Sur; related species also invasive	CCo,SnFrB,NW
Cytisus striatus	striated broom	Often confused with *C. scoparius*; coastal scrub, grassland	SnFrB,CCo,SCo,PR
Egeria densa	Brazilian waterweed	Streams, ponds, sloughs, lakes; Sacramento-San Joaquin Delta	n&sSNF,SnJV,SnFrB, SnJt,SNE
Ehrharta calycina	veldt grass	Sandy soils, esp. dunes; rapidly spreading on central coast	CCo,SCoRO,WTR
Eichhornia crassipes	water hyacinth	Horticultural; established in natural waterways, esp. troublesome in Sacramento-San Joaquin Delta	GV,SnFrB,SCo,PR
Elaeagnus angustifolia	Russian olive	Horticultural; interior riparian areas	SnJV,SnFrB,SNE,DMoj
Euphorbia esula[A]	leafy spurge	Rangelands in far no. CA, also reported from Los Angeles Co.	eKR,NCo,CaR,MP,SCo
Ficus carica	edible fig	Horticultural; Central Valley, foothill, South Coast and Channel Is. riparian woodlands	nSNF,GV,SnFrB,SCo
Lupinus arboreus	bush lupine	Native to SCo, CCo; invasive only in North Coast dunes	SCo,CCo,NCo
Mentha pulegium	pennyroyal	Santa Rosa Plain (Sonoma Co.) and Central Valley vernal pools; wetlands elsewhere	NW,GV,CWSCo
Myoporum laetum	myoporum	Horticultural; coastal riparian areas in SCo	SCo,CCo
Saponaria officinalis	bouncing bet	Horticultural, meadows, riparian habitat in SNE, esp. Mono Basin	NW,CaRH,nSNF,SnFrB, SCoRO,SCo,PR,MP,SNE, GV
Spartina alterniflora	Atlantic or smooth cordgrass	S.F. Bay salt marshes; populations in Humboldt Bay believed extirpated	CCo(shores of S.F. Bay)

[2]Distribution by geographic subdivisions per the Jepson Manual

CA=California
CA-FP=California Floristic Province
CaR=Cascade Ranges
CaRF=Cascade Range Foothills
CCo=Central Coast
ChI=Channel Islands
CW=Central Western CA
D=Deserts
DMoj=Mojave Desert
DSon=Sonoran Desert
GB=Great Basin
GV=Great Valley
KR=Klamath Ranges
MP=Modoc Plateau
NCo=North Coast
NCoRI=Inner NCo Ranges
NCoRO=Outer NCo Ranges
NW=Northwestern CA
PR=Peninsular Ranges
SCo=South Coast
SCoRI=Inner SCo Ranges
SCoRO=Outer SCo Ranges
ScV=Sacramento Valley
SnJV=San Joaquin Valley
SN=Sierra Nevada
SNE=East of SN
SNF=SN Foothills
SNH=High SN
SnFrB=San Francisco Bay Area
SnGb=San Gabriel Mtns
SW=Southwestern CA
Teh=Tehachapi Mtns
WTR=Western Transverse Ranges

List B: Wildland Pest Plants of Lesser Invasiveness

Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Ageratina adenophora[F]	eupatory	Horticultural; coastal canyons, coastal scrub, slopes, Marin to San Diego Co; San Gabriel Mtns.	CCo,SnFrB,SCo,SCoRO
Bassia hyssopifolia	bassia	Alkaline habitats	CA (except NW,SNH)
Bellardia trixago	bellardia	Grasslands, on serpentine, where a threat to rare natives	NCoRO,CCo,SnFrB
Brassica nigra	black mustard	Coastal communities, esp. fog-belt grasslands; disturbed areas	CA-FP
Cardaria chalepensis[B]	lens-podded white-top	Wetlands of Central Valley	CA
Carduus pycnocephalus[C]	Italian thistle	Grasslands, shrublands, oak woodlands	sNCo,sNCoR,SNF,CW,SCo,ScV
Centaurea calcitrapa[B]	purple starthistle	Grasslands	NW,sCaRF,SNF,GV,CW,SW
Centaurea melitensis	tocalote, Malta starthistle	Widespread; sometimes misidentified as *C. solstitialis*; perhaps a more serious invader than currently recognized	CA-FP,D
Cirsium arvense[B]	Canada thistle	Especially troublesome in riparian areas	CA-FP
Cirsium vulgare	bull thistle	Riparian areas, marshes, meadows	CA-FP,GB
Conium maculatum	poison hemlock	Mainly disturbed areas but may invade wildlands; known to poison wildlife; early expanding stage in many areas, esp. San Diego Co. riparian, oak understory	CA-FP
Crataegus monogyna	hawthorn	Horticultural; recent invader, colonizing healthy native forest around Crystal Springs reservoir on S.F. peninsula	SnFrB,CCo,NCo,NCoR
Ehrharta erecta	veldt grass	Wetlands, moist wildlands; common in urban areas; potential to spread rapidly in coastal, riparian, grassland habitats	SnFrB,CCo,SCo
Erechtites glomerata, E. minima	Australian fireweed	Coastal woodlands, scrub, NW forests, esp. redwoods	NCo,NCoRO,CCo,SnFrB,SCoRO
Festuca arundinacea	tall fescue	Horticultural (turf grass); coastal scrub, grasslands in NCo, CCo	CA-FP
Hedera helix	English ivy	Horticultural; invasive in coastal forests, riparian areas	CA-FP
Holcus lanatus	velvet grass	Coastal grasslands, wetlands in No. CA	CA exc. DSon
Hypericum perforatum[C]	Klamathweed, St. John's wort	Redwood forests, meadows, woodlands; invasion may occur due to lag in control by established biocontrol agents	NW,CaRH,n&cSN,ScV,CCo,SnFrB,PR
Ilex aquifolium	English holly	Horticultural; coastal forests, riparian areas	NCoRO,SnFrB,CCo
Iris pseudacorus	yellow water iris, yellow flag	Horticultural; riparian, wetland areas, esp. San Diego, Los Angeles cos.	SnFrB,CCo,sSnJV,SCo
Leucanthemum vulgare	ox-eye daisy	Horticultural; invades grassland, coastal scrub	KR,NCoRO,n&cSNH,SnFrB,WTR,PR
Mesembryanthemum crystallinum	crystalline iceplant	Coastal bluffs, dunes, scrub, grasslands; concentrates salt in soil	NCo,CCo,SCo,ChI
Myriophyllum aquaticum	parrot's feather	Horticultural; streams, lakes, ponds	NCo,CaRF,CW,SCo
Olea europaea	olive	Horticultural and agricultural; reported as invasive in riparian habitats in Santa Barbara, San Diego	NCoR,NCoRO,CCo,SnFrB,SCoRO,SCo
Phalaris aquatica	Harding grass	Coastal sites, esp. moist soils	NW,cSNF,CCo,SCo
Potamogeton crispus	curlyleaf pondweed	Scattered distribution in ponds, lakes, streams	NCoR,GV,CCo,SnFrB,SCo,ChI,SnGb,SnBr,DMoj
Ricinus communis	castor bean	SoCal coastal riparian habitats	GV,SCo,CCo
Robinia pseudoacacia	black locust	Horticultural; riparian areas, canyons; native to eastern U.S.	CA-FP,GB
Schinus molle	Peruvian pepper tree	Horticultural; invasive in riparian habitats in San Diego, Santa Cruz Is.	SNF,GV,CW,SW,Teh

List B: Continued

Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Schinus terebinthifolius	Brazilian pepper	Horticultural; riparian areas	sSCo
Senecio jacobaea[B]	tansy ragwort	Grasslands; biocontrol agents established	NCo,wKR,s&wCaR, nSNF, nScV,SW
Spartium junceum	Spanish broom	Coastal scrub, grassland, wetlands, oak woodland, NW forests, esp. redwoods; also roadcuts	NCoRO,ScV,SnFrB, SCoRO,SCo,sChI,WTR
Verbascum thapsus	woolly or common mullein	SNE meadows, sagebrush, pinyon-juniper woodlands; shores of Boggs Lake (Lake Co.)	CA
Vinca major	periwinkle	Horticultural; riparian, oak woodland, other coastal habitats	NCoRO,SnFrB, CCo, sSCoRO,SCo

Red Alert: Species with potential to spread explosively; infestations currently restricted

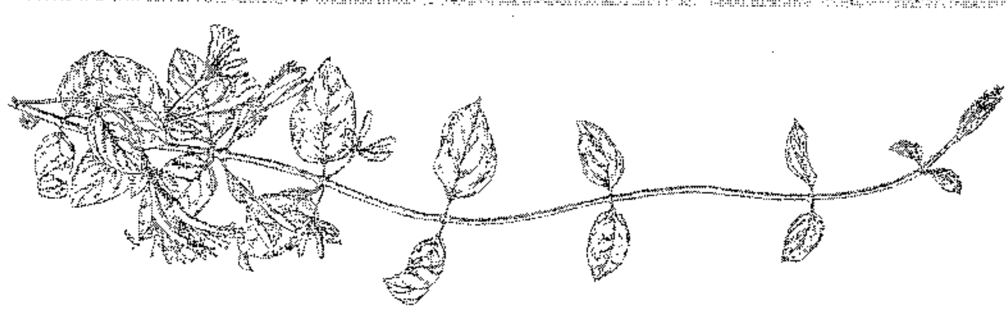
Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Alhagi pseudalhagi[A]	camel thorn	Noxious weed of arid areas; most infestations in California have been eradicated	GV,sSNE,D
Arctotheca calendula[A]	Capeweed	Seed-producing types are the problem; most are vegetative only	NCo,SnFrB,CCo
Centaurea maculosa[A]	spotted knapweed	Riparian, grassland, wet meadows, forest habitats; contact CA Food & Ag if new occurrences found	CaR,SN,nScV,nCW,MP, nSNE,sPR,NW
Crupina vulgaris[F,A]	bearded creeper, common crupina	Aggressively moving into wildlands, esp. grassland habitats	NCoR (Sonoma Co.),MP
Halogeton glomeratus[A]	halogeton	Noxious weed of Great Basin rangelands; report locations to CA Food & Ag; goal is exclusion from CA	GB
Helichrysum petiolare	licorice plant	North coastal scrub; one population on Mt. Tamalpais, w. Marin Co.	Not in Jepson
Hydrilla verticillata[F,A]	hydrilla	Noxious water weed; report locations to CA Food & Ag; eradication program in place; found in Clear Lake (Lake Co.) in 1994	NCoRI,n&cSNF,ScV,SCo,D
Lythrum salicaria[B]	purple loosestrife	Horticultural; noxious weed of wetlands, riparian areas	sNCo,NCoRO,nSNF,ScV, SnFrB,nwMP
Ononis alopecuroides[Q]	foxtail restharrow	Eradication efforts underway in San Luis Obispo Co.; to be looked for elsewhere in CA	CCo; not in Jepson
Retama monosperma	bridal broom	First noted at Fallbrook Naval Weapons Station, San Diego Co.; could rival other invasive brooms	San Diego Co.; not in Jepson
Salvinia molesta[F]	giant waterfern	Ponds, lakes, reservoirs, canals	Napa, Sonoma cos., lower Colorado River; not in Jepson
Sapium sebiferum	Chinese tallow tree	Horticultural; riparian, wetland habitats, open areas and understory	ScV,SnFrB; not in Jepson
Sesbania punicea	scarlet wisteria tree	Horticultural; riparian areas; American River Parkway, Sacramento Co., Suisun Marsh, San Joaquin River Parkway	ScV,SnJV; not in Jepson
Spartina anglica	cord grass	Scattered in S.F. Bay	Not in Jepson
Spartina densiflora	dense-flowered cord grass	Scattered in S.F. Bay, Humboldt Bay salt marshes	CCo,NCo
Spartina patens	salt-meadow cord grass	One site in S.F. Bay, also Siuslaw Estuary, OR and Puget Sound, WA	CCo

Need More Information

Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Acacia dealbata	silver wattle	Aggressive in natural areas?	SnFRB,SCoRO,SCoRI,CCo
Acacia decurrens	green wattle	Sometimes confused with A. dealbata; aggressive in natural areas?	Unknown
Acacia melanoxylon	blackwood acacia	Reported from S.F. Bay area, central coast, Santa Cruz Is.; spreads slowly; other areas?	SnFrB,SCoRO,SCo,CCo
Aeschynomene rudis[3]	rough jointvetch	Princeton area, Colusa Co.; pest of rice crops; potential threat to riparian, wetland habitats?	ScV
Agrostis avenacea	Pacific bentgrass	Invading vernal pools in San Diego area; attempts at manual eradication unsuccessful so far; problem in other areas?	sNCo,sNCoR,SNF, GV,CW,nSCo
Aptenia cordifolia	red apple	Habitats where invasive?	CCo,SCo,sChI
Asphodelus fistulosus	asphodel	Common in SCo highway rights-of-way, other disturbed sites; threats to wildlands?	sSnJV,SCo
Carduus acanthoides[4]	giant plumeless thistle	Threatens wildlands?	NCoRI,nSN,SnFrB, nSCoRO,MP
Cistus ladanifer	gum cistus	Horticultural; invades coastal sage scrub, chaparral; areas where problematic?	sCCo,SnGb
Cordyline australis	New Zealand cabbage	Infestation at Salt Point State Park; bird-dispersed; other problem areas?	Not in Jepson
Cotoneaster spp. *(exc. C. pannosus, C. lacteus)*	cotoneaster	Horticultural; bird-distributed; which species are problems in wildlands?	Unknown
Cupressus macrocarpa	Monterey cypress	Native only to Monterey Peninsula; planted and naturalized CCo, NCo; threat to wildlands?	CCo
Descurainia sophia	flixweed, tansy mustard	Entering Mojave wildlands through washes; threat to wildlands?	CA
Dimorphotheca sinuata	African daisy, Cape marigold	Horticultural; reported as invasive in w. Riverside Co., Ventura Co.; problem elsewhere?	SnJV,SCoRO,SCo,PR
Echium candicans, E. pininana	pride of Madeira, pride of Teneriffe	Horticultural; riparian, grassland, coastal scrub communities; spreads by seed	CCo,SnFrB,SCo,sNCo
Ehrharta longiflora	veldt grass	Reported from San Diego	Not in Jepson
Erica lusitanica	heath	Threat to wildlands?	NCo (Humboldt Co.)
Euphorbia lathyris	caper spurge, gopher plant	Invades coastal scrub, marshes, dunes: Sonoma, Marin cos.; threat to wildlands?	NCo,CCo,GV,SCo
Gazania linearis	gazania	Horticultural; invades grassland in S.F., coastal scrub?	CCo,SCo
Glyceria declinata		Although reported from Central Valley vernal pools, genetic research is needed to confirm identity; plants that have been called G. declinata key in Jepson to native G. occidentalis	Uncertain; not in Jepson
Hedera canariensis	Algerian ivy	Horticultural; invasive in riparian areas in SoCal?	Not in Jepson
Hirschfeldia incana	Mediterranean or short-pod mustard	Increasing in western, southern Mojave; threat to wildlands?	NCo,SNF,GV,CW,SCo, DMoj
Hypericum canariense	Canary Island hypericum	Reported in San Diego area, coastal sage scrub, grassland; threat to wildlands?	SCo
Hypochaeris radicata	rough cat's-ear	Widespread in coastal grasslands, wetlands; threat to wildlands?	NW,CaRF,nSNF,ScV, CW,SCo
Isatis tinctoria[3]	dyers' woad	Well-known invader in Utah; threat to wildlands?	KR,CaR,nSNH,MP
Ligustrum lucidum	glossy privet	Horticultural; spreading rapidly on Mendocino coast; problem in other areas?	NCo; not in Jepson
Limonium ramosissimum ssp. *provinciale*	sea lavender	Reported spreading in Carpinteria Salt Marsh; problem in other areas?	Not in Jepson

Need More Information: Continued

Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Ludwigia uruguayensis (= *L. hexapetala*)	water primrose	Invasive in aquatic habitats; non-native status questioned?	NCo,sNCoRO,CCo, SnFrB,SCo
Malephora crocea	ice plant	Invades margins of wetlands, bluffs along SCo	CCo,SCo,sChI
Maytenus boaria	mayten	Horticultural; scattered in riparian forests, ScV; east SnFrB	ScV,SnFrB
Mesembryanthemum nodiflorum	slender-leaved iceplant	Abundant on Channel Islands; invades wetlands; habitats where problematic?	SnFrB,SCo,ChI
Nicotiana glauca	tree tobacco	Disturbed places; not very competitive with natives in coastal scrub, chaparral; spreading along Putah Creek (Yolo Co.); problems elsewhere?	NCoRI,c&sSNF, GV,CW,SW,D
Oxalis pes-caprae	Bermuda buttercup	Invades disturbed sites, invasive in undisturbed habitats?	NCo,NCoRO,CCo, SnFrB,SCoRO,SCo
Parentucellia viscosa		Threat to NCo (Humboldt Co.) dune swales?	NCo,NCoRO,CCo,SCo
Passiflora caerulea		Horticultural; reported from SoCal; threat to wildlands?	SCo; not in Jepson
Pennisetum clandestinum[F,C]	Kikuyu grass	Disturbed sites, roadsides; threat to wildlands?	NCo,CCo,SnFrB,SCo, Santa Cruz Is.
Phyla nodiflora	mat lippia	Most varieties in CA are native; taxonomy unclear; status of plants in vernal pools, wetlands?	NW(except KR,NCoRH), GV,CCo,SnFrB,SCo, PR,DSon
Pinus radiata cultivars	Monterey pine	Cultivars invading native Monterey, Cambria forests, where spread of pine pitch canker is a concern	CCo
Piptatherum miliaceum	smilo grass	Aggressive in SoCal creeks, canyons; threats to wildlands?	NCo,GV,CW,SCo
Pistacia chinensis	Chinese pistache	Horticultural; invades riparian areas and woodlands in ScV	ScV
Prunus cerasifera	cherry plum	Oak woodland, riparian areas; esp. Marin, Sonoma cos.; bird-distributed; problems elsewhere?	SnFrB,CCo
Pyracantha angustifolia	pyracantha	Horticultural; spreads from seed in S.F. Bay area; bird-distributed; problem elsewhere?	sNCoRO,CCo,SnFrB, SCo
Salsola soda	glasswort	Threat to salt marshes?	nCCo,SnFrB
Salsola tragus[C]	Russian thistle, tumbleweed	Abundant in dry open areas in w. Mojave Desert, Great Basin; not limited to disturbed sites; threats?	CA
Salvia aethiopis[C]	Mediterranean sage	Creates monocultures in E. Oregon grasslands; threat to CA wildlands?	MP
Stipa capensis		Distribution and threats?	Not in Jepson
Tamarix aphylla	athel	Spreading in Salton Sea area; threats to wildlands?	nSnJV,nSCo,D
Tanacetum vulgare	common tansy	Jepson reports as uncommon, escape from cultivation in urban areas; problem in wildlands?	NCo,NCoRO,CaRH, SCoRO
Verbena bonariensis, *V. litoralis*	tall vervain	Horticultural; invades riparian forests, wetlands; extensive along ScV riparian corridors, roadsides (Yuba Co.); elsewhere?	ScV,nSnJV,nSnFrB,CCo



Annual Grasses

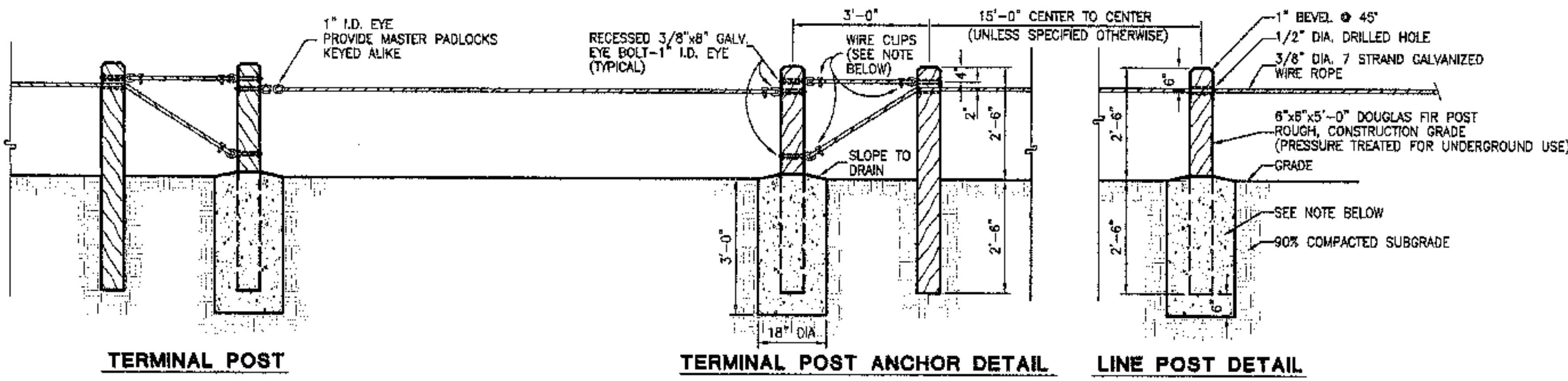
Latin Name[1]	Common Name	Habitats of Concern and Other Comments	Distribution[2]
Aegilops triuncialis[3]	barbed goatgrass	Serpentine soils, grasslands	sNCoR,CaRF, n&cSNF, ScV,nCW
Avena barbata	slender wild oat	Lower elev. in SoCal; coastal slopes, coastal sage scrub, disturbed sites	CA-FP,MP,DMoj
Avena fatua	wild oat	Lower elev. in SoCal; coastal slopes, coastal sage scrub on deeper soil, disturbed sites	CA-FP,MP,DMoj
Brachypodium distachyon	false brome	Expanding in SoCal; common in Orange Co.	sNCoR,sCaRF, SNF,GV, CW,SCo,sChI
Bromus diandrus	ripgut brome	Coastal dunes, coastal sage scrub, grasslands	CA
Lolium multiflorum	Italian ryegrass	Wetland areas, esp. vernal pools in San Diego Co.; common in disturbed sites	CA-FP
Schismus arabicus	Mediterranean grass	Threat to Mojave and Colorado desert shrublands?	SnJV,CW,sChI,D
Schismus barbatus	Mediterranean grass	Threat to Mojave and Colorado desert shrublands?	SnJV,SW,D

Considered, but not listed

Latin Name[1]	Common Name	Habitats of Concern and Other Comments
Albizia lophantha	plume acacia	Not invasive
Anthoxanthum odoratum	sweet vernal grass	Disturbed sites on coast: Marin, Sonoma, Mendocino cos.
Carpobrotus chilensis	sea fig	Native status in question; not a threat to wildlands
Centranthus ruber	red valerian	Horticultural; roadcuts in Marin Co.; not a threat to wildlands
Convolvulus arvensis[C]	field bindweed	Disturbed sites; ag lands
Coprosma repens	mirror plant	No evidence of wildland threat
Crocosmia x crocosmiiflora		Generally in disturbed coastal, urban areas, roadsides
Digitalis purpurea	foxglove	Horticultural; scattered in prairies, meadows, disturbed sites; not a major wildland threat
Dipsacus sativus, D. fullonum	wild teasel, Fuller's teasel	Roadsides, disturbed sites
Fumaria officinalis, F. parviflora	fumitory	S.F. Bay area, Monterey Bay salt marshes, sandy disturbed sites
Medicago polymorpha	California bur clover	Grasslands, moist sites; mainly restricted to disturbed sites
Melilotus officinalis	yellow sweet clover	Restricted to disturbed sites in CA
Nerium oleander	oleander	Horticultural; not invasive, although reported from riparian areas in Central Valley, San Bernardino Mtns.
Picris echioides	bristly ox-tongue	Disturbed areas
Silybum marianum	milk thistle	Disturbed areas, especially overgrazed moist pasturelands; may interfere with restoration
Xanthium spinosum	spiny cocklebur	Identified as native in *The Jepson Manual* (Hickman, 1993) and *A California Flora* (Munz and Keck, 1968); restricted to disturbed areas
Zantedeschia aethiopica	calla lily	Horticultural; mainly a garden escape in wet coastal areas
Zoysia cultivars	Amazoy and others	Horticultural; no evidence of wildland threat

ATTACHMENT J

Fencing Typical Details



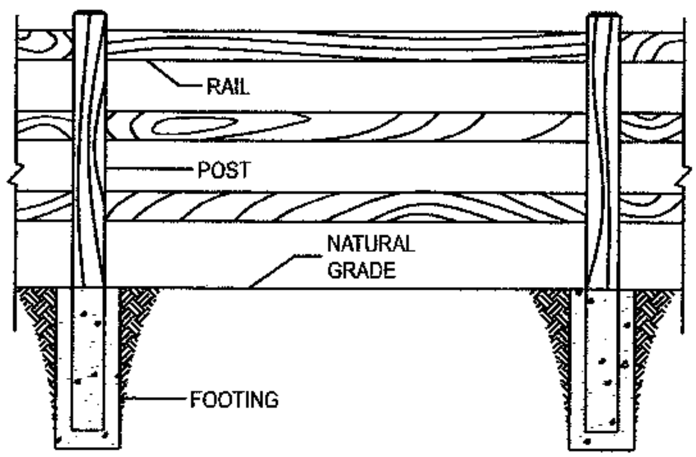
NOTES:

1. PROVIDE CONCRETE FOOTINGS AT ALL END POST, AT ALL BENDS AND AS SPECIFIED IN SPECIAL CONDITIONS.
2. USE 3/8"x2" GALVANIZED WIRE ROPE CLIPS FOR CONNECTION AND SPLICES. ALL CLIPS SHALL BE PLACED WITH NUTS FACING DOWNWARD.

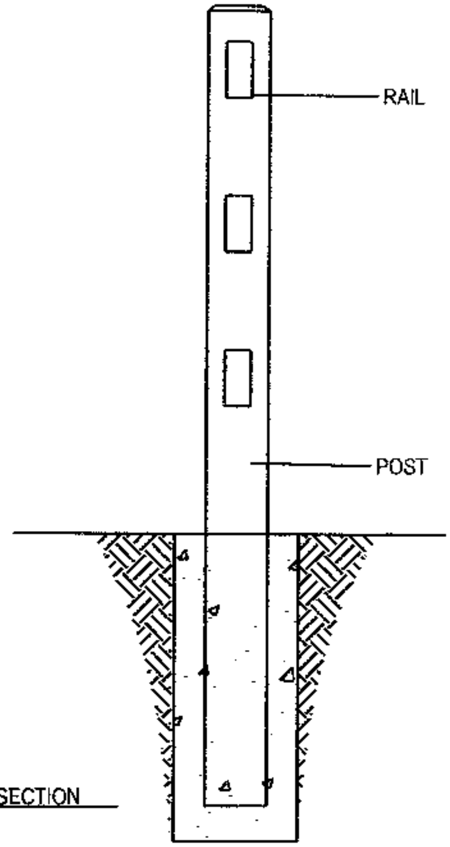
Not To Scale

Post & Cable Fence Detail

ECORP Consulting, Inc.
ENVIRONMENTAL CONSULTANTS



3 RAIL FENCE - ELEVATION

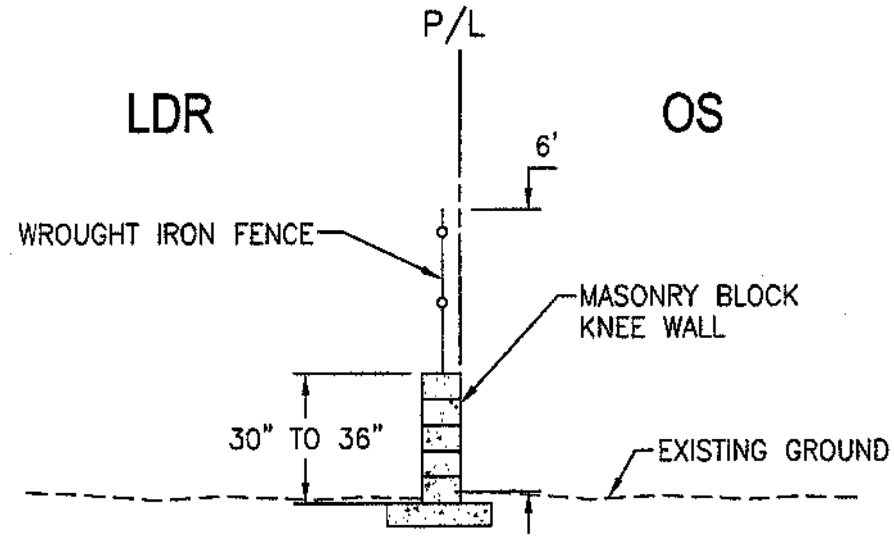


3 RAIL FENCE - SECTION

NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. ALL REINFORCING STEEL SHALL CONFORM TO ASTM A615 GRADE 60.
4. FIBER REINFORCEMENT IN ALL POSTS, PANELS AND CAPS.
5. ALL PIER FOUNDATIONS ARE TO BE LOCATED IN UNDISTURBED SOIL.
6. POSTS AND RAIL ARE MADE OF CONCRETE ATTAINING A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI @ 28 DAYS AND MANUFACTURED BY AN AMERICAN TECHNOCRETE LICENSED MANUFACTURER.
7. DEEP NATURAL WOOD GRAIN TEXTURE ON ALL POSTS AND RAILS.
8. INTEGRAL COLOR BY DAVIS COLORS OR APPROVED EQUAL.
9. LOCATION AND FENCE HEIGHT SHALL COMPLY WITH CITY FENCING CODES.
10. ALL WORK SHALL COMPLY WITH CITY GRADING ORDINANCES.
11. ALL DIMENSIONS SHOWN ON THIS SHEET ARE FOR INFORMATION PURPOSES ONLY. ACTUAL DIMENSIONS MAY VARY DUE TO MANUFACTURING AND MOLDING TOLERANCES.
12. REFERENCE NUMBER 516-004.

Concrete Rail Fence Detail



Not To Scale

Open Space Fencing with Knee Wall Detail

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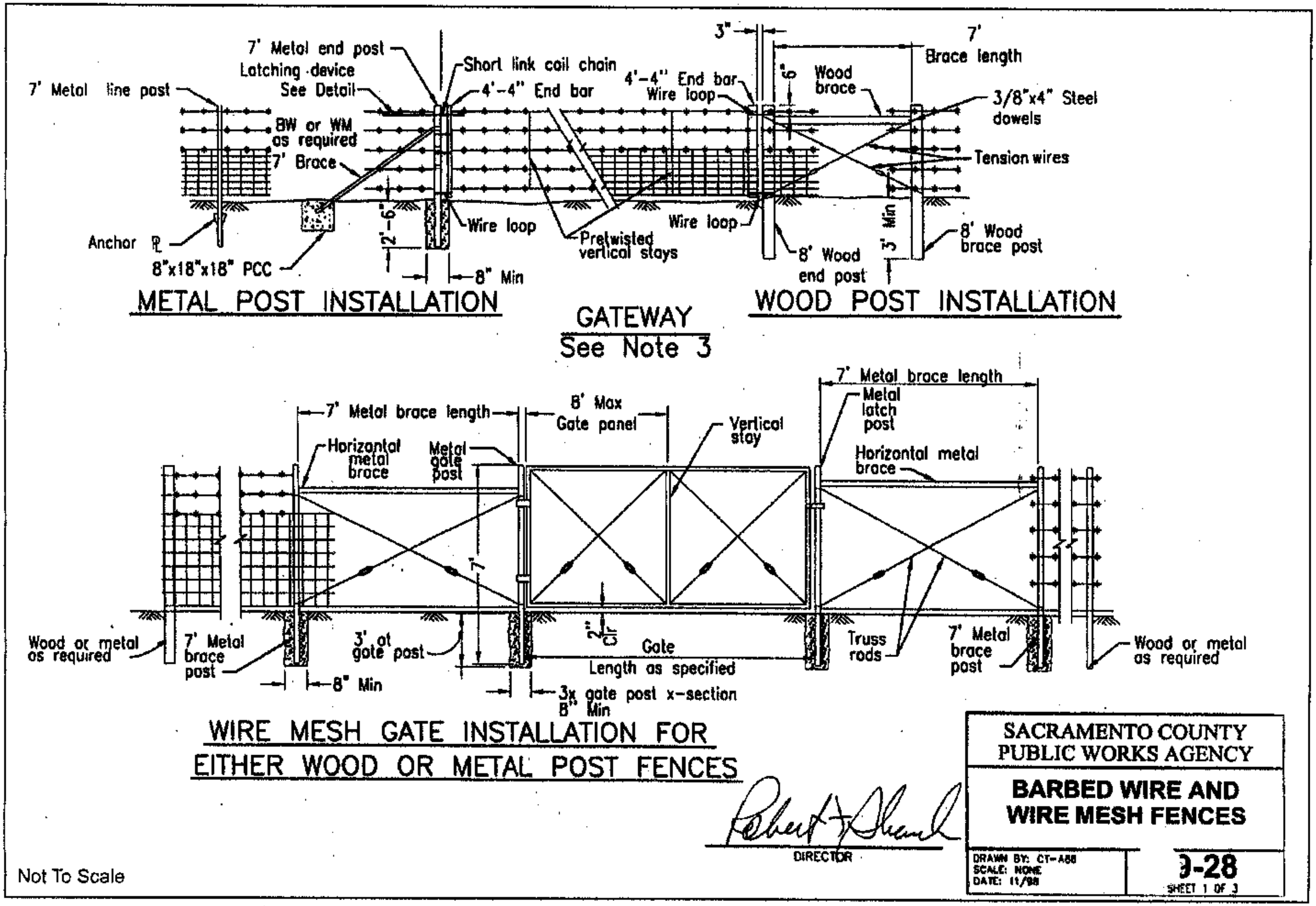
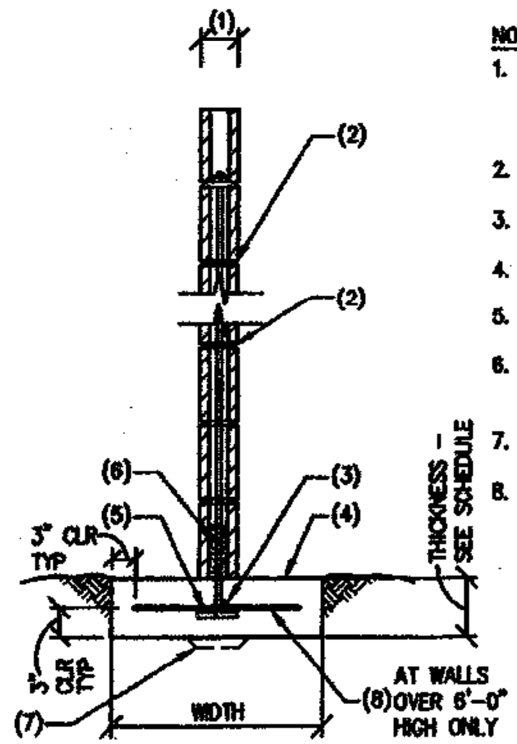


Five-Strand Barbed Wire Fence Detail



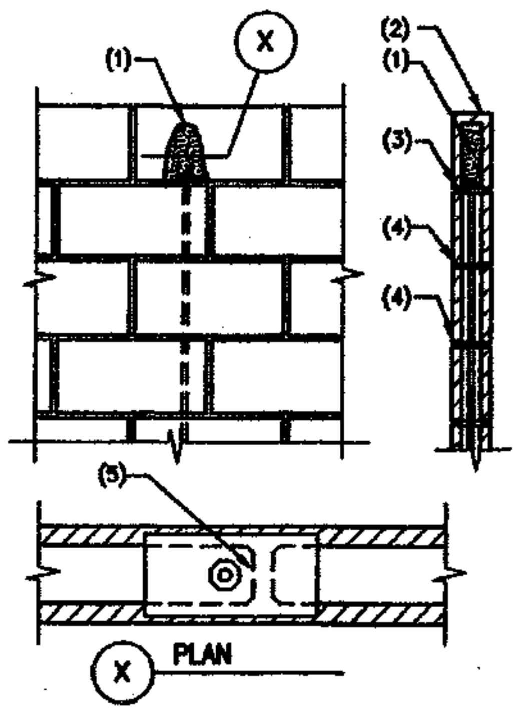
NOTES:

1. 4" NOMINAL (3 5/8" ACTUAL) OR 6" NOMINAL (5 5/8" ACTUAL) OR 8" NOMINAL (7 5/8" ACTUAL) MASONRY.
2. HORIZONTAL JOINT REINFORCING - SEE NOTE #14.
3. CONTINUOUS REINFORCING - SEE TABLE BELOW.
4. SPREAD FOOTING - SEE SCHEDULE.
5. ALTERNATE HOOKS OF POST TENSION RODS AT SPREAD FOOTINGS.
6. 3" MORTAR COVER AROUND COUPLER AND/OR POST TENSIONED ROD FOR CORROSION PROTECTION.
7. THICKEN FOOTING TO PROVIDE MIN 3" COVER AS REQUIRED.
8. TRANSVERSE REINFORCING FOR WALLS OVER 6'-0" HIGH - #4 AT 24" O.C.

FOOTING WIDTH	CONTINUOUS REINFORCING
0 - 18"	1 #4
19" - 26"	2 #4
27" - 36"	3 #4
37" +	4 #4

TYPICAL WALL SECTION AT SPREAD FOOTING

NO SCALE



NOTES:

1. FILL CAP BLOCK WITH MORTAR. IMMEDIATELY "FLIP" ONTO ROD.
2. CAP BLOCK OF SUFFICIENT SIZE TO COVER PLATE AND ROD.
3. STEEL PLATE SIZES:
   A. 4" PROTO II: 1/4" x 3" x 6"
   B. 6" PROTO II: 1/4" x 4 1/2" x 6"
   C. 6" SLUMP PROTO II: 1/4" x 4" x 6"
   D. 8" PROTO II: 1/4" x 6 1/2" x 8"
   STEEL PLATES TO BE PLACED AT THE EDGE OF THE CELL SO THAT THE PLATE BEARS FULLY ON THREE SIDES EXCEPT AT 8" PROTO II WHERE THE STEEL PLATE SHOULD BEAR ON ALL FOUR SIDES.
4. CONTINUOUS HORIZONTAL JOINT REINFORCING PER NOTE #14.
5. CENTER WEB BELOW.

TOP OF FENCE DETAIL

NO SCALE

Masonry Sound Wall Fence Detail

2000-169 West Roseville Specific Plan

ATTACHMENT K

Sample Preserve Sign Text

City of Roseville
Open Space/Wetland Preserve

Please respect and help protect our open space.
Thank you for your cooperation.

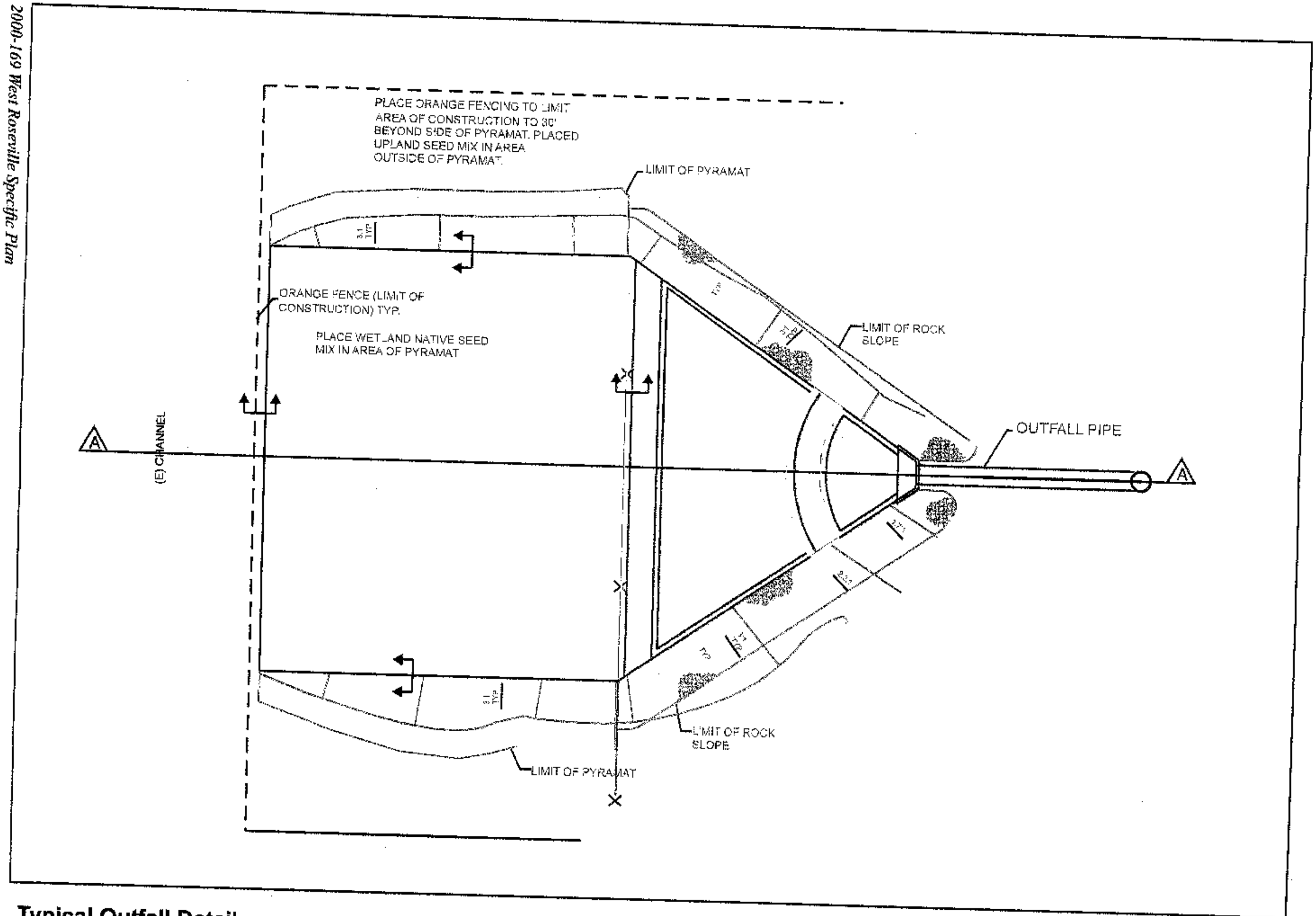
The following activities are **prohibited** within open space areas:

Camping: 10.56.010 RMC
Alcohol Consumption/Open Containers: 10.30.010 RMC & 647 e PC
Littering: 10.38.010 RMC & 374.4 (a) PC
Motorized Vehicles: 602 PC
Dogs (on or off leash): 8.02.240 RMC
Dumping: 374.3 (b) PC

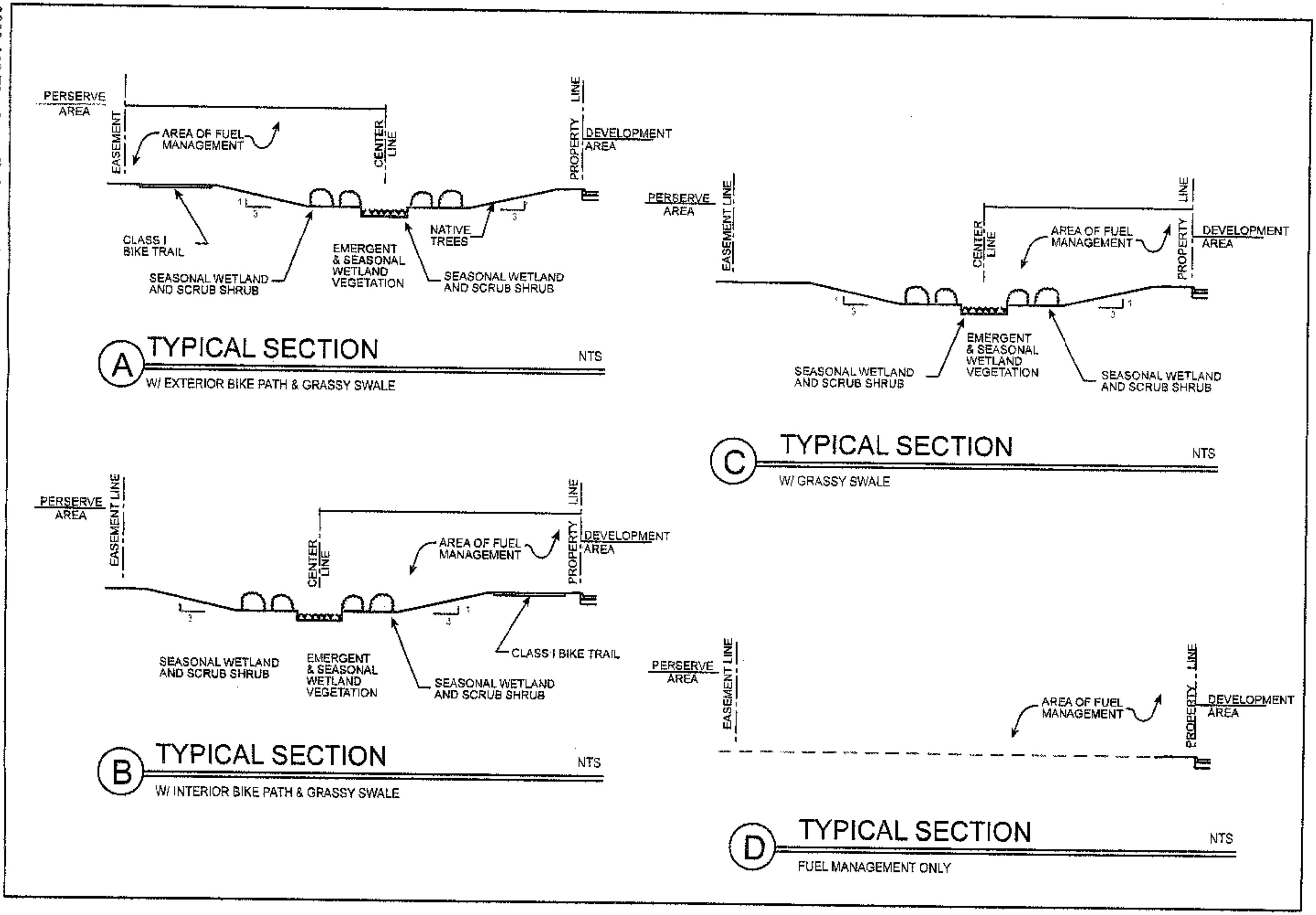
Violators will be held liable for any damage.

ATTACHMENT L

Outfall and Drainage Typical Details



Typical Outfall Detail



Typical Cross Section Details

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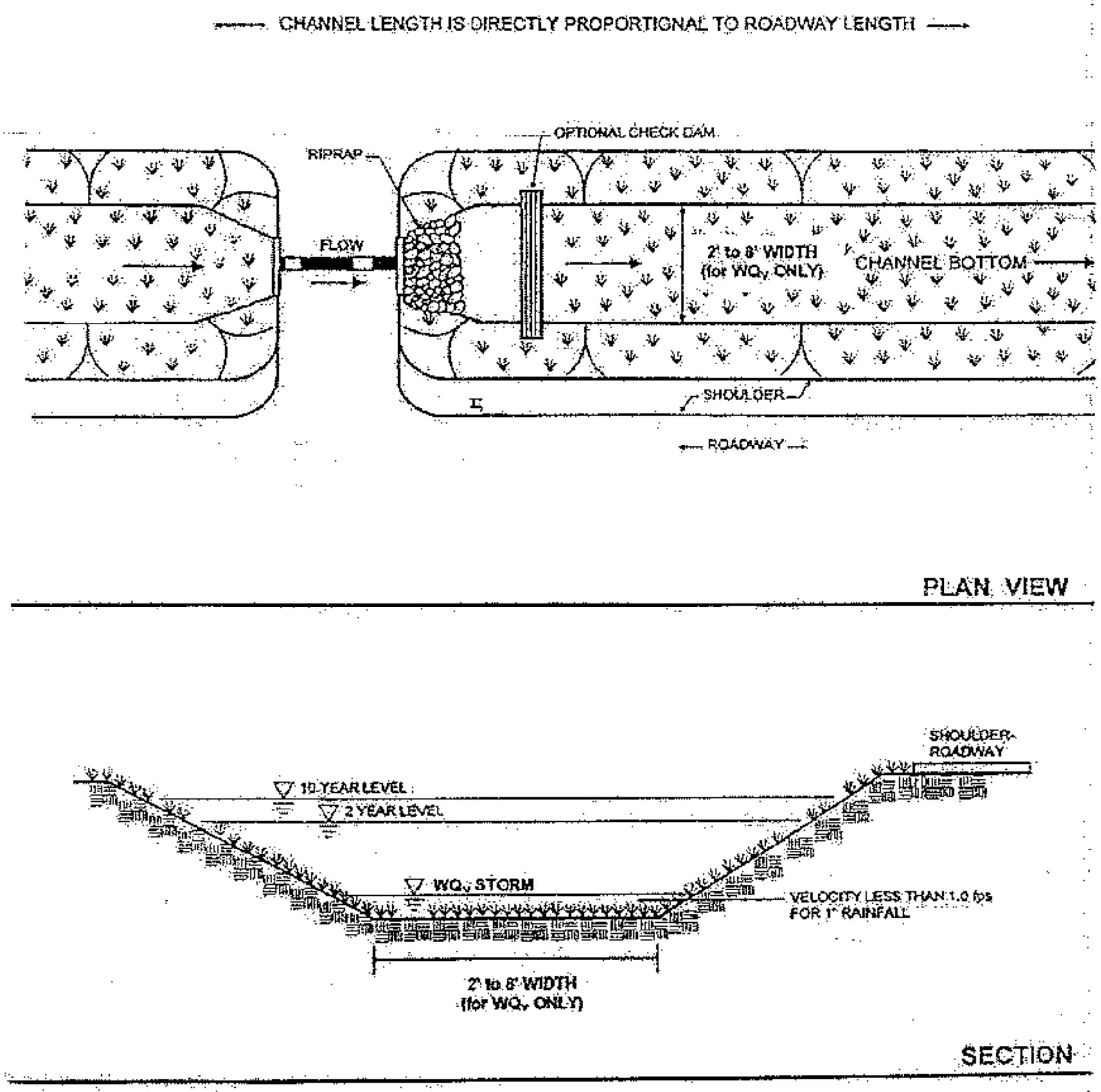


Figure 6-1 Grass Swale (MDE, 2000)

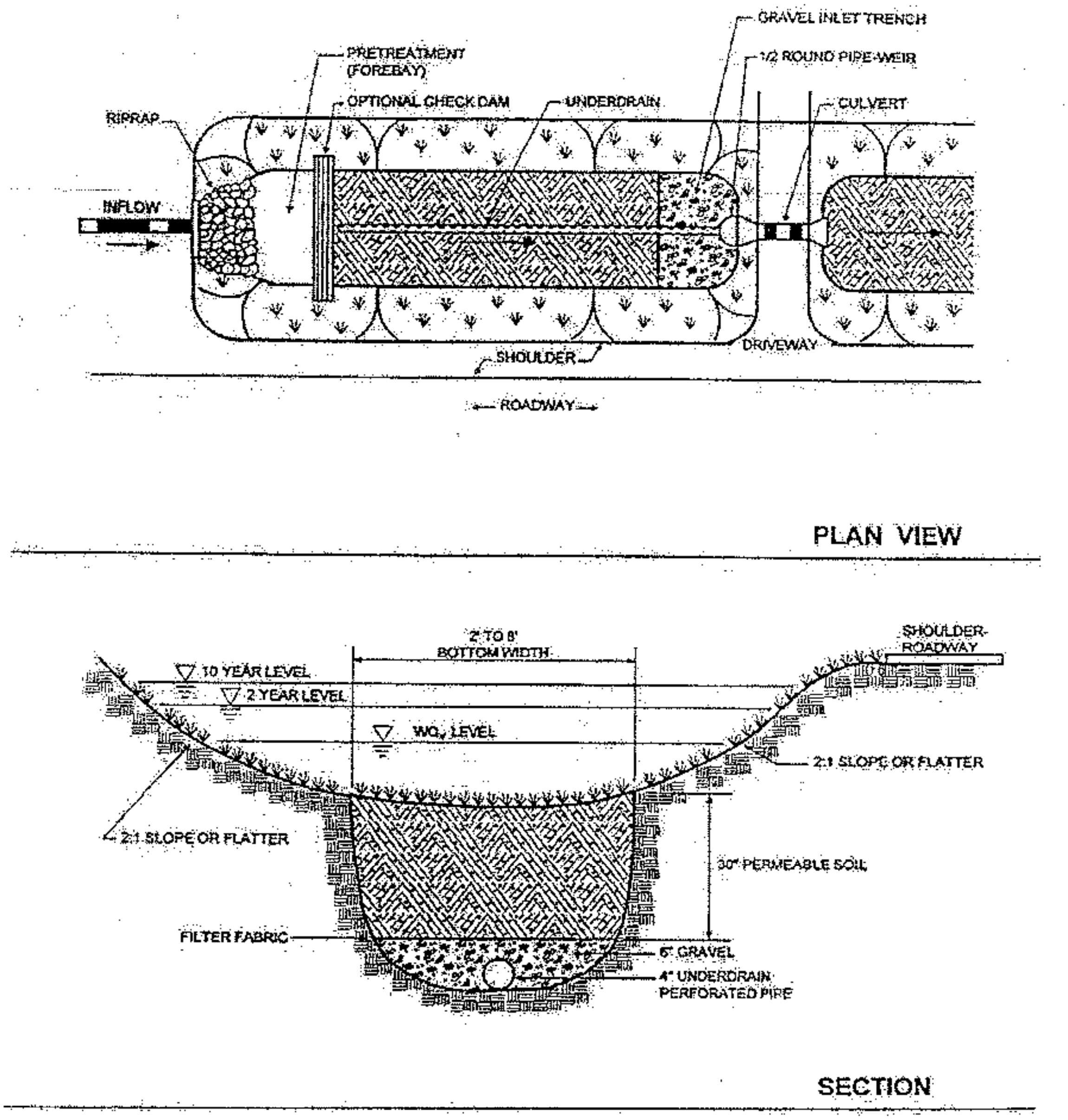


Figure 6-2 **Wet Swale** (MDE 2000)

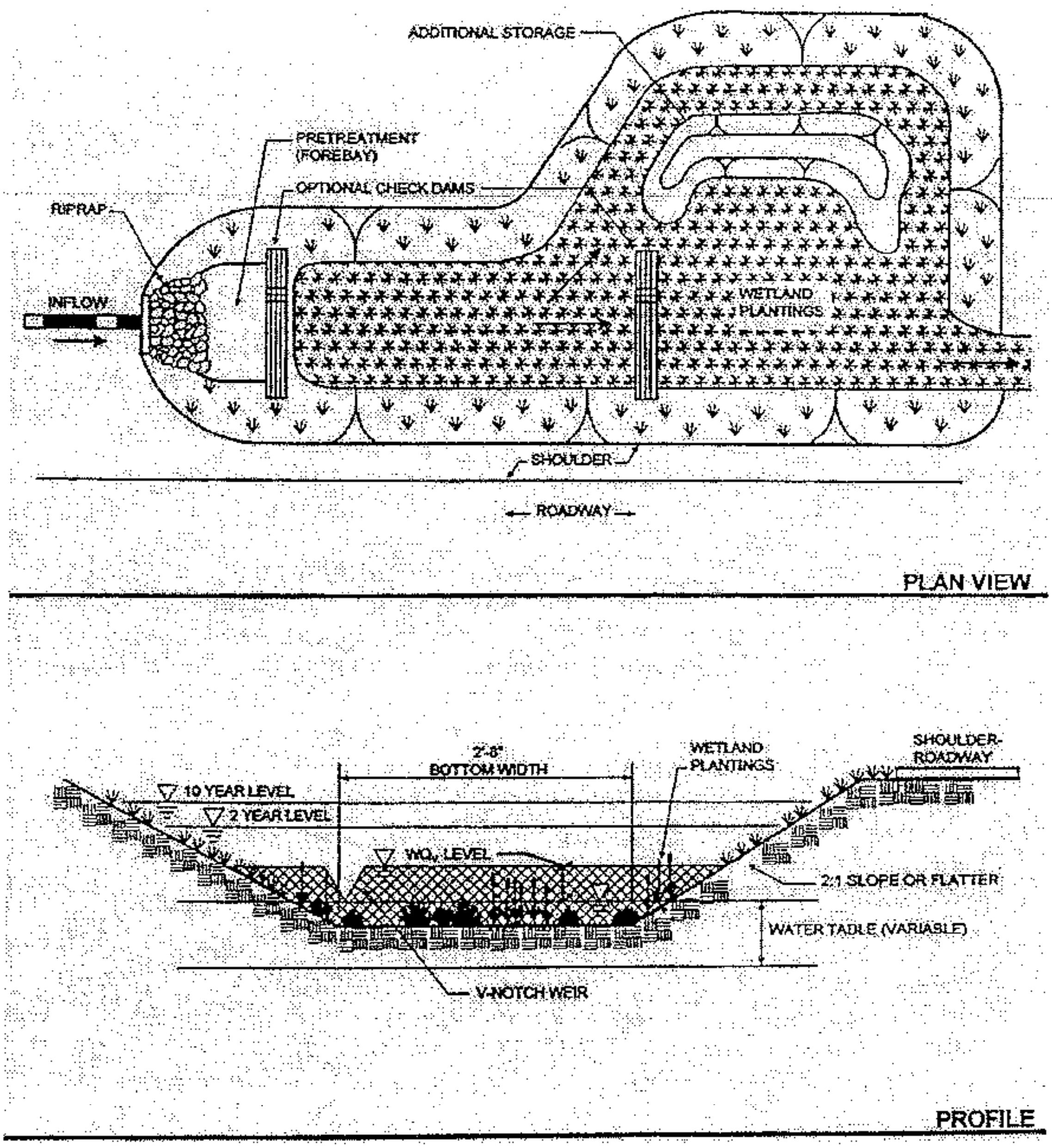


Figure 6-3 Typical Vegetative Filter Strip (CRC, 1996)

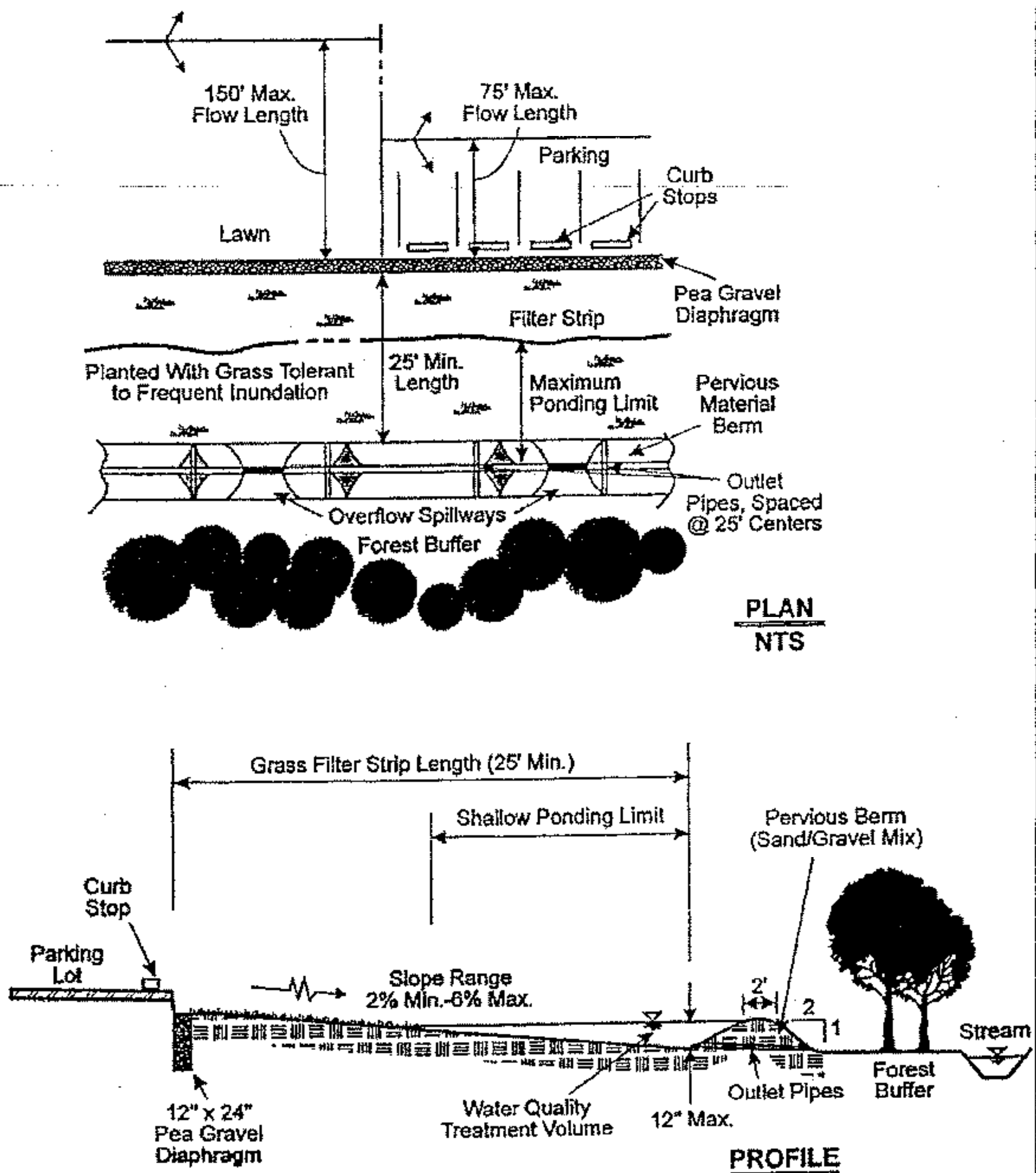


Figure 6-4 Typical Bioretention Cell (MDE, 2000)

ATTACHMENT M

Native Plants for Use in Restoration

Native Plants for Use in Restoration

Scientific Name	Common Name
Trees	
Acer negundo	Box elder
Aesculus californica	California buckeye
Fraxinus latifolia	Oregon ash
Platanus racemosa	Western sycamore
Populus fremontii	Freemont cottonwood
Quercus douglasii	Blue oak
Quercus lobata	Valley oak
Quercus wislizeni	Interior live oak
Salix gooddingii	Goodding's black willow
Salix laevigata	Red willow
Shrubs	
Baccharis pilularis	Coyote brush
Ceanothus cuneatus	Wedgeleaf ceanothus
Ceanothus thrysiflorus	Blue blossom
Cephalanthus occidentalis	Button-willow
Cercis occidentalis	Western redbud
Rubus ursinus	California blackberry
Rosa californica	California rose
Salix exigua	Narrow-leaved willow
Salix lasiolepis	Arroyo willow
Vitis californica	California wild grape
Grasses	
Bromus carinatus	California brome
Elymus elymoides	Squirreltail
Elymus glaucus	Blue wildrye
Frestuca idahoiensis	Idaho fescue
Hordeum branchyantherum	Meadow barley
Leymus triticoides	Creeping wildrye
Melica californica	Oniongrass
Muhlenbergia rigens	Deer grass
Nassella pulchra	Purple needle grass
Poa secunda	One-sided bluegrass

ATTACHMENT N

List of Problematic Species

This list includes non-native plants considered to be invasive and noxious, and may become updated as more information becomes available. Invasive plants have the ability to spread quickly, displace desired native plants, and can damage natural ecosystems. Many of these plants listed can be found in your local plant nursery- please be aware that everything for sale is not necessarily good to plant in the garden, and that most plants have more than one common name. Be sure to check the <u>scientific name</u>, as this name should be universal. Thank you for your cooperation in keeping our natural open spaces native and healthy!

<u>Landscaping Plants, Water Plants, and Garden Flowers</u>

Common Name	**Scientific Name**
Acacia, Mimosa	(*Acacia species)*
African bermuda grass	(*Cynodon transvalensis)*
Amazon frogbit	(*Limnobium laevigatum)*
Argentine screwbean	(*Prosopis strombulifera)*
Australian saltbush	(*Atriplex semibaccata)*
Baby's breath	(*Gnaphalium paniculata*)
Beaumont thistle	(*Cirsium ochrocentrum)*
Bermuda grass	(*Cynodon dactylon*)
Black locust	(*Robinia pseudoacacia*)
Blue gum	(*Eucalyptus globulus*)
Blue panicgrass	(*Panicum antidotale)*
Bouncing bet	(*Saponaria officinalis)*
Brazilian pepper	(*Schinus terebinthifolius*)
Brazilian water weed	(*Egeria dens)*
Broom	(*Cytisus scoparius, Genista monspessulana, Spartium junceum, Cytisus striatus*)
Camel thorn	(*Alhagi pseudalhagi)*
Capeweed	(*Arctotheca calendula)*
Chinese pistashe	(*Pistacia chinensis*)
Chinese tallow tree	(*Sapium sebiferum*)
Common gorse	(*Ulex europaeus)*
Cotoneaster	(*Cotoneaster lacteus, C. pannosa)*
Crimson grass/fountain grass	(*Pennisetum setaceum*)
Cut-leaved pondweed	(*Potamogeton crispus)*
Dalmatian toad-flax	(*Linaria genistifolia ssp. dalmatica)*
Dayflower	(*Commelina benghalensis)*
Dense-flowered cord grass	(*Spartina densiflora)*
English holly	(*Ilex aquifolium*)
English ivy or Algerian ivy	(*Herdera helix, H. canariensis*)
Eupatory	(*Ageratina adenophora*)
Field bindweed	(*Convolvulus arvensis)*
German ivy	(*Senecio mikanioides)*
Giant reed	(*Arundo donax*)
Gorse	(*Ulex europaeus*)

Hawthorne	(*Crataegus monogyna*)
Heart-shape false-pickerelweed	(*Monochoria vaginalis)*
Horse-nettle	*(Solanum carolinense, Solanum elaeagnifolium)*
Hydrilla	(*Hydrilla verticillata)*
Ice plant or Hottento fig	(*Carpobrotus edulis, Conicosia pugioniformis, Mesembryanthemum crystallinum*)
Indian Bean Tree	(*Catalpa bignonioides)*
Illyrian cottonthistle	(*Onopordum illyricum)*
Java-bean	(*Senna obtusifolia)*
Knapweed; spotted, Russian, diffuse, Iberian and squarrose	(*Centaurea maculosa, Acroptilon repens, C. diffusa, C. iberica* and *C squarrosa*)
Amazon frogbit	(*Limnobium laevigatum)*
Little marigold	(*Tagetes minuta)*
Lollypop Tree	(*Myoporum laetum)*
Meadow sage	*(Salvia virgata)*
Mediterranean lineseed	(*Bellardia trixago)*
Mediterranean sage	(*Salvia aethiopis)*
Mexican water-lily	(*Nymphaea mexicana)*
Milfoil, Eurasian milfoil	(*Myriophyllum hippurioides, M. spicatum)*
Musk thistle	(*Carduus nutans*)
Ox-eye daisy	(*Leucanthemum vulgare*)
Pampasgrass or Jubatagrass	(*Cortaderia selloana, C. jubata*)
Periwinkle, dwarf periwinkle	(*Vinca major, V, minor*)
Peruvian pepper tree	(*Schinus molle*)
Plumeless thistle	(*Carduus acanthoides)*
Privet	(*Ligustrum lucidum, Ligustrum ovalifolium*)
Purple leaved Plum	(*Prunus cerasifera)*
Purple starthistle	(*Centaurea calcitrapa)*
Purple-top Vervain	(*Vervain bonariensis*)
Pyracantha	(*Pycnantha angustifolia*)
Russian olive	(*Elaeagnus angustifolius)*
Russian salt tree	(*Halimodendron halodendron)*
Saltcedar or Tamarisk	(*Tamarix* species)
Scarlet wisteria	(*Sesbania punicea*)
Taurian thistle	(*Onopordum tauricum)*
Thoroughwort	(*Ageratina adenophora*)
Tree of Heaven	(*Ailanthus altissima*)
Wand mullein	(*Verbascum virgatum)*
Water hyacinth	(*Eichhornia crassipes)*
Water iris	(*Iris pseudacorus)*
Water spinach	(*Ipomoea aquatica)*
Wavyleaf beeblossom	(*Gaura sinuata, G. villosa)*
White licorice, Licorice plant	(*Helichrysum petiolare)*

Yellow bush lupine	(*Lupinus arboreus*)

Edible, Useful, or Medicinal Plants

Common Name	**Scientific Name**
African rue	(*Peganum harmala*)
Artichoke thistle	(*Cynara cardunculus*)
Asian mustard	(*Brassica tournefortii)*
Castor bean	(*Ricinus communis)*
Common goldenthistle	(*Scolymus hispanicus)*
Dudaim melon	(*Cucumis melo var. dudaim*)
Dyer's woad	(*Isatis tinctoria)*
Edible fig	(*Ficus carica*)
Fennel	(*Foeniculum vulgare*)
Gooseberry gourd	(*Cucumis myriocarpus)*
Grape ground-cherry	(*Physalis viscosa)*
Himalayan blackberry	(*Rubus discolor*)
Nightshade	(*Solanum dimidiatum, Solanum lanceolatum, Solanum marginatum*)
Olive	(*Olea europaea*)
Pennyroyal	(*Mentha pulegium*)
Prickly comfrey	(*Symphytum asperum)*
St. John's wort	(*Hypericum perforatium*)
Wild oats	(*Avena barbata, A. fatua, A. sterilis)*

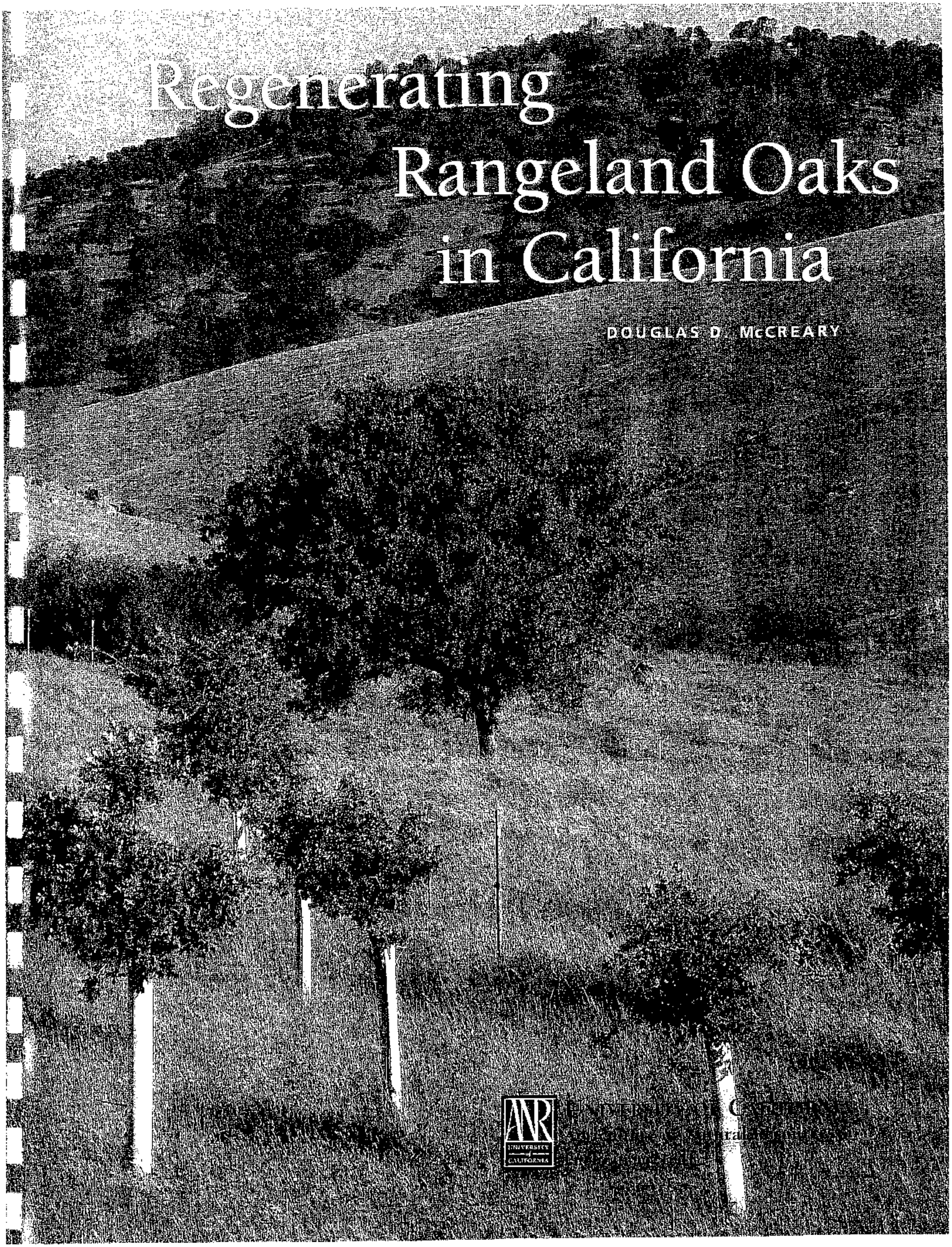
Other Exotic Plants Not Usually Planted (weeds)

Common Name	**Scientific Name**
African Boxthorn	(*Lycium ferocissimum*)
Argentine needlegrass	(*Achnatherum brachychaetum)*
Austrian field cress	(*Rorippa austriaca)*
Austrian peaweed	(*Sphaerophysa salsula)*
Beancaper	(*Zygophyllum fabago)*
Bearded creeper	(*Crupina vulgaris)*
Biddy-biddy	(*Acaena novae-zelandiae)*
Black mustard	(*Brassica nigra)*
Blueweed	(*Helianthus ciliaris)*
Canada thistle	(*Cirsium arvense)*
Creeping Yellow-cress	(*Rorippa sylvestris)*
Crossflower	(*Chorispora tenella)*
Drummond's beeblossom	(*Gaura drummondii)*
Eggleaf spurge	(*Euphorbia oblongata)*
False brome	(*Brachypodium distachyon)*
Five-horn bassia	(*Bassia hyssopifolia)*
Foxtail restharrow	(*Ononis alopecuroides)*
Giant Ragweed	(*Ambrosia trifida)*
Giant salvinia	(*Salvinia molesta*)
Goat grass	(*Aegilops cylindrica, Aegilops ovata, Aegilops triuncialis)*

Halogeton	*(Halogeton glomeratus)*
Italian thistle	*(Carduus pycnocephalus, Carduus tenuiflorus)*
Johnsongrass	*(Sorghum halepense)*
Knotweed	*(Polygonium cuspidatum, P. sachalinense, P. polystachyum,* and *Fallopia* or *Reunoutria japonica,)*
Leafy spurge	*(Euphorbia esula)*
Lens-podded hoary cress, hoary cress	*(Cardaria chalepensis, C. draba)*
Long-leafed tomatillo	*(Physalis longifolia)*
Longstalk whitetop	*(Cardaria pubescens)*
Medusa-head grass	*(Taeniatherum caput-medusae)*
Nimblewell	*(Muhlenbergia schreberi)*
Oxford ragwort	*(Senecio squalidus)*
Perennial Pepperweed	*(Lepidium latifolium)*
Puncture-vine	*(Tribulus terrestris)*
Red Aeschynomene	*(Aeschynomene rudis)*
Russian thistle	*(Salsola damascene, S. paulsenii, S. tragus)*
Salt-water cord grass	*(Spartina alterniflora, S. patens, S. anglica)*
Sandbur	*(Cenchrus incertus, C. longispinus)*
Saw-toothed spurge	*(Euphorbia serrata)*
Scottish thistle	*(Onopordum acanthium)*
Smooth distaff thistle	*(Carthamus baeticus, C. lanatus,* and *C. leucocaulos)*
Star grass	*(Cynodon plectostachyus)*
Tall fescue	*(Festuca arundinacea)*
Tansy ragwort	*(Senecio jacobaea)*
Three-cornered Jack	*(Emex australis, E. spinosa)*
Veldt grass	*(Ehrharta calycina, E. erecta)*
Velvet Grass	*(Holcus lanatus)*
Wavy-leaved thistle	*(Cirsium undulatum)*

ATTACHMENT O

Oak Regeneration Handbook



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DOUGLAS D. McCREARY

UNIVERSITY OF CALIFORNIA
Agriculture & Natural Resources
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SIERRA FOOTHILL RESEARCH AND EXTENSION CENTER

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Contents

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Introduction

For millennia, oaks have graced the valleys, hills, and mountains of California. The state has a rich and diverse assortment of *Quercus* species, which range in appearance from majestic solitary valley oaks (*Quercus lobata* Nee), with enormous trunks and massive canopies, to small, shrublike, huckleberry oaks (*Quercus vaccinifolia* Kellogg) that never grow more than a few feet tall. For many residents and nonresidents alike, golden-brown hills dotted with gnarled oak trees epitomize the California landscape, and native oaks symbolize values we hold dear—strength, beauty, adaptability, and longevity. The deep and endearing value of oaks in the psyche of the early settlers is clearly seen by a glimpse at any state map, where so many city and landmark names include *oak* or the Spanish equivalents *encina* and *roble*. To California's native peoples, oaks were even more revered and figured prominently in their world view and spiritual beliefs. Among other things, oaks were the source of *acorn*, a staple food source of many tribes.

The value of oaks goes well beyond their stature and beauty and how people view them. Oaks and oak woodlands are home to a rich and diverse assortment of wildlife. More than half of the 662 species of terrestrial vertebrates in California utilize oak woodlands at some time during the year, and the food and shelter provided are essential to their survival. Oaks are also critical in protecting watersheds and ensuring the quality of water resources. The majority of the state's water is stored as snowpack in high-elevation mountains before flowing through oak woodlands in rivers that support fisheries, farms, and cities. Oak trees anchor the soil, preventing erosion and sedimentation.

But not all is well with California's oaks and oak woodlands. In addition to adverse impacts from firewood harvesting, agricultural conversions, intensive grazing, and residential and commercial development, there has been concern for a number of years that several oak species are not regenerating well in portions of the state. These species grow primarily in the foothills of the Sierra, Coastal, and Transverse mountain ranges, regions that are commonly referred to as hardwood rangelands. As a result of concern about poor regeneration, there has been a concerted effort to develop successful techniques for the artificial regeneration of the rangeland oak species. Research has addressed a wide array of subjects, including acorn collection, storage, and handling; seedling propagation methods; and techniques for planting, protecting, and maintaining seedlings in the field. There has been a great deal of research on this subject in the last decade, and we have come a long way in understanding how to grow and plant rangeland oaks. Nevertheless, the results of this research have been largely fragmented and dispersed in a wide range of documents, including homeowner brochures, internal reports, and scientific publications in rather obscure journals.

This manual attempts to bring together the information available on artificially regenerating rangeland oaks in California. The manual's primary purpose is to provide a resource for restorationists, hardwood rangeland managers, and others involved in oak propagation and planting projects so that their efforts are based on the latest scientific information available and are, ultimately, more successful. I also hope that this document will be of interest to others not directly involved in regenerating oaks but who maintain a deep, personal interest in the ecology and management of *Quercus* species.

Organization of this Manual

This manual is divided into four chapters. The first chapter deals with the subject of poor natural regeneration of native California oaks and identifies the oak species that appear to be regenerating poorly and the conditions under which this problem seems most acute. It also describes a number of theories that have been proposed to explain why regeneration appears to be less successful today than in the past.

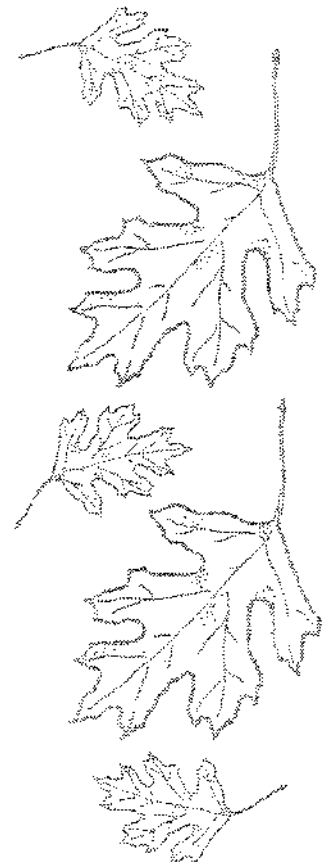
The second chapter focuses on acorns and provides an overview of acorn physiology, as well as a discussion of the suspected causes for the large variability in the size of acorn crops from year to year. This chapter also describes how to collect and store acorns and the recommended procedures for sorting and testing them. There is a brief discussion of genetic variability and the importance of maintaining local seed sources. Finally, information is presented on how, when, and where to sow acorns and the pros and cons of directly planting acorns in the field versus planting seedlings that have been raised in nurseries.

The third chapter discusses oak seedling propagation. Some of the more common methods of growing seedlings are presented, including case studies of three nurseries that have been producing California oaks in containers for well over a decade. The possibility of vegetatively propagating oaks is also discussed, as are the potential benefits of inoculating oak seedlings with mycorrhizae. This chapter is designed to provide a broad overview of production techniques; readers contemplating growing oaks on any large scale are advised to obtain further information from other sources, including those nurseries listed in the appendixes.

The fourth and longest chapter addresses the general subject of planting, protecting, and maintaining oak seedlings in the field. This encompasses how to select planting sites and actually plant seedlings, as well as how to overcome the two main obstacles to successfully establishing oaks: controlling competing vegetation and preventing damage to acorns and young plants by animals. A considerable amount of discussion is devoted to treeshelters since studies at the University of California Sierra Foothill Research and Extension Center (SFREC) show that these devices are particularly useful for artificially regenerating oaks, both in terms of stimulating seedling growth and preventing damage from a wide range of animals. This chapter concludes with a discussion of other practices that may enhance regeneration success, including augering planting holes, fertilizing, irrigating and shading seedlings, and top pruning.

Each of the last three chapters also contains side bars that are intended to summarize the important points covered and provide practical guides for artificially regenerating California's rangeland oaks. Following a brief conclusion are the appendixes, which are included to provide additional resources and information to assist in better understanding oak regeneration and embarking on programs to grow or plant oaks.

Finally, there is a list of all of the references cited in this manual. The main focus of the references has been to identify research conducted in California on native oak species, and most specifically, on blue oak (*Quercus douglasii* Hook. & Arn.) and valley oak. In several instances, however, relevant research from other parts of the United States and the world is also identified. It is important to point out here that the problem of poor oak regeneration, and efforts to overcome it, is not unique to California. Concerns about oak management in the Middle Ages led



to forest ordinances in France—including planting programs—designed to ensure the establishment of oaks. And in the Eastern United States, concerns about oak regeneration go back to the early 1800s. There is, therefore, a large amount of literature and information on this general subject from outside of California. For those who are interested, several general references about oaks and oak regeneration both inside and outside of California are listed in the bibliography, including conference proceedings, books, and software. These references provide readers with a starting point for delving deeper into topics of interest.

It is also important to mention here that, while this manual attempts to be comprehensive and include information from throughout the state, and even from other parts of the world, much of it is based on research conducted over the past 12 years at the University of California Sierra Foothill Research and Extension Center (SFREC), located 15 miles northeast of Marysville, California. I have been very fortunate to be housed at the SFREC and, since it is located in a fairly typical oak woodland, it has proved an ideal location to carry out oak regeneration research. However, while the SFREC is representative of large areas of oak woodlands in the state, it is clearly unlike many other places where oaks grow. Consequently, the results and recommendations contained within this manual should certainly be applied to other situations cautiously. The principal characteristics of the SFREC are listed in table 1. As can be seen, the average annual rainfall is 28 inches (71 cm), which is considerably more than many areas farther south. Supplemental irrigation was not necessary in the studies described, but this may not be the case in areas of lower rainfall. Also, we report on results of trials where we have planted oaks in pastures grazed by cattle. Again, our planting areas are only moderately grazed, and in places where grazing intensity is greater, some of the procedures we recommend may be much less effective.

In spite of these limitations, it is hoped that this manual will be helpful and will, ultimately, promote the long-term conservation of oaks in California. That is the basic goal of the University of California Integrated Hardwood Range Management Program, as well as the goal of all our oak regeneration research and of this document.

Table 1. Characteristics of the University of California Sierra Foothill Research and Extension Center

Location	15 miles (24 km) northeast of Marysville, California, in rolling to steep foothills
Elevation	220–2,020 ft (67–616 m); most oak regeneration research plots are at approximately 600 ft (183 m)
Primary vegetation	oak woodlands and annual grass rangelands; primary woody species: blue oak, interior live oak (*Quercus wislizeni* A. DC.), valley oak, foothill pine (*Pinus sabiniana*)
Soils	generally rocky clay loams; primary series: Auburn, Argonaut, Las Posas, Wyman, Sobrante
Climate	Mediterranean climate zone with hot, dry summers and mild, rainy winters
Average annual rainfall	28 in (71 cm); range: 9–44 in (23–112 cm)
Temperatures	average year-round: 60°F (16°C); summer maximum mean: 90°F (32°C); winter monthly minimum: 40°F (4°C)
Historical use	cattle grazing

1 The Natural Regeneration of California Oaks

Since the turn of the century, there have been reports that certain species of hardwoods in California, including oaks, were not regenerating adequately (Jepson 1910). More recent assessments have also reported that several oak species do not seem to have sufficient recruitment to sustain populations. Describing the oaks in the foothill woodland of Carmel Valley, White (1966) stated that "a prevailing characteristic...is the lack of reproduction...with very few seedlings." Bartolome, Muick, and McClaran (1987) also concluded that "current establishment [throughout California] appears insufficient to maintain current stand structure for some sites." And Swiecki and Bernhardt (1998) reported that, at 13 of 15 blue oak locations evaluated throughout the state, "...sapling recruitment is inadequate to offset recent losses in blue oak density and canopy cover."

These regeneration assessments have relied on inventories of the size-class distribution of oaks, generally classifying the plants into three broad categories: seedlings, saplings, and mature trees. While the definitions of these classes have varied, there has been a consistent trend of finding fewer saplings or intermediate-sized trees than seedlings or mature trees (fig. 1). For instance, Phillips et al. (1997) assessed numbers of four size classes of blue oaks in different rainfall zones and reported fewer sapling- and pole-sized trees than seedlings or mature trees in all rainfall zones. It is important to note, however, that the trend of poor regeneration has only been observed in 4 of California's 22 native oak species, and patterns have varied greatly from place to place.

For these species, a general pattern of inadequate sapling recruitment has emerged in some locations. Since saplings are the trees that must be recruited into the mature size class when the older trees die, there is worry that, if these trends continue, current population densities will decline. Some areas that have historically been oak woodlands may therefore convert to other vegetation types, such as brushfields or grasslands. Generally, this regeneration problem is further exacerbated by land management practices that directly remove trees (firewood harvesting, clearing associated with construction, agricultural conversions, etc.), as well as by activities, such as intensive year-round grazing, heavy vehicle use, or yearly burning, that may create conditions in which it is much more difficult for oak seedlings to become established or grow.

However, not all assessments of existing oak stand structures have concluded that oaks are declining.

Figure 1. This mature oak stand at the SFREC has few oak saplings.

Holtzman and Allen-Diaz (1991) conducted a study that revisited vegetation plots charted in the 1920s and 1930s as part of a statewide effort to map vegetation (Wieslander 1935). They found that, in most plots originally containing blue oaks, there was an increase in the basal area of blue oaks, as well as an increase in the number of trees present. There was a decrease in the largest size class of trees, but this was offset by increases in other size classes. Davis, Brown, and Buyan (1995) also conducted an assessment of the cover and density of blue oak woodlands throughout the blue oak's current range to determine changes between 1940 and 1988. While they found many sites where woody cover had decreased, these were more than offset by sites where cover had increased. They concluded that there was little evidence of landscape-level or large-scale patterns of change. Both of these studies suggest that, in the time periods evaluated, the stands examined were sustaining themselves with sufficient recruitment to replace mortality.

Another approach to evaluating whether there are fewer or more oaks today than there were in the past utilizes pollen analysis. Pollen from oak flowers can be identified hundreds or even thousands of years after dispersal. The amount of pollen produced by a given species or genus is thought to correlate positively with the density of those plants present at the time of dispersal. In some lake beds, a pollen record can be determined by examining extracted layers of sediment. Deeper levels of this layer correspond to periods further in the past. By sampling varying depths of these lake beds and analyzing the pollen present, it is possible to estimate the abundance of oaks in different eras. Byrne, Edlund, and Mensing (1991) and Mensing (1998) evaluated sediment cores from lake beds in California and developed pollen diagrams for various species, including oaks. They concluded that, 5,000 to 10,000 years ago, the number of oaks in the Sierra Nevada Mountains increased, most likely as a result of climatic warming. In the last 500 years, however, the density of oaks has been fairly constant, except for the last 120 years. During this recent period, the density of oaks (primarily *Quercus agrifolia* Nee in the Santa Barbara coastal region studied) again increased and the authors of the studies hypothesize that this may have resulted from reduced burning by Native Americans and changes in grazing and woodcutting practices associated with intensified land use during the mid-nineteenth century.

There is obviously some disagreement about the severity of the regeneration problem and whether inventory assessments reflect real changes in population dynamics or merely natural fluctuations in the levels of recruitment that are normal. It also seems that recruitment levels can vary widely among oak species, from location to location within the state, and even over small distances within stands. As will be pointed out below, there appears to be no single cause for poor regeneration at all locations but rather many different factors that can affect recruitment success at different locations.

Oak Species with Poor Regeneration Rates

The three California oak species that are commonly reported to have regeneration problems are blue oak, valley oak, and Engelmann oak (*Quercus engelmannii* Greene) (Muick and Bartolome 1987; Bolsinger 1988), which are all deciduous white oaks. Blue and valley oaks are widely distributed and endemic to the state, while Engelmann oak has a narrower distribution range, growing only in the southern part of California and extending into Baja California, Mexico (Griffin and Critchfield 1972). In addition to these three species, coast live oak may also have insufficient recruitment to maintain existing stand structures in certain areas (Muick and Bartolome 1986; Bolsinger 1988).

It is common in stands of all of these species to find adequate numbers of seedlings and mature trees but a shortage of saplings or intermediate-sized trees. And while there are locations in the ranges of each of these species where regeneration is insufficient to sustain populations, there are also areas where regeneration appears to be adequate (fig. 2). As a result of this wide range in apparent ability to regenerate successfully, there have been efforts to correlate regeneration with both site and climatic factors, as well as with management history, to determine what is causing success and failure (Davis, Brown, and Buyan 1995; Muick and Bartolome 1987; Swiecki, Bernhardt, and Drake 1997a, 1997b; Lang 1988). While no universal reason for poor regeneration has been identified, several possible causes have been proposed.

Causes of Poor Regeneration

Introduction of Mediterranean Annuals

One widespread theory about why oaks are having more trouble regenerating today than 200 to 300 years ago claims that the change in vegetation, from predominantly perennial bunch grasses to introduced Mediterranean annual grasses and taprooted annual forbs, has created environmental conditions that make it much more difficult for oaks to establish successfully (Welker and Menke 1987). Mediterranean annuals, including bromes, ryes, oats, and filaree, are believed to have spread widely in California during the eighteenth and nineteenth centuries with the advent of widespread grazing (Heady 1977). A detailed study of the flora at the University of California Hastings Natural History Reservation in Carmel Valley reports that introduced annual grasses are now the dominant species in grasslands and in the understory of oak foothill woodlands (Knops, Griffin, and Royalty 1995). This spread of Mediterranean annuals seems to coincide roughly with the decline in oak regeneration, suggesting a possible cause and effect relationship.

Competition for Soil Moisture. The probable reason why rangeland oaks may have more difficulty regenerating in an environment dominated by annuals is that annuals often deplete soil moisture at more rapid rates than perennials, especially in the early spring when acorns are sending down their roots. Danielson and Halvorson (1991) compared the growth of valley oaks in proximity to either an alien

Figure 2. This hillside has good blue oak regeneration and a wide range of size classes.

nnual grass or a native perennial and found that seedlings near the annuals grew slower. They concluded that "the introduction of alien annual grasses has reduced valley oak seedling growth and survivorship by limiting soil moisture availability." Gordon et al. (1989) also evaluated competition between blue oak seedlings and several introduced annuals and stated that "competition for soil water with introduced annual species contributes to the increased rate of blue oak seedling mortality observed in woodland systems in California." In contrast, a study that evaluated the competition for soil water between blue oak seedlings and a native perennial bunch grass concluded that "densities of *Elymus glaucus* lower than 50 plants per square meter [5/ft^2] could allow survival and successful establishment of blue oak in understories, and are of relevance to patterns of natural regeneration" (Koukoura and Menke 1995). Finally, Welker and Menke (1990) found that the ability of blue oak seedlings to survive was related to the rate at which water stress developed. Rapid soil moisture depletion rates, which would be expected in oak-annual grass communities, were much more damaging than the gradual depletion rates expected for seedlings growing among perennial grasses.

Livestock Grazing

Livestock grazing is also believed to be a cause of poor rangeland oak regeneration. This theory is supported by the rough coincidence of changing patterns of oak regeneration and widespread introduction and spread of livestock into the state during the Mission Period (Pavlik et al. 1991), beginning in the late seventeenth century. The direct evidence that livestock contribute to reduced regeneration is that both cattle and sheep browse oak seedlings, as well as consume acorns. At the University of California Sierra Foothill Research and Extension Center (SFREC), for instance, it is easy to find small oak seedlings that have been heavily browsed or trampled by cattle. A study there found that saplings were much more likely to occur in nongrazed plots than in currently grazed plots (Swiecki, Bernhardt, and Drake 1997a). Heavy grazing, especially over many years, can also indirectly affect oak recruitment because it increases soil compaction and reduces organic matter, both of which can make it more difficult for oak roots to penetrate downward and obtain moisture (Welker and Menke 1987).

There may be other factors inhibiting oak regeneration, as well, so that livestock removal alone may have little impact. In a statewide oak regeneration assessment, Muick and Bartolome (1986) reported that the presence or absence of livestock was not sufficient to explain the pattern of oak regeneration. And Griffin (1973) stated that "experiences in nongrazing areas, such as the Hastings Natural History Reservation, suggest that even without cows, sapling valley oaks may be scarce."

Increased Rodent Populations

A consequence of the change in range vegetation from predominantly perennials to annuals is a change in the number and types of seeds present. It is possible that this change in flora has been accompanied by changes in certain rodent populations that feed primarily on the seeds of the introduced annuals. Since several species of rodents eat acorns and oak roots, higher populations of these animals could cause sufficient damage (see **Animals that Damage Acorns and Seedlings** in chapter 4) to inhibit regeneration in certain locations. Unfortunately, no one was counting gophers, squirrels, or voles two centuries ago, so it is hard to know whether their populations and impacts on oak regeneration have dramatically changed since then.

Changing Fire Frequencies

Another theory for poor regeneration concerns fire. Historical fire frequency rates in foothill woodlands are different today than they were in presettlement times when there was little effort to put out naturally occurring fires (Lewis 1993). In addition, Native Americans regularly burned oak woodlands to keep areas open for hunting, stimulate the sprouting of plants used for various products, facilitate acorn collection, and reduce populations of several insects that damage acorns (McCarthy 1993).

While there was a period of even higher fire frequency around the middle of the nineteenth century (Mensing 1991), and burning by ranchers was relatively common up until the early part of the twentieth century, fire frequencies in the last 60 years have greatly decreased as a result of intensive fire suppression activities (McClaran and Bartolome 1989). This has caused an increase in brush and a buildup of fuels in some understories, especially in the denser woodlands of the Sierra Foothills. Since foothill oaks evolved with, and are adapted to, fire, the change in fire regimes may have adversely affected oak regeneration. Because postfire sprout growth can be rapid, fires in the past may have contributed to oak establishment and continuation (Plumb and McDonald 1981; McClaran and Bartolome 1989). Also, fuel buildup as a result of fire suppression may have created conditions unfavorable for recruitment (Mensing 1992).

There is little evidence to support the theory that changes in fire frequencies have influenced oak regeneration. White (1966) concluded that fire probably played hardly any role in modifying the structure or composition of foothill woodlands in a study area in the Carmel Valley since stands unburned for at least 25 years showed no greater or lesser density of oak seedlings than in recently burned stands. Allen-Diaz and Bartolome (1992) also reported that prescribed burning at the University of California Hopland Field Station in Mendocino County did not affect blue oak seedling recruitment. And Swiecki and Bernhardt (1999), examining the effects of a wildfire on blue and valley oak seedlings, could find no growth or survival advantage associated with burning.

Changing Climate

Global climate change, and specifically a warming trend in California, has also been hypothesized as a factor influencing regeneration success. According to this hypothesis, populations at the edge of some oak species distribution ranges may no longer be able to regenerate and survive because they have not adapted to changed climatic conditions (Bayer, Schrom, and Schwan 1999). Thus, blue oak in the hotter and drier portions of its range may have more difficulty regenerating than in areas where conditions are less harsh. To date, there has been no research to verify this hypothesis.

The Pulse Theory of Regeneration

Finally, it is possible that the apparent shortage of oak saplings may not really signal a regeneration problem but only a lull in natural recruitment levels that happen in spurts or pulses. These pulses may only happen when a rare combination of events, such as low grazing and browsing pressures, good acorn years, and wet winters, occur simultaneously (Griffin 1973). Good regeneration may only take place once or twice a century because the necessary events occur simultaneously so rarely. For very long-lived species, such as oaks, however, these infrequent pulses may be perfectly adequate to sustain populations.

At present, there is not much evidence to support this theory, since studies evaluating the ages of blue oak (Kertis et al. 1993; McClaran 1986; Mensing 1991; White 1966) tend to indicate that seedling recruitment occurs irregularly, but continuously, over long intervals, rather than during short, distinct periods of simultaneous establishment. A significant exception to this pattern, however, is in stands where most of the trees have originated at the same time following fire or cutting (see **Stump Sprouting as a Mechanism of Natural Regeneration**, below).

Is There a Regeneration Problem?

Regardless of the cause of the problem, owners and managers of hardwood rangelands need to evaluate their oak stands to determine if there is adequate recruitment for maintaining stand density or if steps need to be taken to establish new trees. Figure 3 shows a decision key (Lang 1988) to assess oak regeneration. Regeneration is not a problem if there are enough seedlings and saplings present to replace the trees that are expected to die. Neither is there a problem (at least for 20 to 30 years) if the canopy is at the desired level, all overstory trees are healthy, and existing management practices do not adversely affect them. There is a problem, however, if seedlings and saplings are scarce or if a higher stand density is desired.

A Model for Oak Regeneration

Recently, Swiecki and Bernhardt (1998) have argued that blue oak recruitment is often naturally dependent on advanced regeneration and commonly occurs when gaps are created in stands, allowing sufficient light to reach the ground. Advanced regeneration consists of seedlings originating from acorns that are able to survive under the shade of mature trees, but remain small and stunted because of competition and environmental limitations, forming a "seedling bank" for future growth. When a tree falls down, for instance, and suddenly opens up the area in which the seedlings are growing, they receive much more light and have access to greater amounts of moisture and nutrients. They are then able to grow more rapidly and become saplings. However, grazing by livestock or wildlife can reduce the reproductive potential of blue oak by damaging or killing advanced regeneration through repeated browsing that depletes or eliminates the seedling bank over time. Grazing can also suppress the vertical height growth of released seedlings that are shorter than the browse line. Under current grazing management, even when gaps are created, there may simply not be enough seedlings in many locations to respond to new openings.

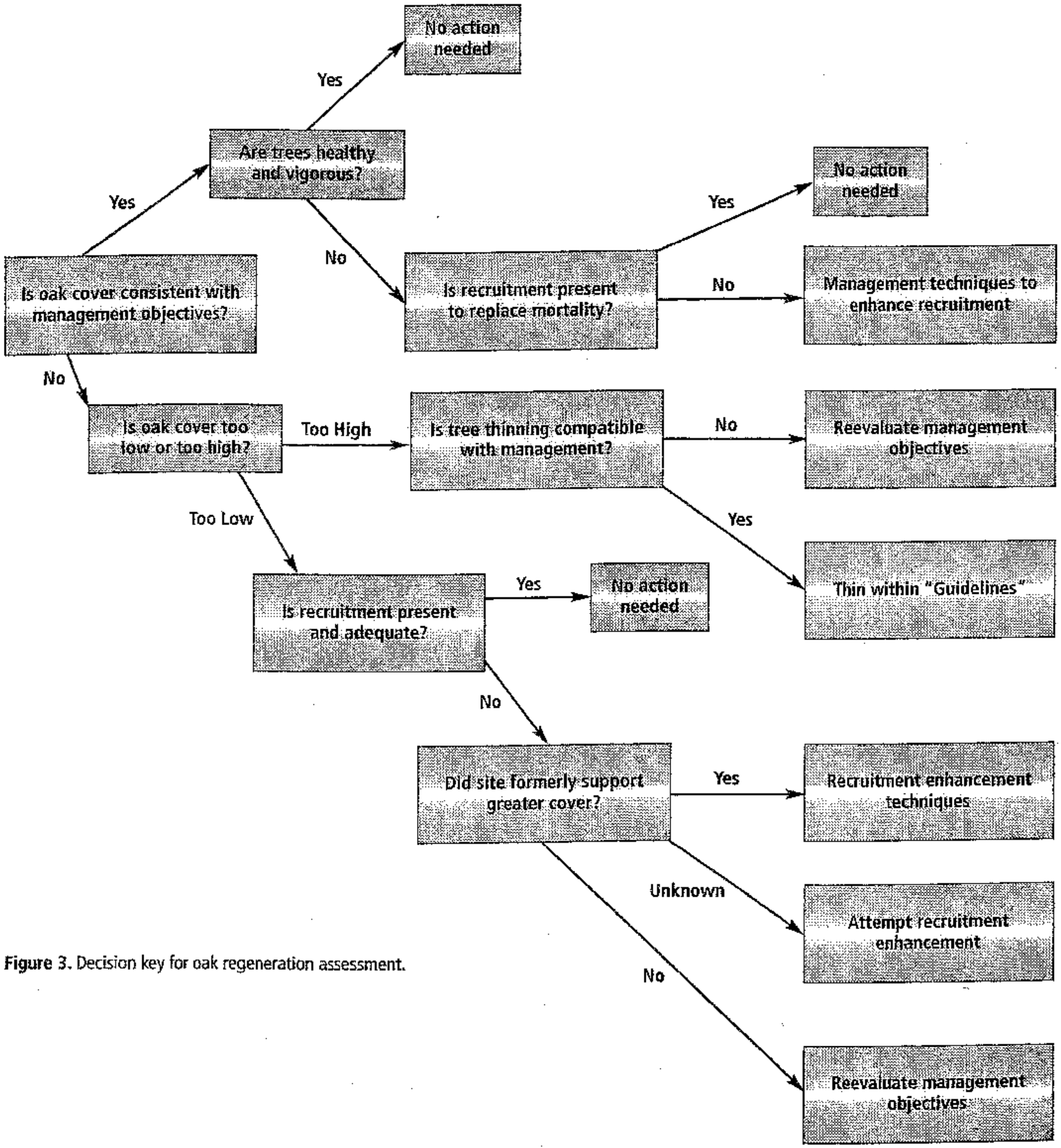


Figure 3. Decision key for oak regeneration assessment.

Stump Sprouting as a Mechanism of Natural Regeneration

There is no doubt that many of the oak trees that are alive today originated from sprouts that grew from a stump after the top was killed by fire or felling. Most stump-origin trees are easily recognized because they have multiple stems. The number of stems tends to decline with age, and older trees often have two or three main trunks. In areas where fire destroyed the stand, or where all of the oaks were cut down at the same time, most of the trees have several stems, and tree-ring studies reveal that many originated simultaneously (McClaran and Bartolome 1989; Mensing 1988).

The ability of oaks to sprout from their base following death of the aboveground portion of the tree varies by species, size of the individual tree, and environmental conditions at the site. Generally, sprouting is greater for evergreen or live oaks than for deciduous oaks; for smaller diameter stumps; and for trees growing in moister environments. While blue oak is commonly thought of as a weak sprouter compared to tan oak and California black oak (McDonald 1990), Standiford et al. (1996) found that 54 percent of blue oaks sampled in a study in the northern Sacramento Valley sprouted, even though many stumps had originally been treated with herbicides to prevent regrowth. In another large blue oak sprouting study at five sites throughout the state, almost two-thirds of the harvested trees sprouted within 2 years of harvest (McCreary et al. 1991). In general, the smaller stumps tended to sprout more, but this study detected no differences in sprouting among the four seasons of harvest, in contrast to Longhurst (1956) who reported higher sprouting for blue oaks harvested in winter.

The 1991 sprouting study also compared stumps that were protected from livestock and deer browsing to unprotected stumps. We recently assessed all trees in this study 10 years after harvest and found that protection had a tremendous effect. While the number of protected stumps that had at least one living sprout was initially higher than it was for unprotected stumps, these differences increased greatly over time. Between 1989 and 1997 the percent of protected stumps with living sprouts went down from 67 to 54 percent. Over the same interval, the percent for unprotected stumps diminished from 59 to 14 percent. Clearly the ability of sprouts to survive over time was greatly influenced by browsing.

It is not clear how many times oak stumps can sprout—several perhaps, but certainly not indefinitely. Therefore, even if sprouting is vigorous and nearly 100 percent, it will eventually be necessary for at least a portion of replacement trees to come from acorns if the stand is to be sustained over the long run.

Variable Acorn Crops

It has long been known that acorn production varies significantly from year to year (Sudworth 1908; Jepson 1910). In years with good acorn crops, large individual trees can have many thousands of acorns, while, in bad years, it can be difficult to find a single acorn on the same tree, or even on most of the trees in a stand or in a region. Masting cycles have been reported to vary greatly among the California oaks species examined, with good mast years occurring every 2 to 6 years.

There have been several inventories of acorn production on native California oaks. In 1977, the California Department of Fish and Game began assessing annual acorn production from 360 blue oak trees at the Dye Creek Ranch in Tehama County (McKibben and Graves 1987). They found that, in addition to highly variable annual acorn production patterns, there were certain trees in stands that were consistently better or worse producers than others. Even in heavy acorn years, about a quarter of the sampled trees had few or no acorns.

Weather As a Factor

For nearly two decades, Walt Koenig and others at the University of California Hastings Natural History Reservation in Carmel Valley have also evaluated the acorn production of several species of native California oaks, including blue and valley oak (Koenig et al. 1991; Koenig et al. 1996; Koenig et al. 1999; Koenig and Knops 1995; Koenig and Knops 1997). They have been particularly interested in finding trends in production patterns in California that are related to environmental variables that may explain why acorn crops are much larger in some years. The closest correlation they have found is related to weather at the time of flowering. When conditions are dry and warm at flowering, crop sizes for blue and valley oak tend to be larger compared to years when it is cold and wet during the same period (Koenig et al. 1996). Since acorns are wind pollinated, dry and warm conditions seem to favor pollination and subsequent acorn production. Interestingly, because some oak species, such as California black oak (*Quercus kelloggii* Newb.) and interior live oak (*Quercus wislizeni* A. DC.), require 2 years from flowering to acorn production and others, such as blue oak and valley oak, require only 1 year, it follows that production patterns between 1- and 2-year species could be very different, while trends within these groups should be similar. To date, these studies have found high synchrony throughout California within the 1-year species, but less for those requiring 2 years (Koenig et al. 1999).

Geographic Synchrony

This research has also evaluated whether or not there is geographic synchrony within individual species, that is, when acorn crops are good for blue oaks in the northern Sacramento Valley, are they also likely to be good along the central California coast or even farther south? Preliminary evidence suggests that there is widespread geographic synchrony, possibly on a statewide scale, among some of the 1-year species (especially blue oak), but much less synchrony among the 2-year species (Koenig et al. 1999).

Collecting Acorns

Timing

Acorns should be collected shortly after they are physiologically mature. While there are various indicators, such as moisture content, levels of carbohydrate, and acorn color, that have been used to predict ripeness for oak species in other parts of the country (Bonner and Vozzo 1987), the easiest and best characteristic we have found for blue and valley species is the ease with which acorns can be dislodged from the acorn cupule or cap. When acorns are ripe, they can be easily removed from the cap by gentle twisting. If they are not ripe, the caps are difficult to remove and some of the fleshy meat may be torn off the acorn and stay attached to the cap when separated. Because immature acorns cannot be ripened artificially after picking (Bonner 1979), acorns should not be collected until they are ripe. For blue oak, McCreary and Koukoura (1990) found that viable acorns could be collected over a fairly wide interval, extending from late August until mid October. Generally, acorns should be collected a few weeks after the first ones begin to drop. The early fallers often contain a large percent that are diseased or damaged by insects (Swiecki, Bernhardt, and Arnold 1991) and should be avoided.

Sensitivity to Drying

After collection, acorns are especially sensitive to drying, and their ability to germinate can decrease rapidly with even small losses in moisture content. McCreary and Koukoura (1990) found that even a 10 percent reduction in fresh weight of mature acorns resulted in nearly a 50 percent decrease in germination, and all acorns that lost 25 percent or more of their moisture failed to germinate (fig. 4). Because acorns can dry rapidly in the late summer and early fall when they drop to the ground, it is better to collect them directly from tree branches. Other researchers have reported that tree-collected acorns (fig. 5) have better germination than those col-

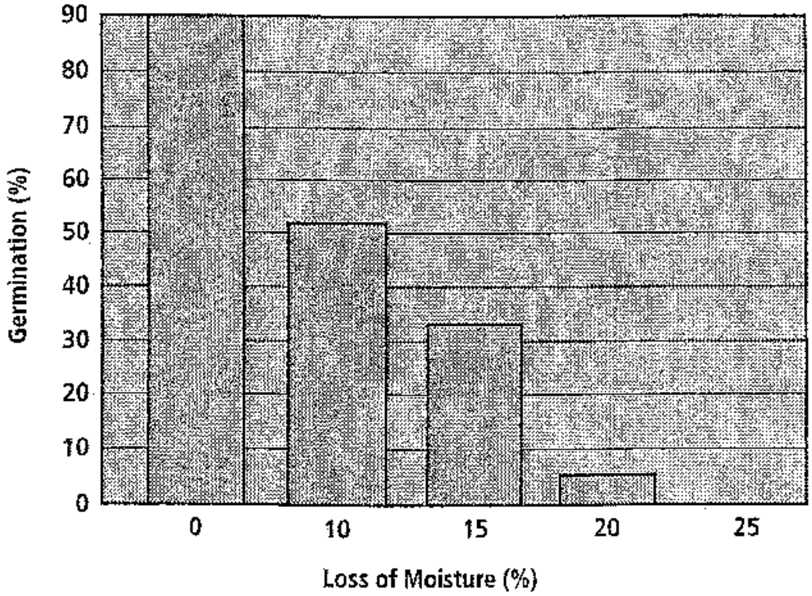


Figure 4. Acorn germination decreases with moisture loss.

lected from the ground (Teclaw and Isebrands 1986) and that damage ratings for ground-collected acorns are higher (Swiecki, Bernhardt, and Arnold 1991). On the ground, acorns can be rapidly consumed by animals. Sometimes, however, it can be impossible to collect directly from branches that are too high to reach. In these instances it is best to come back to collect acorns from the ground several times so that none remains exposed for long periods. If acorns have partially dried out, it may be possible to improve their quality by rehydrating them. Gosling (1989) found that the germination capacity of English oak (*Quercus robur* L.) acorns that had lost moisture could be improved by resoaking them for 48 hours prior to storage. However, it is best not to allow acorns to dry out in the first place.

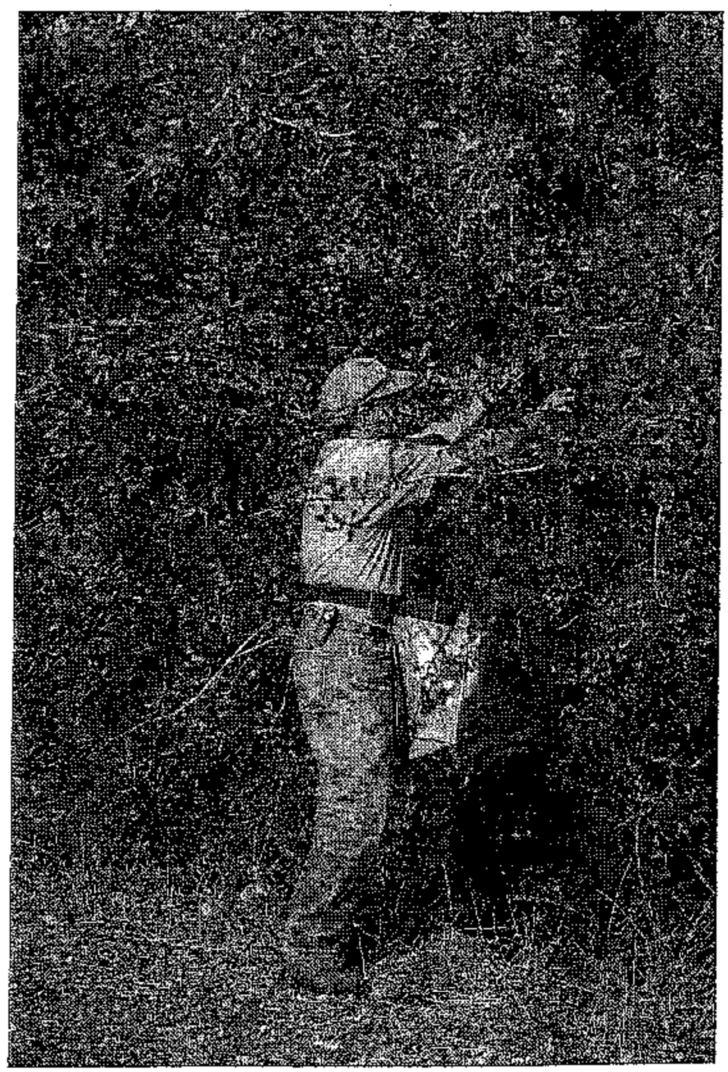


Figure 5. Using a waist bag frees both hands to collect acorns from branches.

Acorns can also be knocked to the ground from tree branches using long plastic or bamboo poles. However, it is essential to do this when the acorns are ripe. If done too early, acorns do not dislodge from the caps and remain on the tree. If too late, acorns have already fallen and may have deteriorated or been lost to animals. We have gathered acorns this way for blue oaks using tarps placed under the limbs to collect acorns as they fall (fig. 6). But many acorns knocked from the tree this way still have their caps, which must be removed prior to storage. Care should be taken not to beat the branches too forcefully so that tender new growth and even older shoots do not fall.

Sorting Acorns

Any collection of acorns contains individuals of varying quality and potential to germinate. If acorns are collected directly from the tree branches and obviously hollow or damaged acorns are discarded as they are picked, the percentage of viable acorns collected is very high, and it is generally not necessary to sort them further. But acorns collected from the ground usually have a much higher incidence of damage, and the quality of the seed lot can be improved considerably by sorting. The easiest, least expensive, and fastest sorting method is the float test. Acorns are dumped into a sufficiently large container filled with water. They are then stirred and left for several hours to either settle to the bottom, or float to the top. "Floaters" are discarded, and "sinkers" are retained. Studies have evaluated the float test for various collections of northern red oak (*Quercus rubra* L.) and found that it works reasonably well for culling damaged or insect-infested acorns (Gribko and Jones 1997; Teclaw and Isebrands 1986). The float test identifies those acorns that are hollow or damaged inside. For example, if an acorn has been infested by weevils, and a large part of the cotyledons (the white, fleshy material that provides energy and nutrition for early seedling growth) has been consumed, it will likely float.

Similarly, if acorns have been exposed on the ground for some time before collection and have desiccated and shrunk, there might be an internal air pocket that causes them to float. Finally, some acorns drop from the tree before becoming fully developed. These will also float. While the float test is inexpensive and easy, it is not 100 percent foolproof. In large seed lots, there are always some floaters that will germinate, and some sinkers that do not. Gribko and Jones (1997) reported that the float method was much better at identifying damaged, rather than sound, northern red oak acorns. That is, most of the damaged acorns floated, but many sound acorns failed to sink. However, in heavy production years, acorns are plentiful and discarding some sound acorns is probably not important. But when acorns are very scarce, it is important to retain each acorn that might germinate, so the float test may not be helpful.

Another method of sorting acorns is to select them according to size. This is fairly easy to do, and there have been reports for some oak species that larger acorns perform better (Korstian 1927) or produce larger seedlings (Matsuda and McBride 1986). A trial to evalu-

Figure 6. Long poles can be used to knock ripe acorns onto tarps.

ate the effect of acorn size on blue oak seedling performance was conducted at the Sierra Foothill Research and Extension Center between 1987 and 1989 (Tecklin and McCreary 1991). Results indicated that larger acorns did, in fact, produce larger seedlings, including both larger roots and larger shoots. However, after 2 years there were no significant differences in field survival between seedlings grown from acorns of different sizes.

Stratification

Dormancy in seeds can be defined as a state that prevents germination under environmental conditions that would otherwise be favorable for growth (Olson 1974). To overcome or break dormancy and stimulate subsequent germination, some seeds need a period of cold, wet conditions. Plants have evolved this delaying tactic to ensure that they do not germinate before seasonal changes make survival of the plant likely. Thus, even though there may be a week of spring-like weather in late January, these seeds will not germinate because they have not yet been naturally exposed to the necessary period of winter-like conditions. Over the long run, this is advantageous in environments where frosts following unseasonable warm spells are likely because early germination could prove lethal to the new shoot.

White Oaks

As noted previously, the *Quercus* genus can be divided into two main subgenera: white and black oaks. White oaks in California have little or no embryo dormancy. This means that they do not have to be exposed to any special environmental conditions and are ready to germinate soon after they have been gathered. Anyone who has collected valley or blue oak acorns and stored them in the refrigerator for any length of time can testify to the fact that these acorns begin germinating within a few weeks or months, even in such a cold environment. If left long enough, the acorns can form a tangled mass of elongated radicles. It can be difficult to plant (and sometimes even to separate) such acorns, but research in the southern United States suggests that it is not essential to keep the radicles intact. Bonner (1982) found that breaking radicles prior to sowing in a nursery did not adversely affect seedling production for any of the three oak species he tested. At the University of California Sierra Foothill Research and Extension Center (SFREC), we also found that when long radicles of blue oak were cut back to a .4-inch (1-cm) length, they grew as well as acorns with intact radicles (McCreary 1996). However, when the radicles were cut all the way back to the acorn, the acorns failed to produce shoots.

Black Oaks

Acorns from this group generally have embryo dormancy although it is variable, and there can be differences in dormancy even within species (Bonner and Vozzo 1987). After collection, black oak acorns need stratification, a period of artificial, winter-like conditions that helps break dormancy and allows the acorns to germinate. According to Olson (1974), stratification for oaks "should be in moist, well-drained sand, sand and peat, or similar material for 30 to 90 days at a temperature of 32° to 41°F [0° to 5°C]." We have found that it is also possible to provide stratification for black oak acorns in California by soaking the acorns for 24 hours and then putting them in a refrigerator (but not a freezer) for 30 to 90 days, though precautions must be taken to ensure that acorns do not dry out.

Our experience with black oaks in California has been limited to California black oak (*Quercus kelloggii* Newb.), interior live oak (*Quercus wislizeni* A. DC.), and coast live oak. All of these species have germinated in storage without stratification, indicating that they do not have particularly strong dormancy or stratification requirements. Matsuda and McBride (1989b) evaluated germination of seven California oak species and found that there were fast and slow germinators, with white oaks generally in the former, and black oaks in the latter group. Longer stratification periods increased the rapidity of germination after sowing for all of these species. However, even some black oak acorns not receiving stratification eventually germinated. For tree seeds in general, stratification tends to make germination more even, reducing the interval between early and late germinators. It also widens the range of conditions over which seeds can subsequently germinate. Both of these effects can be helpful when sowing acorns in a greenhouse or nursery where it is desirable to produce seedlings of uniform size.

Storing Acorns

After collection, acorns should be stored in a refrigerator or cooler preferably at a temperature just above freezing (between 33.8° and 37.4°F [1° and 3°C]). They should be placed in plastic bags that act as moisture barriers but allow some gaseous exchange. Prior to storage, the acorn caps should be removed. Because acorns continue to respire during storage, some gas exchange with the atmosphere is necessary and airtight storage containers should be avoided. It is therefore recommended that plastic bags be kept partially open at the top so that the moisture that tends to condense on the insides of the bags can evaporate and does not accumulate. Nevertheless, it is important to regularly check acorns to make sure they are not drying out.

Recommended Acorn Collection and Storage Procedures

- Collect acorns in the fall; several weeks after the first ones have started to drop and when those remaining on the tree can be easily dislodged from the acorn cap by gentle twisting.
- If possible, collect acorns directly from the branches of trees, rather than from the ground.
- If acorns are collected from the ground, place them in a bucket of water for several hours, and discard floaters.
- Stratify acorns from the black oak group by soaking them in water for 24 hours and then storing them in a cooler or refrigerator (33.8° to 37.4°F [1° to 3°C]) for 30 to 90 days before sowing.
- Store acorns in a cooler or refrigerator in loosely sealed plastic bags, but do not store acorns from the white oak group for more than 1 or 2 months before planting to ensure greatest viability.
- If acorns start to germinate during storage, remove and plant them as soon as possible.
- If mold develops during storage, and acorns and radicles are discolored and slimy, discard acorns.

Keeping acorns cool during storage serves several functions. First, it tends to slow respiration, which utilizes energy and can deplete carbohydrate reserves. Second, it slows the tendency for sprouting which is especially common for white oaks. And third, refrigeration tends to reduce the incidence of harmful microorganisms that can damage or kill acorns. To further retard molds, some restorationists suggest treating acorns before storage or placing fungicides inside storage bags. Bush and Thompson (1990) recommend rinsing acorns in a solution of ½ cup (118 mL) household bleach per 1 gallon (3.8 L) of cool water to kill harmful fungi. To prevent disease problems, Adams et al. (1991) dusted acorns with the fungicide Captan prior to storage. We have generally found that treating acorns prior to storage is not necessary as long as acorns are stored at the temperatures and conditions described above, and as long as they are not stored for extended periods of time. However, if molds on acorns during storage become so extensive that the radicles become discolored and slimy, it is best to discard them.

There are also several insects that can damage acorns (see **Animals that Damage Acorns and Seedlings** in chapter 4), but most damage occurs before collection. Moreover, it is difficult to kill these insects once they are inside the acorns without damaging the acorns themselves.

White oaks cannot generally be stored for more than a single season, but some researchers have reported that acorns from certain black oak species can be stored for at least 3 years (Bonner 1973). However, little research on prolonged storage has been conducted for California species. We have kept both California black oak and interior live oak acorns in a refrigerator for more than a single season but have observed that the number that subsequently germinate drops dramatically, such that only a few acorns remained viable into the second year.

Testing Acorn Quality

There may be instances when it is important to accurately determine acorn quality. Such information may be valuable before proceeding with a large-scale collection, or to assess whether temporary storage or handling procedures have been detrimental. Seed tests are also important for nurseries that need to calculate sowing densities. The most accurate measure of potential acorn performance is to incubate a representative sample of intact acorns under environmental conditions that bring about germination. Standard conditions recommended by the Association of Official Seed Analysts (AOSA 1993) for conducting germination tests on acorns are a day temperature of 86°F (30°C) and a night temperature of 68°F (20°C), with an 8-hour photoperiod (length of daily light interval). It is also critical that the acorns be placed on a moist medium, such as sand, sand and peat, or vermiculite, and not be allowed to dry during the test. These tests provide an estimate of germination percentage. Unfortunately, germination tests on the intact acorns of many oak species can take 2 months or more to complete, and this is often too long to wait. One way to speed tests is to partially dissect the acorns before sowing them. Cutting acorns in half (discarding the cap end) and peeling away the pericarp (acorn skin) can reduce the germination time to about 3 to 4 weeks. However, even this is frequently too long. Consequently, a number of more rapid viability tests have been developed and may be of use in special situations.

A viability test identifies those seeds that are alive, but that does not necessarily mean that they are capable of germinating. Bonner and Vozzo (1987) describe three options for quick viability tests. The first, simplest, oldest, crudest, and probably best technique is a cutting test. In this test, a sample of acorns are cut in half and those with clean, firm, and healthy-looking cotyledons are considered viable. Those that are entirely empty or in which the embryo appears undeveloped, shriveled, moldy, or insect-damaged are not viable.

Another method of testing is X-radiography. This is a quick and nondestructive technique for identifying empty and damaged fruits and seeds of most species. Unfortunately, for acorns it can be difficult to interpret because the high moisture content of live acorns renders the X-ray images opaque.

Finally, there is the tetrazolium test. This relies on the premise that only living cells have the enzymes capable of converting a colorless solution of tetrazolium salt into a colored precipitate. Although this test has been widely applied to the seeds of a large number of species, it is only moderately successful for acorns (Bonner 1984). This is probably because acorns contain secondary compounds that interfere with the staining reaction.

Genetic Considerations

Genetic Differences within Oak Species

Restoration is defined as bringing something back to a former or normal condition. For restoration, therefore, only a given species of oak should be planted in areas where it naturally grows or grew in the past. But even within an oak species, the source of the acorns must be considered. Both blue oak and valley oak are widely distributed species in California, ranging in latitude over much of the length of the state and in elevation from near sea level to 5,600 feet (1,700 m) for valley oak (Griffin and Critchfield 1972), and to over 4,500 feet (1,400 m) for blue oak (McDonald 1990). Clearly, there is a very wide range of environments in which different populations within these species grow. For instance, blue oak grows on Santa Cruz and Santa Catalina Islands, as well as at lower to middle elevations in the northern Sierra Nevada. While the coastal environment is generally temperate and mild, growing seasons in Northern California are shorter, and frosts commonly occur in late spring. If acorns collected from coastal trees were planted in the north, they may grow quite well for a number of years. But in the life span of an oak tree (which can be 200 to 300 years), it is likely there will be an environmental extreme that they are not genetically adapted to. A serious freeze in late spring, for instance, could seriously damage or kill a tree from a coastal source, while local trees may suffer few negative effects.

Although there has not been a lot of research on the genetics of native California oaks, Rice, Richards, and Matzner (1997) found evidence for local adaptation of blue oak populations collected at the University of California Sierra Foothill Research and Extension Center and at the University of California Hopland Research and Extension Center. However, Riggs, Millar, and Delany (1991) found only relatively small genetic differences within valley and blue oak populations using biochemical assay techniques and could detect no geographic pattern in variation in these biochemical markers.

Genetic Contamination

Another potential problem of moving oaks from one locale to another is genetic contamination. Oaks are wind pollinated and require pollen from male flowers to pollinate and fertilize female flowers. If pollen-producing trees are from off-site locations and contain genetic traits poorly adapted to the area where they are growing, there is a risk that they could introduce these ill-adapted traits into the population via newly produced acorns. While there certainly is debate over how serious a threat this is for oaks as well as for other species, it makes sense to avoid this potential danger when possible. It is, therefore, recommended that acorns be collected as near to the planting site as possible. Furthermore, to ensure adequate genetic variability within the local population, Lippitt (1992) recommends collecting acorns from at least 15 trees at any given site.

Timing of Acorn Planting

As mentioned above, blue and valley oak acorns generally ripen in late summer to mid fall. However, at this time soils can still be extremely dry because the first heavy, fall rains may not have occurred. While even fairly dry soils can have relatively high humidities under the surface, these soils can also be extremely hard, and, even if acorns do germinate, root penetration is likely difficult. We, therefore, recommend that acorns are only directly planted in the field after there has been sufficient rainfall to soak the soil at least several inches down. But how soon after these rains should acorns be planted? In a trial at the University of California Sierra Foothill Research and Extension Center with blue and valley oaks, we compared field performances of acorns sown at monthly intervals for 5 months starting in early November (McCreary 1990a). Acorns for each species were collected from single trees in early October and were stored in the refrigerator for intervals ranging from 1 to 5 months before planting. We then recorded emergence date, total emergence, first- and second-year heights and diameters, and survival of seedlings in the field. There were profound and consistent effects of acorn planting date, with better performance for those that were sown earlier. They tended to emerge earlier, have higher survival, and grow more. While early emergence might increase the risk of frost damage, we have never observed such damage at SFREC. Sowing acorns on the last date in early March was particularly harmful since the seedlings seemed to get such a late start that they apparently were not able to grow a very large root system before the summer dry period. Based on these results, we recommend that blue and valley oak acorns be planted early in the season, as soon as possible after the soil is sufficiently wet. As a rule of thumb, planting should take place no later than the end of January, and even this may be too late in areas with less rainfall and shorter winters.

How to Sow Acorns

Planting Depth

When directly sowing acorns in the field, it is important to bury them since the likelihood of depredation, as well as desiccation damage, is much greater for exposed rather than buried acorns. In a study with blue, valley, and coast live oaks, Griffin (1971) found that burying acorns did not eliminate rodent damage but did reduce losses. And Borchert et al. (1989) reported that recruitment of buried blue oak acorns was twice that of surface-sown ones. We generally sow acorns ½ to 1 inch (1.0 to 2.5 cm) deep, but in some situations it may be better to plant them deeper. In an area where rodents were a threat, Tietje et al. (1991) found that, in general, emergence was better for blue oak and valley oak acorns planted 2 inches (5 cm) in the ground because shallower plantings (½ in [1 cm]) had much higher depredation, while deeper plantings (4 in [10 cm]) made it too difficult for shoots to grow up through to the soil surface. However, if acorn depredation is not a serious concern, shallower plantings are generally preferred.

Pregermination

We have found that by pregerminating acorns before field planting, more than 90 percent will initially grow. Pregerminating acorns is easily done by filling pie pans or other shallow dishes with moist vermiculite, sand, or peat. Acorns are then placed on their sides and gently pressed into the medium (fig. 7). It is important that the material stay moist, but not overly saturated, while the acorns are germinating. The trays can be placed at room temperature on a table, windowsill, or bench for observation. Blue oaks generally begin germinating in 1 to 2 weeks, as evidenced by a white tip, or radicle, protruding from the pointed end of the acorn. They are then ready to outplant. When planting pregerminated acorns with developed radicles, use a pencil, screwdriver, or other pointed object to make a hole in the soil and carefully position the acorn in the hole with the radicle pointing downward. Acorns can then be covered as described above.

Multiple Seeding

When directly planting acorns, it is a good idea either to sow those that you are sure will germinate or several at each planting spot to ensure germination of at least one individual. Some restorationists feel it is important to plant two or three acorns per planting spot (Bush and Thompson 1989). This is particularly important if planting spots are protected with cages or tubes because such planting requires considerable expense and effort. Since acorns are generally easy to obtain, multiple seeding is far less expensive than replanting. However, mul-

Recommended Methods for Sowing Acorns of Rangeland Oaks in the Field

- Sow acorns in the fall and early winter, as soon as soil has been moistened several inches down.
- If possible, pregerminate acorns before planting and outplant when radicles are ¼ inch to ½ inch (½ to 1 cm) long.
- Cover acorns with ½ to 1 inch (1 to 2 ½ cm) of soil.
- If acorn depredation is suspected as a serious problem (high populations of rodents are present), plant deeper, up to 2 inches (5 cm).
- If acorns begin to germinate during storage, outplant as soon as possible with the radicle pointing down. Use a screwdriver or pencil to make a hole in the soil for the radicle.
- If radicles become too long, tangled, and unwieldy to permit planting, clip them back to ½ inch (1 cm) and outplant.
- If acorn planting spots have aboveground protection (treeshelters), and acorns have not been pregerminated, plant two or three acorns per planting spot and thin to the best seedling after 1 year. (See chapter 4.)
- Keep planting spots free of weeds for at least 3 years after planting. (See chapter 4.)

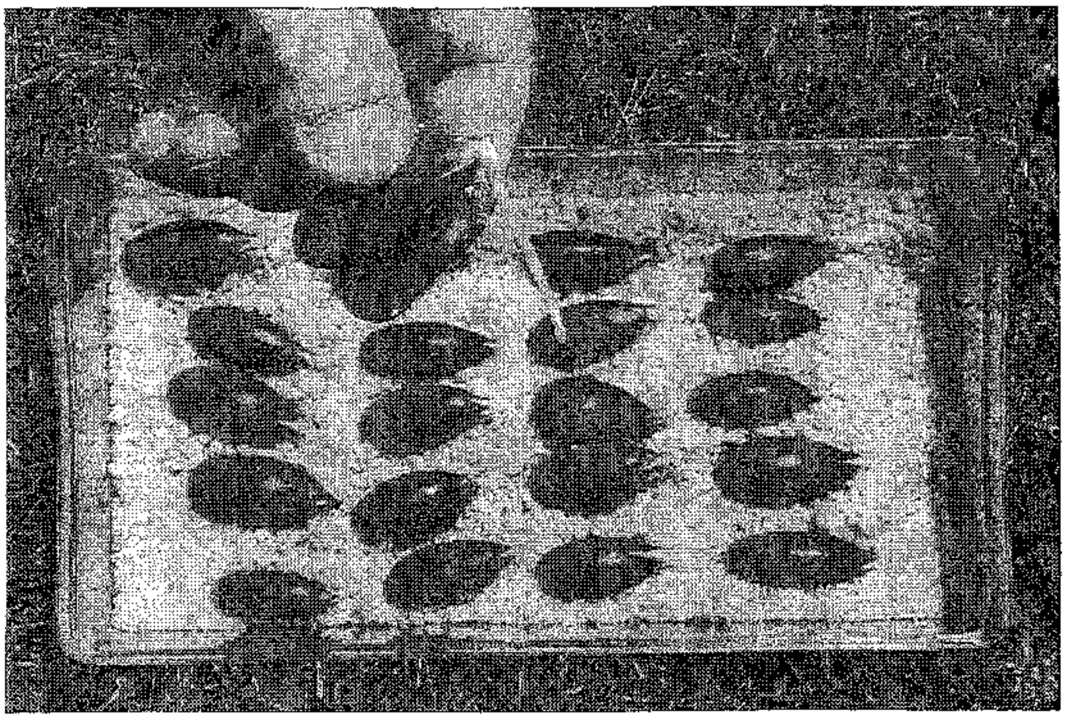


Figure 7. Place acorns in trays of moist vermiculite for easy pregermination.

tiple seedlings should eventually be thinned to the single best plant, which is not always easy to do inside of tubes. This can be time consuming and expensive, and, if acorn quality is extremely good and expected germination rates are above 90 percent, it is probably not necessary to sow more than one acorn per spot.

Acorn Orientation

Some researchers have questioned how acorns should be oriented when planted. Both the shoot and the root emerge from the pointed end of the acorn, so whether they are planted point up or point down may subsequently affect how seedlings grow. McDonald (1978) reported the results of a field test that compared point up vs. point down plantings of tanoak acorns (*Lithocarpus densiflorus*), a species closely related to *Quercus*. He found that planting point up resulted in earlier and more complete emergence. A study with northern red oak, however, found that, while planting position (point up, point down, or sideways) had no statistically significant effect on seedling survival and growth, acorns lying sideways had the highest average survival (Trencia 1996). In our research trials at SFREC, we have opted to plant acorns horizontally, and this has proven quite effective.

Acorns or Seedlings?

The choice of whether to plant acorns or seedlings depends on a host of factors including availability of suitable planting material and conditions at the planting site. Sometimes it is difficult to obtain seedlings from local sources. Only by collecting acorns yourself can you be sure that your planting will be adapted to local conditions. However, if large numbers of acorn-eating rodents, such as mice or ground squirrels (*Spermophilus beecheyi*), are present, it can be difficult and costly to successfully establish oaks by direct seeding. In these situations, the best solution may be to plant seedlings.

We have conducted several trials to compare the field performance of acorns and seedlings from the same seed source. In one study, we detected very little difference between blue oak seedlings that originated as directly sown acorns and those that were grown for 4 months in containers and then transplanted. Both had over 90 percent survival, and, after 5 years, there were no significant differences in height (McCreary and Tecklin 2001). This is consistent with a previous blue oak trial at the SFREC (McCreary 1996) in which these two stock types were also compared. In the 1996 trial, however, acorns had far greater growth than 1-year-old seedlings planted at the same time. It is important to note that both of these trials were conducted in highly controlled environments, and in less intensively managed wildland settings, transplants might perform better.

Because it is easier and less expensive to directly plant acorns, this method may be preferable in many situations. However, if direct sowing is used, it is important that steps be taken to ensure that acorn depredation will not be a problem since this can negate any benefits hat might otherwise be realized. Our plots were kept fairly weed free, and, therefore, there were not many rodents, which are attracted to locations where weed cover is dense (see **Animals that Damage Acorns and Seedlings** in chapter 4).

3 Propagating Rangeland Oak Seedlings

Until a decade ago, there were relatively few native oaks produced for artificial regeneration in California, mainly because there was little demand. Historically, most California oak species have not been considered desirable landscape plants, partly because they had a reputation for growing slowly. Also, few seedlings were commercially grown because oaks in California have never been considered important timber trees. The lack of commercial importance also meant that there was almost no research carried out on how to grow oaks, either in containers or in bareroot nurseries. While such research has been extensive for commercially important eastern oak species, such as northern red oak (Johnson 1988; Ruehle and Kormanik 1986; Thompson and Schultz 1995), in California the propagation methods used have evolved from the growers' experiences and have been based largely on trial and error.

The last decade has seen a significant increase in demand for, and production of, oak seedlings. Oak seedling quality has also improved over the same period, reflecting improvements in nursery husbandry. Nurseries, such as Tree of Life in San Juan Capistrano, Circuit Rider in Windsor, and the California Department of Forestry and Fire Protection L. A. Moran Reforestation Center in Davis, have now been growing oaks for many years. Below are some general comments about propagation methods for container-grown oak seedlings, followed by case histories summarizing production methods used by these three nurseries. For further information about container production practices, consult one of the nurseries listed in appendix A.

Seedling Production in Containers

The vast majority of native oaks produced in California are grown in containers, which range in size from a few cubic inches to large boxes of many cubic feet. In general, oak seedlings tend to put a large amount of energy into producing a taproot with a carrot-like configuration. Seedlings can, therefore, quickly become pot-bound in small containers, meaning the volume of seedling roots produced can exceed the growing space in the container. Planting such stock can result in poor subsequent field performance or even death. It is, therefore, important not to grow seedlings in containers that are too small. Some nurseries start oaks in small sleeves called "liners"

Preparing Potting Mix

Combine the following:

5 ft^3 course peat moss

5 ft^3 course vermiculite

4 ft^3 fir bark (1/8- to 1/4-inch size)

1 lb lime

2 lb slow-release fertilizer granules

or in flats, and then transplant the seedlings to larger containers as they become bigger. In general, better quality oak seedlings are produced in narrower, deeper containers, rather than in wide, shallow containers. For this reason, a common container for raising oaks is a "treepot," with dimensions of approximately 4 by 4 by 14 inches (10 by 10 by 36 cm) although large-scale production is often started and completed in liners or small containers called "plant bands."

Preventing the Formation of Deformed Roots

Oak taproots generally reach the bottom of a container before the shoots emerge from the soil surface. Once at the bottom, these roots tend to circle around unless they are checked or prevented from growing. Such root circling creates a plant that is poorly adapted to growing in the field. Deformed roots can persist for years and even decades after field planting and can cause poor tree growth and lack of stability.

Air Pruning. Many container production systems employ air pruning to thwart root circling. As the seedling roots grow to the bottom of the container, they are exposed to air. This is accomplished by using open-ended containers that are placed on screens or mesh to prevent the soil from falling out while still exposing roots that reach the bottom. Since the air is dry, and roots need moisture, the root tips stop growing. This, in turn, causes the production of lateral branch roots farther up the main root, creating a much more fibrous root system. This type of air pruning is used at the California Department of Forestry L. A. Moran Reforestation Center with excellent results (Lippitt 1992).

Chemical Pruning. There are also commercially available copper compounds that can be painted on the interior of containers. These compounds arrest the growth of root tips (Regan, Landis, and Green 1993). When roots come in contact with these chemicals, they are pruned, causing further root branching and development of a more fibrous root system.

Planting Medium

Oak seedlings grow well in a variety of potting mixes. According to Schettler and Smith (1980), "nearly any reasonable planting medium can be used with good results as long as it is well-drained."

Fertilizing

Container seedlings generally need to be fertilized within a few weeks after sowing. Fertilizer can be provided in irrigation water or in slow-release fertilizers incorporated into the soil mix. A fertilization regime that has been used successfully is adding 20-20-20 at 100 parts per million of nitrogen in irrigation water, plus micronutrients.

When to Transplant

Most container seedlings are grown for a year or two before transplanting to the field. In some cases, however, the time in the container can be considerably longer as plants are repeatedly transplanted to increasingly larger containers in order to produce large-sized (and very expensive) landscape plants. At SFREC, we have experimented with a shorter production schedule. We collected acorns in October, sowed them in outdoor shadehouses at the California Department of Forestry Nursery in Davis in December, and then planted the young seedlings back at the University of California Sierra Foothill Research and Extension Center in late March. While these seedlings appeared quite fleshy and tender at the time of outplanting, they performed well in the field (McCreary 1996). In fact, in this trial they were superior to 1-year-old container stock in terms of survival and growth. Obviously, it is far less expensive to produce a 4-month-old seedling than one grown for a full year, so this stock type may be suitable in some situations.

Growing Your Own Seedlings

Germination

It is possible to grow your own oak seedlings without sophisticated greenhouses or other equipment. Acorns are easy to collect and germinate, and the requirements for small seedlings are relatively modest. Pregerminate acorns in shallow trays to make sure that all of the acorns that are planted are viable and ready to grow.

Containers and Potting Mix

As previously discussed, tall, narrow containers are preferable to short, wide ones. We have had good success with small milk-carton-like boxes that are open at both ends. These are available in a variety of sizes (see appendix A), and a size of 2 by 2 by 10 inches (5 by 5 by 26 cm) seems particularly well suited to growing oak seedlings. These containers are wide enough to lay acorns flat for planting, and tall enough to allow good root development. For growing large numbers of seedlings, the potting mix described in the box on page 20 has worked well. But for growing fewer than two hundred seedlings, it is probably easiest to buy commercially available potting mixes in ¾-cubic-foot bags. Course mixes that have better drainage are preferable to finely textured ones.

To prevent the potting mix from falling out of the open-ended containers, we place a single sheet of newspaper in the bottom of the rack. These decompose about the time the roots reach the base of the containers, but by that time, there is little risk of the soil falling away. Racks should not be placed on a solid surface, but should be elevated slightly or placed on screen, narrow strips of wood, or mesh.

Containers can be kept indoors or outdoors; but if outdoors, the seedlings must be protected from severe freezes. It may also be necessary to make sure that birds or rodents do not remove acorns. While the roots start to grow right away, it may take several months for the shoots to emerge. As noted above, we have found that 4-month-old blue oak seedlings grown this way (sown in containers in December and field planted in March) have performed well in the field, as long as they are irrigated at the time of planting. But since the seedlings are fairly tender and fleshy, they need to be handled and planted carefully.

Recommended Procedures for Growing Oak Seedlings in Containers

- Grow oak seedlings in tall and narrow, rather than short and wide, containers.
- Select appropriate container sizes and transplant seedlings to larger-sized containers before seedlings become "pot-bound."
- Use containers that promote the pruning of root tips at the bottom.
- Use a coarse, well-drained, potting mix; keep it moist, but not saturated, and make sure it does not dry out during warm weather.
- Ensure seedlings have adequate nutrition by incorporating a slow-release fertilizer into the potting mix or using a balanced, liquid fertilizer in irrigation water.

Other Ways to Grow Oak Seedlings

There are also other ways to grow oak seedlings. A video and manual produced by the University of California Cooperative Extension in Calaveras County, *Oak Tree Project*, (Churches and Mitchell 1990) describes a program to collect acorns and grow seedlings, targeting school and community groups.

Nursery Case Histories Involving Container-Grown Seedlings

Circuit Rider Productions

Circuit Rider Productions is a nonprofit service corporation dedicated to the enhancement of environmental and human resources. Since 1978 they have operated a native plant nursery where they produce plants for restoration and revegetation projects, specializing in site-specific liner stock. From the beginning, they have grown a number of California oak species, including valley, blue, California black, coast live, canyon live (*Quercus chrysolepis* Liebm.), interior live, and Oregon white oaks (*Quercus garryana* Douglas ex Hook.).

Container Types. Many are grown in tapered plastic tubes called "super cells" (1½ inches [4 cm]in diameter and approximately 10 inches [26 cm] deep). These tubes have ribs on the internal walls that help direct roots downward, resulting in air pruning and preventing root circling. Other containers that are used at Circuit Rider Productions include deepots (2 in [5 cm] in diameter and 10 in [26 cm] deep) and treepots (4 by 4 by 14 in [10 by 10 by 36 cm]). The containers are filled with a well-drained growing medium and are regularly irrigated during the dry season to ensure that the growing medium stays moist, but not saturated. A slow-release fertilizer is incorporated into the potting mix prior to sowing, and liquid fertilizer is added during the growing season. Oaks grown in super cells develop an 8-inch (21-cm) root and a shoot that is about 4 to 8 inches (10 to 21 cm) tall, and they are ready for field planting the fall following container planting. These seedlings are particularly suited for planting in remote areas because they are lightweight and easy to transport. Seedlings in deepots are also grown for a single season, while those in treepots are transplanted into larger containers and require 2 years to reach the desired size.

Acorn Collection and Storage. Acorns sown by Circuit Rider are generally collected close to the future planting site within the same watershed to ensure adaptation to local conditions. Collection sites are tracked by accession numbers and, for the more common oak species, collections are made at 20 to 25 different sites for a given year in Northern and Central California. Circuit Riders usually harvest acorns directly from trees, either by picking them from branches or by knocking them to the ground with poles. After discarding obviously defective acorns and sorting them by flotation, acorns are placed in small to medium resealable polyethylene bags containing a moist medium consisting of vermiculite or perlite, or a combination of the two. Acorns are mixed with a high volume of medium to maintain high acorn moisture during storage. The bags are then placed in a refrigerator at 40°F (4.4°C) until sowing in containers. If radicles become long and tangled during storage, they are trimmed prior to sowing. When planting in containers, acorns are sown with the pointed tip buried halfway at an angle of approximately 45 degrees and placed in a shadehouse to germinate. They are kept in partial shade during the summer to ensure that the containers don't dry out too quickly.

Tree of Life Nursery

The Tree of Life Nursery has been producing native California plants for more than two decades and claims to be the largest supplier of native plants in the state. Their grounds, located in San Juan Capistrano, include 30 acres of growing area with both shadehouses and greenhouses, and they maintain laboratory facilities for the propagation and testing of mycorrhizal plants and inoculum. They grow a wide variety of native oak species, including blue, valley, coast live, California black, canyon live, island (*Quercus tomentella* Engelm.), scrub (*Quercus berberidifolia* Liebm.), coastal scrub (*Quercus dumosa* Nutt.), and Engelmann oak. They are particularly well known for growing Engelmann oak seedlings since the nursery is located within the very narrow range of this species, and they have worked closely with conservation groups focusing on Engelmann oak restoration.

Acorn Storage and Sowing. The Tree of Life Nursery collects acorns from a variety of collection areas for most species, and records identifying the location of the seed source are maintained. Acorns are then put in water, with floaters discarded and sinkers placed in lugs or flats containing moist peat moss. After germination, radicles are pinched off, the acorns are sown in super cells, and the seedlings are grown for one growing season. Nursery manager Mike Evans feels that root pinching is beneficial since it promotes the early development of a more fibrous root system and improves the ratio of roots to shoots. The potting mix consists of 80 percent organic amendments, including bark products and peat, and 20 percent inorganic components, consisting of perlite, vermiculite, and sand. A slow-release, 18-6-12 fertilizer is incorporated into the potting mix prior to planting, and the seedlings are generally inoculated with an endomycorrhizal fungi, VAM 80. This fungi is thought to enhance the ability of seedlings to take up nutrients following outplanting, thereby improving field performance.

Transplanting. After one growing season, seedlings are either sold or transplanted into larger containers. Many are planted in 1-gallon containers that promote the development of a much deeper root system, resulting in better growth and survival after outplanting. After 1 year in this size, some oak seedlings are sold, while the remainder are transplanted into 5-gallon containers. After one additional growing season, seedlings are either sold or transplanted to 15-gallon pots, the largest size grown by the nursery. At each stage of transplanting, excess roots are trimmed off prior to moving the seedlings to larger containers. Generally, the smaller seedling sizes are destined for revegetation plantings, while the larger sizes are for landscaping projects.

California Department of Forestry L. A. Moran Reforestation Center

The L. A. Moran Reforestation Center in Davis is the only container nursery operated by the California Department of Forestry and Fire Protection (CDF). Its primary mission is to sell tree and shrub seedlings to the public. While, historically, the main focus of the nursery has been to produce and sell commercial conifer species, there has been increased emphasis in recent years on growing native plants for restoration purposes. The nursery has produced native oak seedlings since 1987. Their primary species are blue and valley oaks, with lesser quantities of California black, coast live, canyon live, interior live, Engelmann, and Oregon white oaks. However, the species grown and number of seedlings produced depend largely on the availability of acorns, and during poor acorn years, the number of seedlings of a given oak species may be restricted. The nursery produces an average of approximately 5,000 oak seedlings annually and as many as 10,000 additional seedlings as contract requests.

Acorn Processing. CDF is particularly concerned with identifying the sources of all their acorns and only distributing seedlings from acorns that have been collected relatively near the planting area. Acorns are generally collected directly from the tree branches or knocked off trees with poles. They are upgraded by discarding obviously cracked or damaged ones, including those with multiple bore holes and uneven coloration. The CDF nursery then X-rays the seed lot, which provides an additional indication of quality. If the quality is good, no further treatment is done. If there are many empty acorns, the CDF nursery uses an air separator to cull them. After sorting, acorns are stored in plastic bags that are left slightly open at the top and refrigerated at 35°F (1.7°C) until planting.

Sowing. To prevent deterioration and premature germination, acorns are generally sown in early winter, preferably by mid-December. They are sown one per container on their side and covered with about ½ inch (1 cm) of coarse vermiculite. The containers are foil-covered, paper, plant sleeves that are 2½ by 2¼ by 12 inches (6 by 6 by 31 cm) and are open at the bottom to promote air pruning of the roots. A well-drained potting medium containing peat, bark, perlite, and vermiculite is used and a slow-release fertilizer is incorporated into the mix to promote the breakdown of the bark and to encourage initial root growth. Perlite is used as a top dressing to decrease drying. Following sowing, the containers are moved directly into a shadehouse where the acorns germinate. When germination appears complete, the empty containers are removed and the remainder consolidated. Regular irrigations from an overhead system usually commence in the spring and are designed to provide deep thorough soakings, with seedlings drying between each irrigation. A balanced fertilizer is added through irrigation water, but rates are kept low. The following winter, the seedlings are sized, graded, and made available for sale.

Bareroot Seedling Production

Few bareroot oak seedlings are produced in the state. However, the California Department of Forestry and Fire Protection Nursery at Magalia began growing and selling a limited number to the public about 10 years ago. To determine which cultural practices are most effective for bareroot production of blue oak seedlings, a study was initiated at the nursery in 1987 to compare several root pruning (drawing a blade through the soil 8 to 10 inches [21 to 26 cm] deep to cut off deep roots) and sowing treatments (Krelle and McCreary 1992).

Root Pruning

Undercutting roots is common in the production of commercially important oak species such as northern red oak in the East and Midwest (Johnson 1988). Results from the Magalia study indicated that it was essential to prune seedling roots in order to produce acceptable plants. If the roots were unpruned while in the nursery bed, they grew so deep that it was impossible to "lift," or remove, them from the nursery beds without damaging them. However, the timing of the pruning was critical. If pruning was done too early, before the roots had grown down at least 8 inches (21 cm), then it had little or no effect on root form. If pruning occurred too late in the season, after seedlings had produced fairly thick, deep, carrot-like roots, then so much of the roots were lost during pruning that the seedlings were severely damaged, and, in many cases, died.

Based on the results of these experiments, nursery manager Bill Krelle opted for both an early (May) and a late (August) pruning treatment to produce the best blue oak seedlings, with the second pruning approximately 2 inches (5 cm) deeper than the first. This study also found that seedlings from a late fall or midwinter sowing performed much better than those from an early spring sowing since late sowing apparently delayed germination and resulted in greatly reduced growth. In this trial, seedlings were grown for a single season at a density of 12 to 14 per square foot (129 to 151/m^2), though much lower bed densities are common for growing northern red oak (Schultz and Thompson 1997).

Lifting Dates and Storage

The 1987 Magalia study also evaluated different lifting dates and seedling storage treatments and found that bareroot blue oak seedlings could be lifted over a fairly wide interval, extending from early December to early February, without seriously affecting seedling quality. They could also be cold-stored for up to 2 months without damage, as long as the roots were not allowed to dry

Recommended Procedures for Growing, Lifting, and Storing Rangeland Oak Seedlings in Bareroot Nurseries

- Sow acorns in nursery beds by the end of January at a density of no more than 12 to 14 per square foot (129 to 151/m^2).
- Undercut seedling roots in both May and August to inhibit tap-root development and promote a fibrous root system.
- Lift seedlings no later than early February and place in cold storage, making sure roots stay moist.
- Store seedlings for up to 2 months, but avoid extended storage for late-lifted stock (see chapter 4).

Figure 8. These bareroot seedlings were field-planted in 1989, and many are now over 10 feet (3 m) tall.

out. Seedlings from this trial (McCreary and Tecklin 1994b) have now been growing at the University of California Sierra Foothill Research and Extension Center for 10 years, and many are 10 to 15 feet (3.0 to 4.6 m) tall with basal diameters exceeding 2 inches (5 cm) (fig. 8).

Recommended Procedures for Vegetative Propagation

Vegetative propagation may be a desirable alternative to growing seedlings in containers or in bareroot nurseries because it offers the opportunity to produce uniform, genetically superior plants selected for traits such as disease or drought resistance. Another advantage is that this production method does not depend on acorns. As noted previously, acorns do not store well, and because acorn crops are so variable, restoration planning can be very difficult and seedlings unavailable when needed.

At present, however, no vegetatively propagated oak seedlings are commercially produced in California. Even for important eastern species, such as northern red oak, commercial vegetative propagation is uncommon, though there has been considerable research on it. The most widely tested method of vegetative propagation for oaks is with the use of rooted cuttings. While it is generally recognized that oaks are more difficult to root than many other woody species, it can be done. Most of the successes are attributed to combinations of using cuttings from young plants and providing growth regulators, moisture, and shade (Davis 1970; Zaczek, Heuser, and Steiner 1997). Isebrands and Crow (1985) successfully rooted softwood cuttings of 3-week-old northern red oak in a greenhouse, and Drew and Dirr (1989) found that cuttings from younger flushes (a period of stem elongation) rooted better than those from older flushes. Morgan (1979) also reported that the younger the oak, the greater the rooting success. In almost all trials, cuttings were treated with the hormone indoyl butyric acid (IBA) to stimulate rooting.

In vitro plantlet regeneration of several oak species has also been reported. Shoot cultures of English oak have been established and multiplied using original material from both juvenile seedlings and stump sprouts from mature trees (Vieitez, San-Jose, and Vieitez 1985). However, this approach is difficult and expensive, and it is unlikely that California oaks produced in this manner will be available in the near future.

Mycorrhizal Inoculation

Inoculating oak seedlings with mycorrhizal fungi has been reported to improve field performance after outplanting (Garrett et al. 1979; Anderson, Clark, and Marx 1983; Ruehle 1984; Dixon et al. 1981). This improvement is attributed to an increased capacity of the root system to take up moisture and nutrients. On sites in California where oaks were cleared decades ago and have remained treeless since, a lack of mycorrhizal inoculum could be a factor inhibiting natural oak regeneration. While a number of mycorrhizal species can be found in oak woodlands, there has been little evidence that artificially inoculating California oak seedlings, either before or after planting, significantly improves growth and survival. At the University of California Sierra Foothill Research and Extension Center, we compared valley oak seedlings inoculated with the broad spectrum and commercially available *Pisolithus tinctorius* mycorrhizae to uninoculated controls but could detect no subsequent improvement in field performance after outplanting.

However, in a trial that incorporated litter from under Engelmann oak trees (and presumably inoculum of native mycorrhizae) into planting spots with Engelmann oak seedlings and acorns, significant increases in a number of growth variables were reported (Scott and Pratini 1997). While it could not be proven definitively that mycorrhizae from the native soil conferred a growth advantage, it was concluded that this was likely. Berman and Bledsoe (1998) also added soils from valley oak riparian areas to growth media for valley oak seedlings grown in a greenhouse and found that the percent mycorrhizal infection and mycorrhizal diversity on the seedlings were increased more by transfer of oak forest and woodland soil than agricultural field soil. While the benefits of mycorrhizal inoculation for native California oak seedlings are not yet well documented, the Tree of Life Nursery regularly inoculates their oak seedlings, and its staff believes it confers a significant benefit after outplanting.

4 Seedling Planting, Maintenance, and Protection

Regeneration research in California during the past 12 years has indicated that successful oak establishment is dependent upon proper planting, maintenance, and protection. The greatest barriers to success are weed competition and animal damage. Regardless of how well acorns are collected and processed or how well seedlings are grown and planted, if competing vegetation is not controlled and acorns and seedlings are not protected from damaging animals, chances for success are slim. Below are discussions of techniques and practices that can greatly enhance the prospects that outplanted acorns and seedlings will grow into saplings and trees.

Planting Rangeland Oak Seedlings

When to Plant Seedlings

As with date of sowing acorns directly in the field, the planting date for seedlings can influence subsequent field performance. The greatest problems arise from planting seedlings too late in the season. For blue and valley oaks, March is usually too late, and it is preferable for seedlings to be planted by the end of January. Bareroot blue oak seedlings lifted on several dates and stored for varying intervals performed well as long as they were not planted after early March (McCreary and Tecklin 1994b), and 1-year-old container seedlings planted in mid-December tended to grow more than those planted 6 or 12 weeks later (McCreary and Tecklin 1993b). In environments with low average annual rainfall and early onsets of spring and summer, these planting dates should be moved up even earlier.

Because both blue and valley oaks are able to grow roots during winter, early planting allows them to develop well-established root systems while the soil is still moist. In the Mediterranean climate of California, having such a root system is critical because there might be little or no rain for nearly 6 months, and the soil, especially near the surface, can become exceedingly dry. Seedlings planted late in the season may simply not have sufficient time to develop an adequate root system before soil conditions preclude further growth. It should be mentioned, however, that we have successfully planted seedlings of the 4-month-old stock type described in **Seedling Production in Containers** (see chapter 3) in March and even April. But, in all instances, the seedlings have been thoroughly watered at time of planting to ensure sufficient soil moisture for initial root growth.

How to Plant Seedlings

There are standard procedures for planting conifer seedlings (Schubert, Adams, and Richey 1975), and these apply to oaks as well. First, the seedlings should be maintained properly prior to planting, so that they are not injured. Seedling roots are particularly vulnerable and should not be allowed to dry out, heat up, or freeze, and care should be taken to make sure seedlings are not physically damaged by rough handling. It is also important to plant seedlings at the proper depth so that the ground line at planting is roughly similar to the seedling's ground line when it was growing in its container or bareroot nursery bed (fig. 9). The planting hole should be deep enough so that the roots do not turn up ("J-rooting") at the bottom of the hole. Finally, the soil should be suitably moist, not frozen, and any air pockets in the ground adjacent to the roots should be eliminated by gently compacting the soil, or irrigating thoroughly around the seedling immediately after planting.

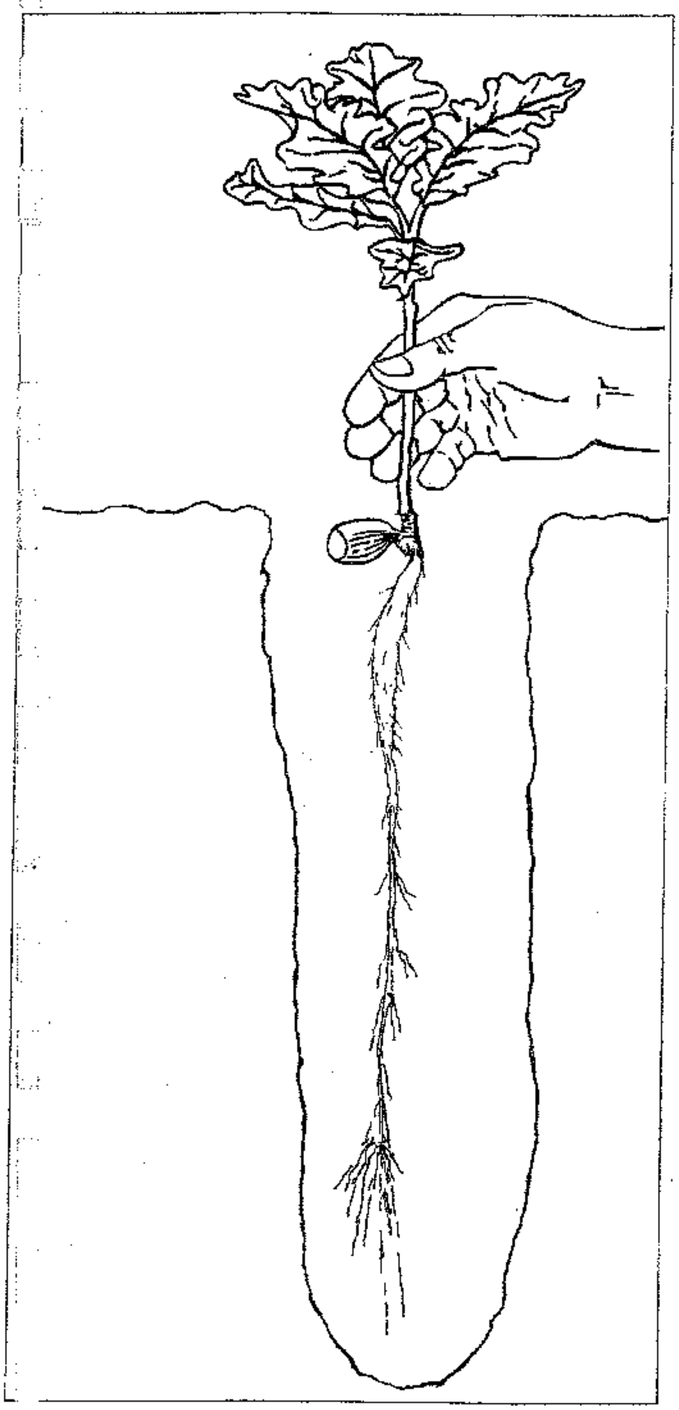


Figure 9. It is important to maintain the same ground line when outplanting oak seedlings.

There are a variety of tools that can be used to make holes prior to planting, including shovels, power augers, tiling spades, hoedads, and clamshell-type post-hole diggers. We have used the latter extensively at the University of California Sierra Foothill Research and Extension Center and have found that holes can be excavated fairly rapidly, as long as the soil is sufficiently moist and the ground is not too rocky or compacted. An additional benefit of post-hole diggers, compared with tools that create a slit in the ground, is that the holes created allow the root to initially have much more of a three dimensional configuration, which can be especially important when planting container seedlings that have a plug of soil and roots. Digging a hole with a post-hole digger also facilitates placement of fertilizer at the appropriate depth.

Auger Planting

Many of the hardwood rangelands in California have been grazed continuously for the past two centuries, compacting the soil in many locations. There are also areas underlaid with natural hard pack. Hard, compacted sites can make it difficult for oak roots, especially those of shallow-planted acorns, to penetrate downward. Augering planting spots (fig. 10) can greatly reduce the bulk density of the soil and make it much easier for the oak roots to grow downward. At SFREC, we evaluated three depths of augering (1, 2, and 3 ft [30, 60, and 90 cm]) and found that, compared to unaugered controls, all three depths improved the growth of surviving blue oak seedlings planted from acorns (McCreary 1995). However, we also found that the 3-foot augering had a negative side effect. In spite of efforts to compact the soil that we placed back in the holes for these deep-augered holes, the holes tended to subside several inches after the first heavy rains. In several instances, this caused acorns to become exposed, resulting in higher acorn depredation, probably from mice. As a consequence, overall mortality for this treatment was higher.

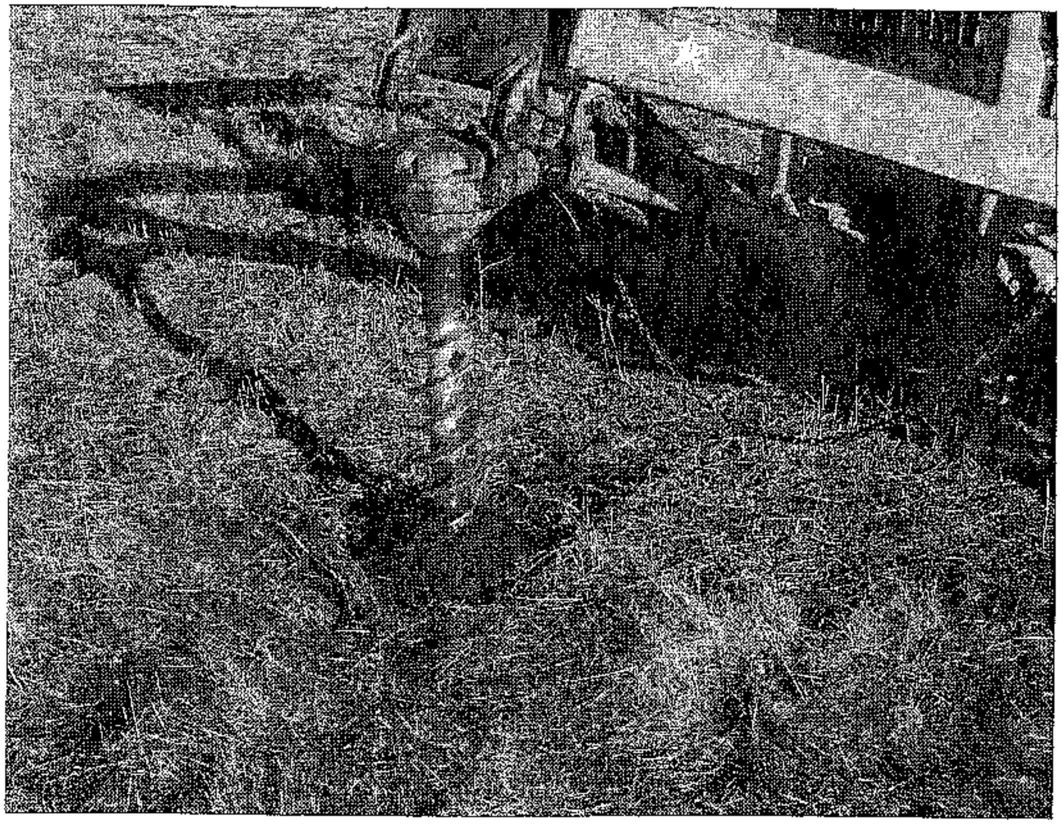


Figure 10. Tractor-mounted augers can be used to break through compacted soil.

We could also detect little difference between the three augering depths tested. We attributed this to the fact that most of the compaction was in the upper foot of the soil, and as long as this area was broken up, the oak roots had little trouble growing deeper. We therefore recommend either augering compacted soils prior to planting or excavating holes with a shovel or post-hole digger, but only to the depth required to penetrate the bottom of the compacted layer. It is important to auger well in advance of planting either acorns or seedlings so that the soil can settle thoroughly with natural rainfall. Finally, in wet, heavy soils, augering can result in a slick, smooth surface on the inside of the hole created. This can make it difficult for the oak roots to penetrate, and even slow water percolation so that the holes act like a pot. If holes become glazed from augering, use a shovel or tiling spade to rough up the sides of the hole before planting.

Selecting Microsites for Planting

Many areas targeted for oak regeneration contain a range of possible planting locations, or microsites, for individual seedlings. Even over short geographical distances, conditions at these planting sites can vary greatly. Some may be adjacent to rocks, logs, or stumps that provide natural protection and reduce direct solar radiation. Others may be close to gullies, swales, or even springs where soil moisture is greater. Still others may be far from obvious animal populations, as evidenced by gopher mounds or ground squirrel tunnels that can pose a threat to seedlings planted nearby. Finally, there is some evidence that certain shrubs may act as nurse plants for blue and valley oaks and promote establishment of seedlings planted near them (Callaway 1992). Because resources for plant restoration projects are generally limited, and it is too expensive to plant everywhere, it makes sense to choose microsites where seedlings will have the best chance to survive and grow. These may be difficult to determine, but insight can often be gained by looking at nearby areas where oaks are present and observing patterns where trees have become established naturally. In oak woodlands, south-facing, exposed ridges are generally less likely to have oaks than are north-facing slopes or drainages because soil conditions are much drier on southern aspects. And in grazed areas, oaks that have survived can often be found in locations that present some natural barrier to livestock and deer, such as rock outcrops. Mimicking such patterns in artificial regeneration efforts and choosing sites that afford some natural protection or better environmental conditions can often enhance success rates.

Planting Patterns

The number of acorns or seedlings to plant in a given area depends on how many oak trees are desired to grow there, as well as on attrition. Unfortunately, it is difficult to predict how many trees will be produced from plantings because a host of factors, including weather, animals, and competing vegetation, can influence survival. But following the steps described below on weed and animal control will help minimize mortality. Using these methods, it is not unreasonable to expect 70 to 80 percent, or higher, survival in many locales after the first 2 years.

The growth rates of seedlings also vary depending on species, site, and intensity of management. To predict the canopy cover after a given number of years, all of these factors need to be considered. A model of blue oak growth based upon the initial 10-year growth of a planting in 1987 (McCreary 1991) and stand structure models for this species developed by Standiford (1997) found that, under a high level of management (weed control for 3 years, protection from animals, fertilization), the canopy cover after 30 years would be 29 percent with 400 seedlings planted per acre (988/ha). With less intensive management (1 year of weed control, no protection), canopy cover over the same interval would be expected to be approximately 13 percent.

When planting, consider spacing seedlings or acorns in a naturalistic manner rather than in straight rows, using surrounding stands of oaks as a model. Also consider planting in small clumps or clusters, with some open areas between the clumps. Planting trees in clusters rather than with relatively uniform spacing can break up the landscape and provide more horizontal diversity of vegetation, which may benefit a wider range of wildlife.

Recommended Procedures for Planting Rangeland Oaks

- Plant oak seedlings early in the growing season, soon after the first fall rains have saturated the soil; do not plant after early March unless irrigation is planned.
- Make sure seedlings are not frozen, allowed to dry out, or physically damaged before, during, or after planting.
- Plant seedlings at proper depth, making sure they are not J-rooted, and eliminate air pockets in soil adjacent to seedling roots.
- In hard, compacted soils, break up soil (using a shovel, auger, or post-hole digger) through the compacted zone prior to planting to promote deeper rooting. If planting holes are augered, make sure the sides of the holes are not glazed.
- Select microsites for planting that afford some natural protection and provide the most favorable growing conditions.
- Plant in a natural pattern, avoiding straight, evenly spaced rows.

Weed Competition

How Weeds Impact Oak Seedlings

Competition for Soil Moisture. The primary effect of competing vegetation on both planted and natural oak seedlings is a reduction in soil moisture available for uptake. In the Mediterranean climate of California, where there is often little precipitation from April to October, a lack of moisture in the soil can limit growth and affect survival. Because all plants growing in an area compete for the same limited amount of water, more competition means less moisture available for oak seedlings (fig. 11). Eliminating this competition by the methods described in this section means greater access to moisture and a greater chance for growth and survival for oak seedlings.

Drought Resistance. Oak seedlings in California have evolved a number of mechanisms to deal with limited moisture in the dry part of the year (Rundel 1980). Germinating acorns tend to produce large and deep root systems before they start to grow a shoot. As mentioned above, this growth pattern allows oak seedlings to reach deeper soil where more moisture is available longer. In a 1986 report, Matsuda and McBride found that during the first growing season, 73 percent of the dry weight of blue oak was allocated to belowground material. They also found that California oaks showed much greater root elongation and smaller leaf area to root weight ratios than Japanese oak species. Their conclusion was that the extensive root systems and small leaf areas of California oaks help seedlings survive under dry conditions (1989b). Momen et al. (1994) evaluated the water relations of planted and natural blue oak seedlings and concluded that they also "resist drought by osmotic adjustment, particularly when seedling water stress progresses slowly because of lack of severe, belowground competition from grasses." Under extremely harsh conditions, oak seedlings can also grow very slowly. Phillips et al. (1997) found that more than 10 percent of blue oak seedlings less than 1 foot (31 cm) tall in portions

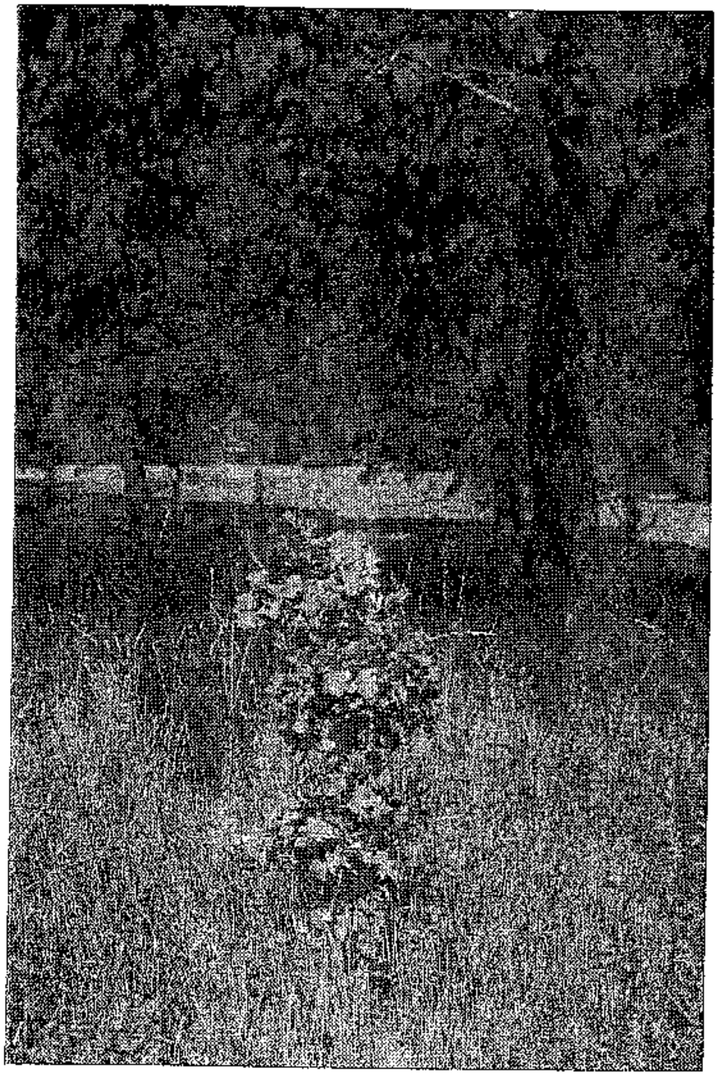


Figure 11. Natural, or volunteer, oak seedlings often face severe competition from dense annual plants.

Figure 12. Oak seedlings typically grow a deep taproot with relatively little lateral root branching.

of the southern Sierra Nevada Foothills were more than 25 years old, even though there was no evidence of browsing.

Taproots. Most oaks initially produce a primary taproot and relatively little side branching (fig. 12). But do nursery production systems that prune this initial taproot, and, therefore, prevent normal root development, predispose seedlings to slow growth or even death after outplanting? We have tried to answer this question by observing roots of both planted and natural, or "volunteer," oak seedlings, as well by monitoring the root growth of acorns planted in root observation boxes. Our experience suggests that the initial taproot configuration may not last long in nature and is probably not critical for regeneration success. Roots growing downward in soil may encounter rocks or other impenetrable objects. Soil microorganisms can also attack the root tips. The result is the development of several taproots at the point of injury or obstruction. These multiple roots continue growing downward and appear to function similarly to single taproots. In one study, we planted pregerminated, blue oak acorns that had intact radicles (and were, therefore, presumably predisposed to a single taproot configuration) alongside acorns that had radicles severed at approximately ½ inch (1 cm) to promote the development of multiple taproots. While this treatment clearly affected root morphology, we could detect no subsequent effect on field growth or survival (McCreary 1996). Koukoura and Menke (1994) found that pinching the roots of blue oak seedlings resulted in faster root growth but did not affect total root length and dry mass.

Competition for Nutrients and Light. In addition to vying for a limited amount of soil moisture, forbs and grasses also compete with oak seedlings for nutrients and light. Although these factors are generally not as important as moisture competition, in certain instances, such competition can severely impact oak seedlings. For example, regardless of moisture availability, small oak seedlings growing in dense competition with forbs and grasses may simply not receive sufficient light for growth.

Recommended Weed Control Procedures

- Select method of weed control (herbicides, physical weed removal, or mulching) based on environmental, fiscal, and philosophical considerations.
- Maintain a weed-free circle that is 4 feet (1.2 m) in diameter around individual seedlings or acorns for at least 2 to 3 years after planting; if using herbicides to control weeds, remove weeds in circle with a diameter of 6 feet (1.8 m).
- Initiate annual weed control by early spring to ensure that weeds do not become established and deplete soil moisture before oak roots can penetrate downward.
- Visit planting sites at least twice annually to remove both early- and late-season weeds and weeds that may have grown through mulch.
- If using postemergent herbicides, make sure that chemicals do not come in contact with foliage or the expanding buds of seedlings.
- After weed control is discontinued, visit plantings regularly to make sure vole populations and damage to seedlings have not increased. If increases are observed, remove thatch.

Secondary Effects of Weeds

In addition to their primary competitive impacts, the undesirable dense growth of annual grasses and other exotics we call *weeds* can also have significant effects on oak seedlings by providing a favorable habitat for animals that can damage them. For instance, large amounts of dead annual grasses, or thatch, can provide an ideal habitat for voles or meadow mice (*Microtus californicus*). The fecundity of these animals is high, and populations can increase dramatically when weeds are neither grazed nor artificially controlled. The result can be serious damage to oak seedlings. At the University of California Sierra Foothill Research and Extension Center, we have observed oak saplings that are 8 feet (2.4 m) tall and girdled half way up the stem when weed control was discontinued and thatch levels rose, providing ideal vole habitat (see **Length of Time for Weed Control**, below). Removing weeds even in relatively small areas around seedlings can greatly reduce vole damage (Davies and Pepper 1989; Tecklin and McCreary 1993).

Grasshopper herbivory is also affected by the amount of herbaceous vegetation in proximity to seedlings. We have successfully reduced grasshopper damage to blue and valley oaks by spraying herbicides and mowing grassy areas inside planting zones, thus reducing late-season green weeds that are attractive for grasshoppers. This usually requires treatment of the entire planting area (as well as a perimeter), rather than treating small areas around individual seedlings since grasshoppers can readily fly short distances from treated to untreated areas.

Weed Control

As indicated above, controlling weeds around planted acorns or seedlings is essential because direct weed competition and the habitat created by weeds can make it very difficult for oak seedlings to survive and grow. Studies have repeatedly shown that weed control can greatly enhance the field performance of blue and valley oaks (Adams et al. 1992; Adams, Sands, and McHenry 1997; McCreary and Tecklin 1997). There are a variety of methods that can be used to eradicate weeds. The actual procedure or technique chosen may depend on many variables, including equipment or materials available, oak species planted (deciduous or evergreen), and even a grower's philosophical orientation. For instance, some people prefer not to use herbicides of any sort because of concerns about health and environmental contamination. Whichever methods are chosen, weed control greatly improves the chances for the success of oak plantings.

Herbicides. These are generally the cheapest, easiest, and most effective method of eliminating weeds. While herbicides are routinely used in California around oak seedlings, there have been no large-scale trials to determine which chemicals are most effective for which weed species and soil types and which cause the least injury to nontarget plants. The most common chemical currently used is probably glyphosate. This is a broad-spectrum, postemergent herbicide that kills grasses and forbs. It is considered to be safer than many herbicides and carries a "caution" rating on the label, meaning that it is an unrestricted chemical. It breaks down rapidly and has no residual activity in the soil. It should not be sprayed on the foliage of oak leaves, however, especially the new growth and initial shoots emerging from planted acorns, because glyphosate might seriously damage or kill seedlings.

We have sprayed glyphosate directly over the tops of deciduous oaks in the winter when they have no leaves, but, even in this situation, a small percentage of seedlings demonstrated signs of herbicide injury. Seedlings appear to be more vulnerable to this type of damage when buds are swelling in the early spring. Even when seedlings are dormant, it is safest to avoid chemical contact with twigs or buds. For very small seedlings, individual plants can be covered with anything from paper cups to 1-gallon or larger containers. Alternatively, spray can be applied directionally away from plants, but it is important that the air be still so there is little chance of drift onto the seedlings. It is also possible to protect small- to medium-sized seedlings by placing a section of stovepipe over them (fig. 13) while spraying, being careful not to allow any drift to enter the open top. Pieces of cardboard or a similar shield can also be used to protect one side of a plant, rotating the cardboard around to the opposite side when spraying weeds on that side, as long as the side that has had contact with the herbicide does not touch the seedlings.

Spraying glyphosate early in the spring is advantageous from a soil moisture point of view because killing competing plants when they are small and have not yet seriously depleted soil moisture means that there will be more water available for the oak seedlings. However, one problem with foliage-active (as opposed to soil-active or pre-emergent) herbicides, such as glyphosate, is that they only affect the plants that are present when the chemical is applied. On California rangelands, there are many annual plants, mainly from the family Asteraceae, such as yellow starthistle *(Centaurea solstitialis)*, that usually germinate quite late in the season and are not present during early-season applications. As a result, there can be a whole new contingent of plants competing with oak seedlings by late spring. If left untreated, these plants can create serious competition problems. We, therefore, recommend an additional weed treatment in May to eliminate these late-germinating plants.

Physical Weed Removal. Several years ago, we initiated an experiment to compare various sizes of weed-free areas around young blue oak seedlings (McCreary and Tecklin 1997). Weed removal was provided by using a hoe to scrape the surface vegetation, leaving only bare soil (fig. 14). This treatment was applied in early spring and not only removed weeds that were currently growing, but greatly reduced the seed bank in the upper inch or so of soil. This essentially eliminated competition in the early part of the growing season. Unfortunately, later in the spring, numerous weeds returned and a repeat scalping was necessary to keep the areas bare. All scalping treatments resulted in significantly better field performance than the control, and the larger the weed-free circles, the greater the subsequent seedling growth. However, it was extremely difficult and time consuming to scalp a 6-foot (1.8-m) diameter circle around each seedling. Scalping also becomes even more difficult in rocky or dry soil. Therefore, we can only recommend scalping when it is done on a small scale.

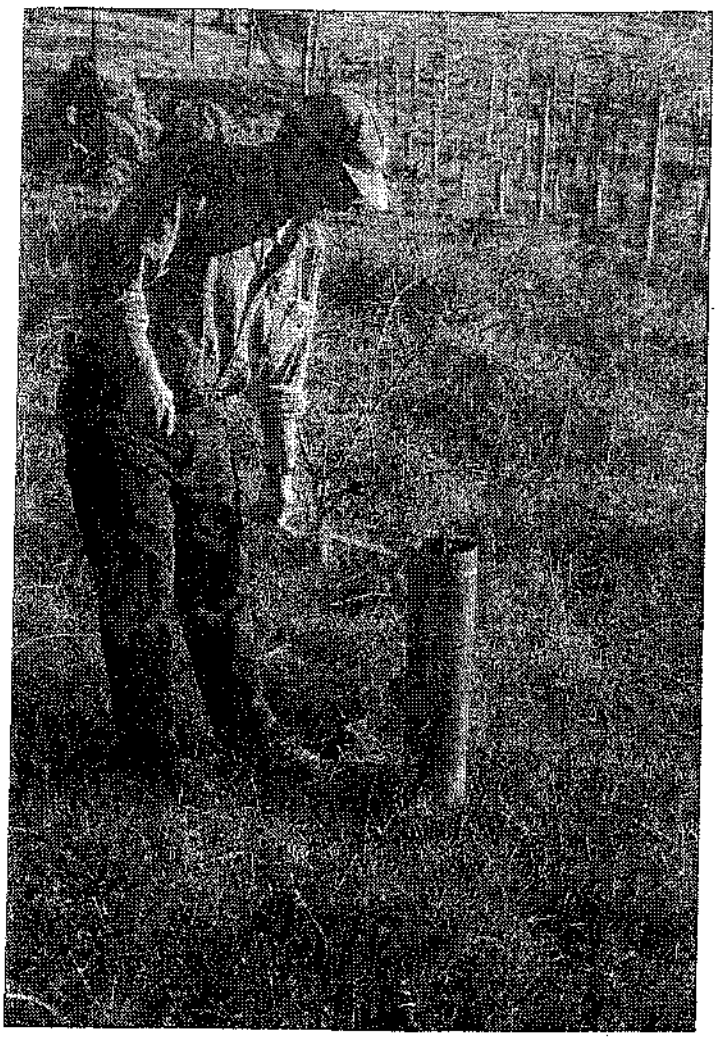


Figure 13. A stovepipe can be placed over oak seedlings to protect them while spraying weeds with postemergent herbicides.

We have also eliminated weeds around oaks late in the season using lawn mowers and weed-eaters. These treatments are not generally recommended because they only remove the top of the plants without killing them. If done early in the growing season, the plants will grow back rapidly and this treatment has little effect. It may even cause an increase in soil moisture loss as vigorous new growth following mowing, especially of grasses, can increase water use (Williamson 1992). However, if mowing is done in early or mid summer when most annuals have stopped growing and have turned brown, it can improve access and remove some of the habitat favorable to damaging animals, such as voles. In these conditions, the plants are not competing seriously with oak seedlings (except, perhaps, for light), but they are still providing habitat. Cutting weeds back may, therefore, reduce the potential for future animal damage. Cultivation is another technique for eliminating weeds but generally requires large equipment and multiple applications.

Figure 14. A hoe was used to remove ground vegetation from around this planted seedling, resulting in better field performance.

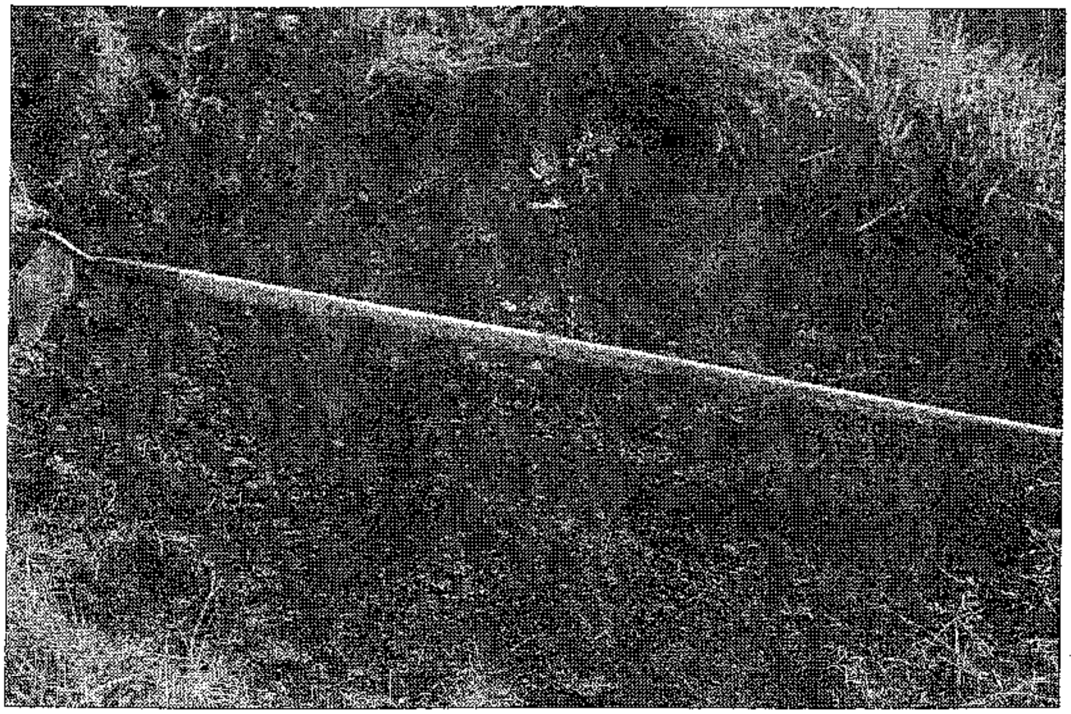
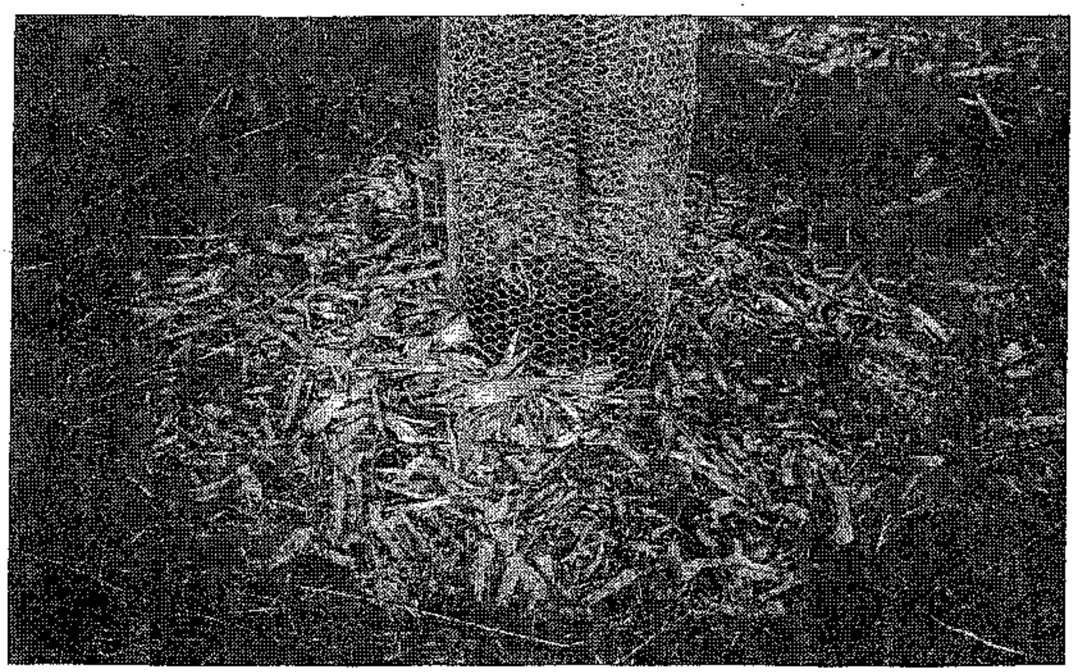


Figure 15. Organic mulches, such as bark chips, can effectively suppress weeds and reduce surface evaporation.



Mulches. There are a variety of organic and inorganic materials that can be used as mulches around young oaks. All of these materials tend to suppress weeds by physically covering them, thereby eliminating the light necessary for photosynthesis and growth. Organic materials include straw, wood chips, and compost (fig. 15). Plastic products are also commonly used, including those that are opaque but porous, allowing moisture to pass through but keeping light out. Mulches also conserve soil moisture by reducing evaporation from the soil surface, resulting in more moisture for the oak seedlings. Organic mulches can, over the long term, improve soil structure. As mulching materials break down and are incorporated into the soil, they tend to reduce soil bulk density, increase percolation, and improve the nutritional status of the soil.

It may be difficult to effectively suppress dense weeds that are already on-site using mulch alone unless the weeds are dealt with first. In these instances, it is often necessary to physically remove weeds before mulching, or to spray herbicides before putting the mulch in place, which reduces the likelihood that weeds will subsequently grow up through the mulch.

A study evaluating a variety of mulches, including black plastic, paper, and hay, on four oak species in the southern United States found that all of these materials positively affected growth for all species studied (Adams 1997). Adams, Sands, and McHenry (1997) compared impervious and porous plastic mulches on outplanted blue oak seedlings at the University of California's Hopland and Sierra Research and Extension Centers and found that both types of mulches significantly improved performance. Bernhardt and Swiecki (1991) also evaluated both organic mulch and polypropylene landscape fabric on valley oak plantings and found that both significantly increased growth. Circuit Rider Productions recommends installing a 3-foot-by-3-foot (91-by-91-cm) square of woven polypropylene fabric, secured with 6-inch (15-cm), heavy-gauge wire staples, around plantings to lessen competition for moisture and nutrients (Bush and Thompson 1990).

A problem with all mulches is that they do not last forever. Plastics tend to become brittle and photodegrade, while organic materials gradually decompose. Over time, weeds tend to grow through holes in the plastic or through shallow places in the organic mulch. For maximum benefit, these weeds should be regularly removed. In general, mulches are more expensive than herbicides and often require considerable upkeep and maintenance. As such, they are probably best suited for small plantings that can be managed intensively.

Area of Treatment. We have found that from a practical standpoint, circles with diameters of 4 feet (1.2 m) around individual seedlings are a good compromise between ease of application and effectiveness. While we found that even larger circles (6 ft [1.8 m]) promoted slightly greater growth (McCreary and Tecklin 1997), larger weed-free areas are considerably more difficult and expensive to provide (except with herbicides) and do not appear to be worth the extra effort and expense.

Length of Time for Weed Control. Determining when seedlings are fully established and need no further protection or maintenance involves site-specific judgments. It is, therefore, difficult to make generalizations about how long areas around oak plantings should be kept weed-free. This depends on the severity of the competition, the environmental conditions at the site, the growth rate of the seedlings, and the potential for animal damage once the weed control ceases. While we generally recommend a minimum of 2 to 3 years of weed control after planting, in some cases this may not be long enough. Although this interval may be adequate from a soil-moisture standpoint, it may not be adequate from an animal-damage standpoint unless other steps are taken to protect oak seedlings from animal damage (see **Treeshelters**, below).

Animal Damage and Control

Those involved in oak restoration projects know that there are many animals that eat or otherwise damage acorns and small oak seedlings. Damage from animals is not limited to artificially generated seedlings. An examination of natural seedlings often reveals shoot browsing, bark stripping, defoliation, and root clipping. Sometimes it seems remarkable that any oak seedlings are able to survive given the overabundance of damaging factors they must contend with in order to grow into trees.

Animals That Damage Acorns and Seedlings

Livestock. Both sheep and cattle browse young oak seedlings. In addition, both animals eagerly seek out acorns on the ground. The severity of browsing damage to young oak seedlings is related to the intensity of grazing (fig. 16). In pastures that are used rarely and for relatively short intervals, some oak seedlings may escape damage, especially if there is an abundance of other plants to eat. In intensively grazed pastures, unprotected oak seedlings have little chance of escaping injury. Repeated browsing can keep plants stunted for years, even decades (fig. 17).

Figure 16. Cattle often graze in oak woodlands and can inhibit both natural and artificial regeneration.

Figure 17. Oak seedlings can be stunted from the repeated browsing of deer and cattle.

In addition to browsing young oaks and eating acorns, large-hoofed animals, such as cattle, can also cause damage to small oaks by trampling them. Hall et al. (1992) found that, in confined pastures, trampling damage from cattle accounted for nearly 15 percent of total damage to blue oak seedlings. This same study also evaluated the extent of damage to planted oak seedlings at different times of the year. Not surprisingly, browsing damage was greatest for deciduous blue oaks in the spring and summer when the plants were fully leafed out and other green vegetation was scarce, and was least in the winter when seedlings were bare. The timing and intensity of grazing can, therefore, influence the extent of damage to unprotected oaks in grazed pastures.

Deer. A common species of deer on hardwood rangelands in California is mule deer *(Odocoileus hemionus Californicus).* The extent of their herbivory on both natural and planted oak seedlings varies greatly by site. In areas where deer are migratory and only pass through briefly at certain times of the year, damage will likely be minor. While annoying, such damage may be acceptable and not require protection. Such is the case at the University of California Sierra Foothill Research and Extension Center, where oak shoots are occasionally clipped off. However, in areas with resident deer herds, damage can be far greater (fig. 18). At the University of California Hopland Research and Extension Center in Mendocino County, deer browsing from a resident population precludes any successful attempt at artificially regenerating oaks without effective protection from these animals. Even oak stump sprouts there are clipped back to the trunk soon after they emerge.

In certain areas, repeated browsing can create bush-like plants that survive for decades. Griffin (1971) reported that it can take more than 20 years in a favorable habitat for coast live oak seedlings to grow above the reach of deer. At the Hastings Reserve in Carmel, White (1966) reported that only 12 percent of 154 oak seedlings were unbrowsed by deer and concluded that deer may be an important factor limiting seedling establishment (fig.19).

Rodents. Several rodents can seriously hamper oak restoration efforts. In a study evaluating various factors affecting survivorship of blue oak, Davis et al. (1991) stated that rodents were the most important predators of both acorns and seedlings. In blue and valley oak plantings at SFREC, the animals that have been the most troublesome are meadow mice, or voles (Tecklin and McCreary 1993), which thrive there in a dense cover of ground vegetation (fig. 20).

Acorns can also constitute a sizable portion of the diet of western gray *(Scirius griseus)* and California ground squirrels at certain times of the year (McDonald 1990), and these animals can destroy unprotected acorn plantings. Adams et al. (1987) reported that more than 5,000 blue and valley oak acorns were dug up at a planting in Madera County, presumably by ground squirrels. Deer mice (*Peromyscus* spp.) also eat acorns that are exposed or planted very shallow.

Pocket gophers *(Thomomys bottae)* constitute a serious pest in many oak plantings because they clip roots below the soil surface. In a study at the Hastings Reserve in Carmel in the early 1970s, Griffin (1971) noted that pocket gophers ate about 250

Figure 18. Many deer live among California's oaks, feeding on seedlings and other plants.

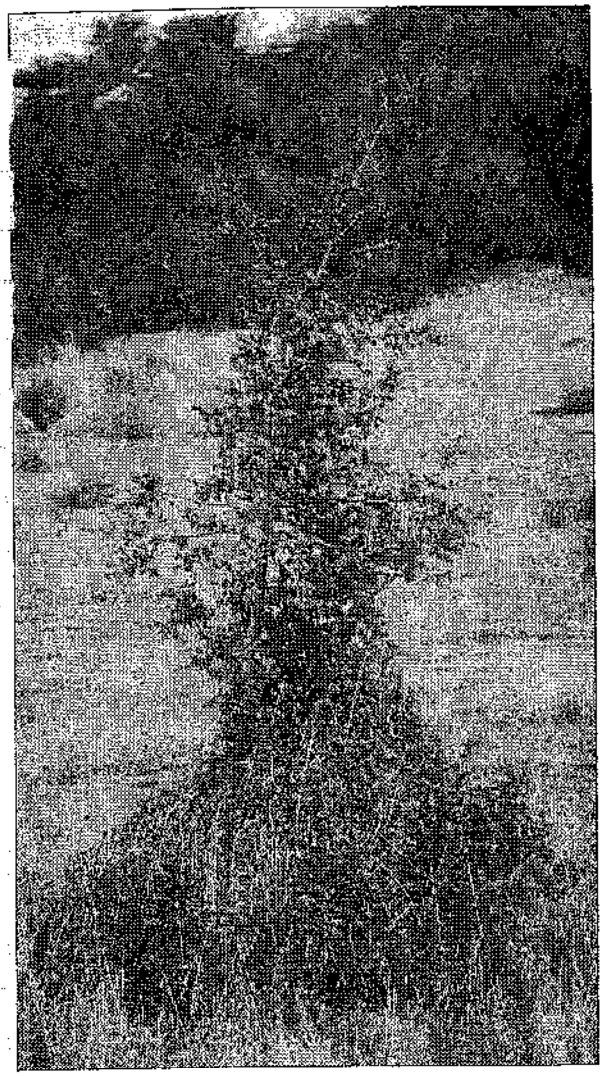


Figure 19. This oak was only able to release and elongate a dominant leader when the oak bush became so large that deer could no longer reach in and clip off shoots near the center.

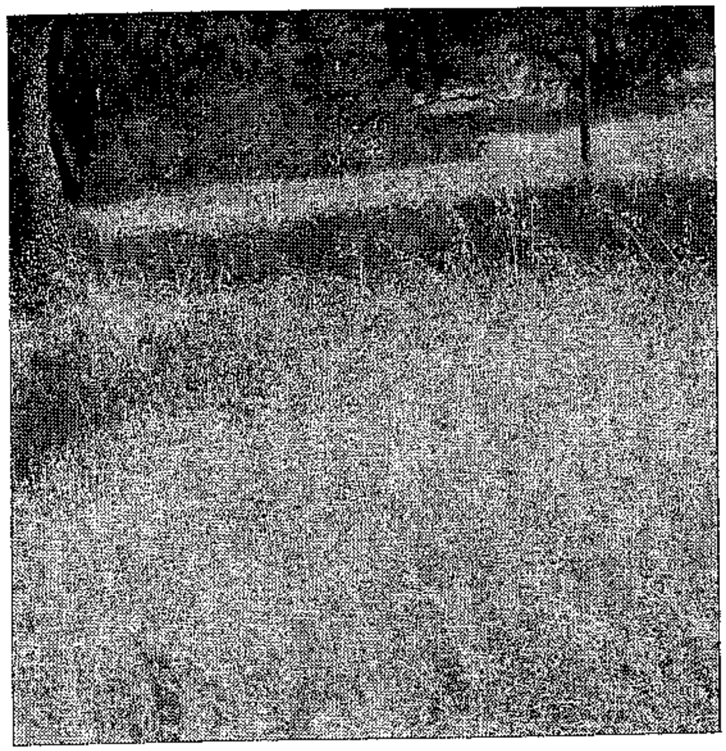


Figure 20. This dense patch of dead grass and forbs, or thatch, is ideal vole habitat.

one-year-old seedlings in a woodland plot. Damage is not limited to newly planted seedlings, as gophers can kill oaks several years old, and also eat acorns (Griffin 1976). Gopher populations vary greatly by area and, in some locations, gophers are not a major concern. Where they are a problem, modifying the habitat can reduce populations and damage. However, this generally means treating entire areas and removing most or all of the surface vegetation. Gophers can also be effectively controlled by baiting with poisoned grain (see **Repellents and Baits,** below).

Insects. The primary insect damaging oak plantings at the University of California Sierra Foothill Research and Extension Center is the grasshopper, and in particular the species *Melanoplus devastator* (McCreary and Tecklin 1994a). As with many pests, populations fluctuate greatly from year to year, as well as over relatively short geographical distances. Even within the SFREC, we have observed large differences in the number of grasshoppers present within just a few hundred yards. Most commonly, populations seem to peak in late July and August. The cycle begins as eggs laid the previous fall hatch in the spring. Heavy rainfall years tend to promote the development and survival of large numbers because grasshoppers thrive in the abundant grass present in uncultivated areas. During years when populations are high, a single oak seedling can be covered with dozens of grasshoppers (fig. 21). During such outbreaks, almost all of the foliage on every unprotected seedling can be consumed. After the foliage is gone, the bark on seedlings is often stripped, and, in some cases, the seedling is completely girdled, killing the top. There are several other foliage-eating insects that also occasionally damage seedlings, but the injury is generally localized and not extensive.

The most common insect pests of California oak acorns are the filbert worm (*Melissopus latiferreanus*) and filbert weevils (*Curculio* spp.). The adults of the filbert worm lay their eggs on the surface of immature acorns, and, when the larvae hatch, they bore into the acorns.

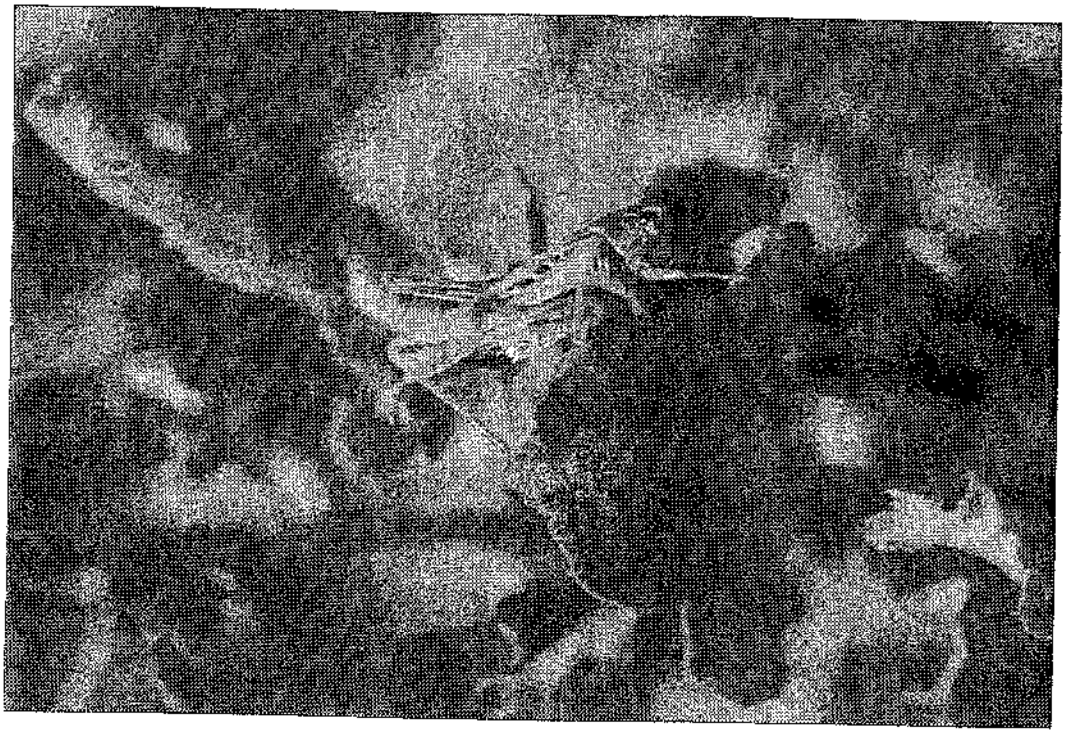


Figure 21. Grasshopper populations can explode during favorable conditions, and large numbers feed directly on oak seedlings.

Adult filbert weevils penetrate the acorn skin or pericarp with their ovipositor and lay their eggs inside the acorns. As the larvae of both species grow, they feed on the cotyledons. Generally, the eggs are laid near the acorn cap and away from the pointed end of the acorn where the embryo is located. The larvae often emerge from the acorns during storage and accumulate in the bottom of bags or containers. Where there are multiple larvae in a single acorn, damage can be extensive. Griffin (1980) reported that over an 8-year period 21 percent of the valley acorns that dropped into collection traps were clearly nonviable due to insect damage, mainly from filbert weevils. However, even when much of the cotyledon is consumed, as long as the embryo is intact, the acorn can still germinate although there is less stored food available for initial root growth. The mature larvae usually chew their way through the shell of the acorn after the acorns drop to the ground in the fall (Brown and Eads 1965). In addition to the direct damage that larvae cause, their entrance and exit holes can also provide a site of entry for other pathogens that affect acorns (Swiecki, Bernhardt, and Arnold 1991).

A comprehensive listing of diseases and arthropods that affect native California oaks is contained in a host index database called CODA that was developed by Swiecki, Bernhardt, and Arnold (1997). CODA contains information on 45 native and cultivated oak species in California, 1,259 agents that affect these oaks, and 320 references that describe these interactions. It also contains information on 2,619 individual interactions between oaks and biotic or abiotic agents. It can be downloaded for free at http://www.phytosphere.com.

Protecting Rangeland Oaks from Animals

Without protection from animals, oak plantings often stand little chance of survival. However, the type of protection necessary depends on the type of damaging animals present. In some situations, large herbivores may be the primary species of concern, while in others, small insects may be the only threat. Below are descriptions of several general categories of animal protectors that have been used and some discussion about which animal pests they are most effective against.

Fences and Large Cages. It is estimated that over 80 percent of the hardwood rangelands in the state are privately owned (Bolsinger 1988). The primary economic use on many of these lands is livestock grazing. Because both cattle and sheep browse young oaks, it is often necessary to protect plants from them. Fences are obviously used to control livestock access to certain areas and can be built around oak plantings to keep animals out. But fences are not only costly to install and maintain, but if they exclude livestock from large areas, then these areas are removed from livestock production. If deer are a problem, higher and more costly fences are needed. Fences alone have not proven to be effective in promoting natural oak regeneration or in protecting artificial regeneration, except in small research exclosures with thorough weed control. This is because there are usually other animals, such as rodents and insects, that damage young oaks, even if livestock and deer are excluded.

However, in instances where deer and livestock are the only threats, fences may be effective. In these situations, it is important to weigh the costs of installing and maintaining fences against the costs of other types of protection. In England, the costs of fences were compared to the costs of protecting individual seedlings with treeshelters (see **Treeshelters**, below). It was concluded that if 450 trees per acre (1,112/ha) were planted, fences would only be cost-effective if more than 2 acres (0.81 ha) needed to be protected (Vickers 1999). However, this model did not consider the lost revenue from deferred grazing while fences excluded livestock.

Several types of small cages have also been used to keep livestock and deer away from individual oak seedlings or groups of seedlings. The simplest is a square exclosure, approximately 5 feet (1.5 m) per side, with metal fence posts at the corners and field fencing on the perimeter (fig. 22). This will effectively keep out livestock and deer since the protected area is too small to allow deer to jump inside. However, the cost is high, approximately $8 for four new fence posts and more for the field fencing and labor. In time, stock may also push the fencing over in efforts to reach young trees.

Another type of cage using metal posts and field fencing has been described by Bernhardt and Swiecki (1991; 1997) and nicknamed a *vaca* cage (*vaca* is Spanish for *cow*). This is a circular structure approximately 4 feet (1.2 m) tall and 1½ feet (.5 m) in diameter, constructed from galvanized 12-gauge wire fencing with welded 2-by-4-inch (5-by-10-cm) mesh (fig. 23). The cage is secured to the ground with a t post and a 3-foot (.9-m) length of steel reinforcing bar. Materials costs per cage were $8 to $10 in 1997. Vaca cages are effective against deer and cattle although they do require periodic inspection and maintenance. They can be assembled and installed in about 12 minutes.

Screen Cages and the Collar-and-Screen Device. In oak regeneration studies initiated at the University of California Sierra Foothill Research and Extension Center in the late 1980s, seedlings were covered with cages made of aluminum window screen (McCreary 1989). These were constructed by cutting pieces of the screen into squares approximately 18 inches (46 cm) per side. These were then rolled into cylinders, folded closed at the top, and stapled to wooden stakes. The cylinders were placed over seedlings after field planting, and the stake was pounded into the ground (fig. 24).

These screen-cylinder cages cost about $1 each, plus labor, to construct. They were effective in preventing deer browsing, rabbit clipping, and grasshopper damage, but were worthless in pastures grazed by cattle since the animals easily knocked over and trampled them. The screens also presented another problem. As the seedlings grew taller, it was necessary to open them up, again making the tops of the seedlings vulnerable (fig. 25). If opening-up was delayed, the seedling became confined and deformed, a condition they do not soon recover from. In addition, insects and rodents could get underneath the screens if they were not buried or stapled down.

Figure 22. These exclosures, built with metal t posts and field fencing, effectively keep out deer and cattle.

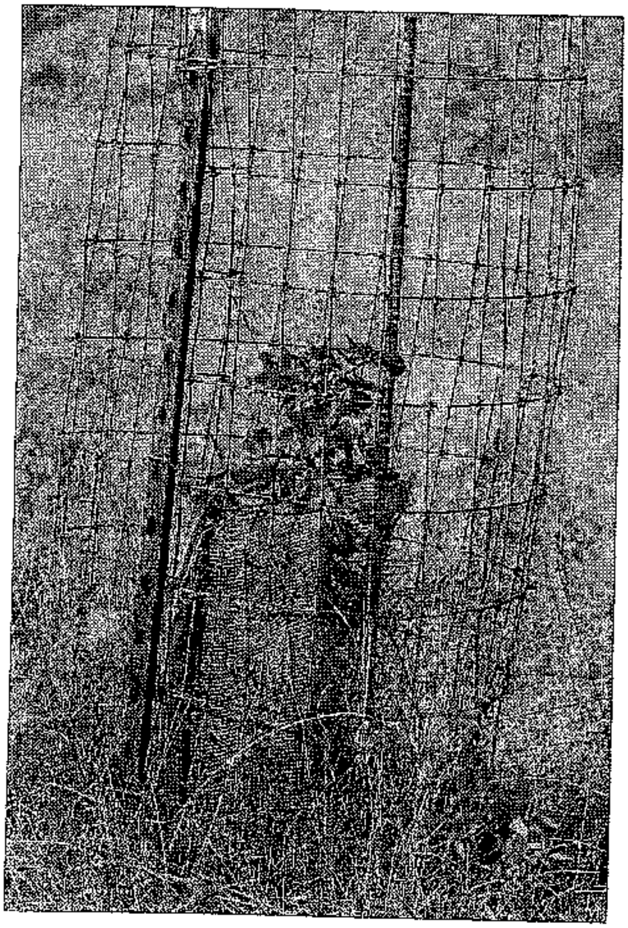


Figure 23. This vaca cage costs approximately $8 to build and consists of a single t post, a 3-foot piece of rebar, and 5 feet of field fencing.

Figure 24. Tubes of aluminum window screen were initially used in oak regeneration trials at the SFREC.

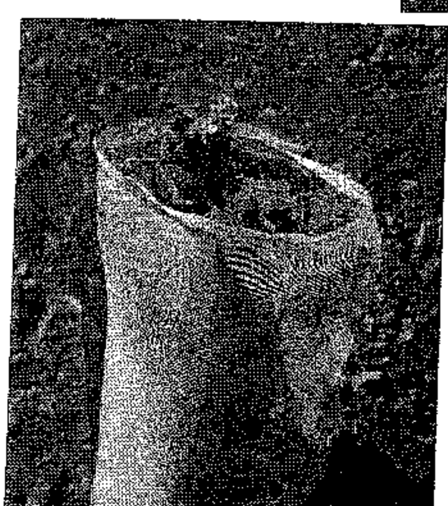


Figure 25. When seedling growth reaches the top of aluminum screen cages, the screen should be opened to allow growth to progress normally.

Animals That Commonly Damage or Kill Rangeland Oak Seedlings and Recommended Seedling Protection

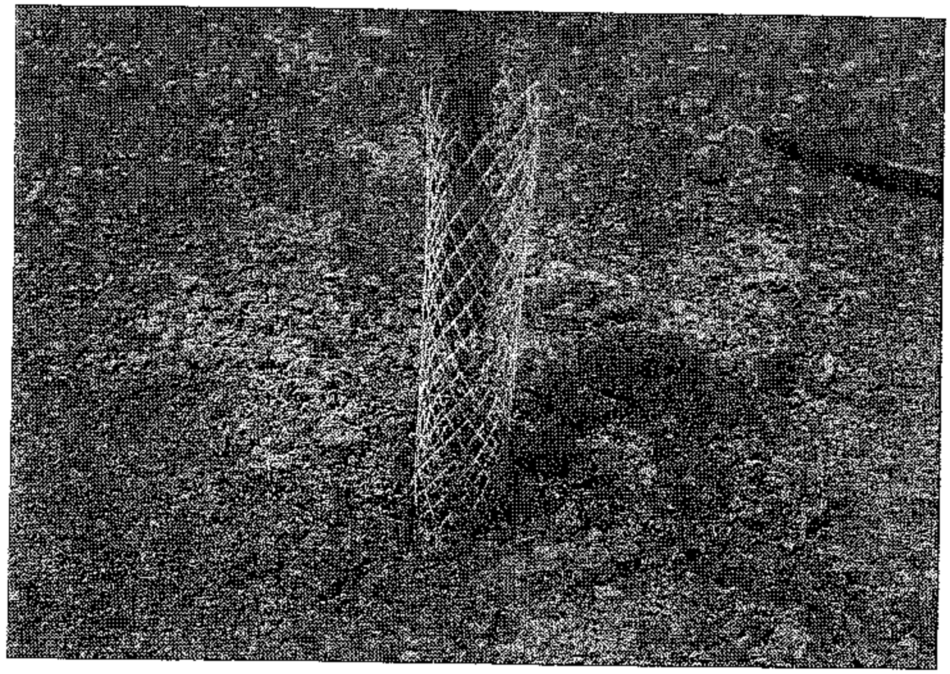
- Livestock, including cattle and sheep, eat oak foliage and consume acorns. In grazed pastures, seedlings must be protected, or they have little chance of growing. Fences can be used to keep livestock out of planting areas, but often other animals still damage plants. Treeshelters (see **Treeshelters**, below) secured to heavy metal posts can protect individual seedlings in moderately grazed areas.
- Deer browse seedlings and consume acorns. Damage is usually greatest when a resident herd is present. Planted areas can be fenced, or individual seedlings can be covered with treeshelters, screen cages, or seedling protection tubes.
- Voles, or meadow mice, strip bark from seedlings and saplings and can girdle and kill oaks. They thrive in dense grass or thatch, and populations can increase explosively. Damage levels can be greatly reduced by keeping the area within 2 feet (.6 m) of oaks free of vegetation.
- Pocket gophers commonly clip roots below the ground and can kill oak seedlings that are several years old. Seedling roots can be protected with hardwire cloth, aluminum window screen, or root guards, but material must degrade or be removed to ensure roots are not damaged as plants grow larger. Damage can be reduced by eliminating ground vegetation. In small areas, gophers can be effectively controlled by baiting.
- Ground squirrels clip seedlings and dig up acorns. High populations are usually evident by extensive mounds, holes, and burrows. Planting near such areas should be avoided.
- Grasshoppers eat foliage, and their damage is usually greatest in midsummer to late summer. Populations can fluctuate greatly from year to year, increasing dramatically during outbreak years. At these times, damage can be reduced by keeping the area where the oaks are planted free of ground vegetation.

A modification of the screen cylinder method developed at the University of California, Davis, and refined by the Pacific Gas and Electric Company and Circuit Rider Productions (Bush and Thompson 1989) is the collar and screen. This consists, first, of a 1-quart (.95-L), plastic, yogurt or cottage cheese container with the bottom cut out. A square of aluminum screen is then wrapped around the plastic container and secured with wire and folded over at the top. The whole device is then placed over the seedling or direct-sown acorn with the plastic container sunk in the ground. This plastic container is believed to afford some protection against gophers (at least for shallow roots) and, if the plants are watered, creates a small, artificial reservoir. As long as plastic containers are available, this device is probably easier to assemble and less expensive than a screen cage.

Seedling Protection Tubes. Several manufacturers make seedling protection tubes from rigid plastic mesh (fig. 26). They can be purchased in lengths from 18 to 36 inches (.5 to .9 m) and are relatively inexpensive, with the 36-inch (.9-m) tubes costing about 28¢ each. They are usually secured to the ground with lath or bamboo stakes. They are not only reasonably effective in protecting against deer damage but also afford protection against rabbits. However, since the mesh is fairly wide, it is very easy for small animals, such as grasshoppers and even voles, to pass through, especially near the ground. As seedling shoots grow through the sides of the mesh (which is very common), the exposed portion is also vulnerable to browsing. Finally, these devices do not offer much protection in pastures grazed by cattle since they are easily uprooted or knocked over. Solid tubes called treeshelters were developed, in part, to overcome this limitation (see **Treeshelters**, below).

Underground Protection. As mentioned above, gophers and ground squirrels can be very troublesome in certain planting locations. In these situations, either the animals must be eliminated or the oak seedlings protected from them. Physical barriers have been successfully used to keep animals away from oak seedling roots. Plumb and Hannah (1991) reported that ¼-inch (6.5-mm) hardwire cloth buried 12 inches (31 cm) in the ground afforded some protection although they were concerned with the cost ($1 per seed spot) and the fact that these devices could restrict root growth as seedlings became larger. Adams and Weitkamp (1992) found that thin tubes of aluminum screening placed in the ground around seedling roots significantly reduced gopher damage. A metal mesh basket called "root guard" comes in several sizes and is designed to protect plant roots from gophers (see appendix B for source information).

Figure 26. This seedling protection tube of rigid, plastic mesh guards seedlings from deer and rabbits but not from grasshoppers or cattle.



Repellents and Baits. Some animals can be eliminated or controlled with poisons or baits. For gophers, probes can be used to place poisoned grain in underground tunnels. For large areas, however, this may not be practical. Also, baited areas must be regularly checked for evidence that gophers may have returned (distinctive C-shaped mounds will be present), and baiting repeated if necessary. Clearly, it is critical that no nontarget animals have access to the bait and that all pesticide labels be carefully adhered to when using any pesticide products.

The movement of grasshoppers into research plots from adjacent grassy areas can also be reduced using poisoned bait. A thin line of bait containing an insecticide can be placed around the perimeter of the oak planting area. The grasshoppers consume the bait as they move toward the plot and die before they reach the seedlings. This treatment has proven moderately effective at the University of California Sierra Foothill Research and Extension Center.

Habitat Modification. As mentioned earlier, animals require specific habitats to live and reproduce. If the habitat is significantly altered such that it is no longer suitable for their needs, the animals will leave or die. This knowledge of habitat requirements and preferences can be used to reduce or eliminate impacts from certain animals. The most effective way we have found to control voles, for instance, is to eliminate grass and forbs from an area. Even eliminating weeds in 4-foot (1.2-m) diameter circles around individual seedlings seems to provide a sufficient barrier that these animals are generally reluctant to cross, presumably because of predatory threats from hawks, owls, and other animals. Removing grasses and forbs in oak planting areas also helps to reduce grasshopper damage and has been used successfully to control pocket gophers in conifer plantations (Engeman et al. 1995).

Treeshelters

Treeshelters are individual, translucent, plastic protectors that fit over seedlings. Most are made from twin-wall polypropylene although some are made from single, flat sheets that are assembled on-site. Treeshelters were initially developed and tested in England 20 years ago (Tuley 1983; 1985). By 1984, over one million treeshelters were commercially manufactured and sold there. Although the number sold in England today is probably less, in 1991 it was estimated that annual production probably exceeds 10 million (Potter). They are reported to not only protect seedlings from a variety of animals but also to stimulate above-ground growth. This growth stimulation seems to result from creating a minigreenhouse inside the shelter, with elevated temperatures, humidity, and carbon dioxide concentrations. The higher relative humidity improves seedling moisture status by reducing transpiration. The treeshelters also help conserve moisture by condensing transpirational water on the tube interior. The condensation then drips back to the soil at the bottom of the shelter. Treeshelters can also make it easier to apply postemergent herbicides without risking contact of the chemical with the seedling's foliage (Potter 1988). Finally, treeshelters can help identify where seedlings are planted, which facilitates subsequent weed control and irrigation treatments; plants are also less likely to be accidentally mown or run over. As a result of these benefits, survival and growth in treeshelters is thought to be better. A large-scale survey of 193 sites in England that were planted with various tree species over the previous 12 years using treeshelters found that 89 percent of the shelters surveyed contained a living tree (Kerr 1995).

Although treeshelters have not been used for as long or as extensively in the United States, they have been evaluated in several oak field trials in California with promising results (Costello, Peters, and Giusti 1996; McCreary 1996; McCreary and Tecklin 1997; Tecklin, Connor, and McCreary 1997). They are effective in preventing animal damage from deer, rabbits, grasshoppers, and voles. When treeshelters are buried a few inches in the ground, they also seem to provide some protection against pocket gophers, though this has not been thoroughly evaluated. Finally, treeshelters show promise for use in pastures grazed by livestock (McCreary 1997; 1999) as long as they are secured to heavy-metal fence posts (fig. 27). But clearly they are not appropriate for all plantings, and, in many cases, it may be more cost-effective to utilize other protective measures.

Methods of Protecting Trees from Animals

- Fences and large cages are effective only if livestock and deer are the only animals of concern. Fences require a large initial investment and result in fenced areas being removed from livestock production. Fences and cages must be maintained regularly.
- Screen cylinders provide adequate short-term protection against insects, rodents, and deer but are ineffective against livestock and must be reopened once seedlings grow to the top, exposing plants.
- Seedling protection tubes are an inexpensive way to protect plants against rabbits and deer, but they are not effective against livestock, insects, or small rodents. Shoots that grow through the sides of tubes are vulnerable to browsing.
- Treeshelters have proven very effective in protecting rangeland oak seedlings from a wide range of animals and stimulating rapid, aboveground growth. They are relatively expensive but can greatly reduce the time required for seedlings to grow to sapling stage.
- Habitat modification can reduce damage from grasshoppers and some rodents, but it is ineffective for larger ranging animals, such as deer. Care must be taken to monitor the regrowth of vegetation or animals will quickly reoccupy site.

Recommended Procedures for Treeshelter Installation

- Select the size of treeshelter based on the browsing height of animals that are a threat.
- Install shelters so that they are upright and secure them to stakes using plastic ratchet clips or wire; make sure that seedlings are not damaged when shelters are secured to posts.
- Where treeshelters are used, plant in an aesthetic, "natural" arrangement rather than in regular, evenly spaced rows.
- Utilize stakes that are durable enough to last the length of time treeshelters will be in place and pound them at least 1 foot (31 cm) into the ground before planting seedlings.
- Make sure that the tops of stakes are lower than the tops of shelters to prevent access by rodents that can climb stakes and damage to seedling shoots from rubbing against stakes.
- To prevent seedling desiccation, install shelters with the base buried in the ground.
- To prevent bird access, install plastic netting over the tops of shelters.
- If treeshelters are placed in pastures grazed by livestock, secure the shelters to metal posts using wire and thread flexible wire through the top instead of using plastic netting.

Treeshelter Design, Construction, and Installation

There are several manufacturers of treeshelters and two main designs. The first design consists of flat sheets that can easily be shipped and transported. Once on site, they are rolled into cylinders or assembled into square boxes and placed over seedlings. The second major type of treeshelter design is made up of cylinders of extruded tubular plastic that need no assembly. The disadvantage of solid, cylindrical treeshelters is that they are bulky and expensive to ship and transport. Consequently, they are usually more expensive. Most types of treeshelters come in a range of heights.

Staking. Shelters more than 1 foot (31 cm) tall require attachment to a stake, usually with nylon ratchet clips, while some short types can be partially buried and are self-supporting. We have found that the nylon ratchet clips are easily broken when cattle rub against shelters and posts, and, therefore, recommend securing shelters to posts with wire in grazed pastures. It is important that the material securing the shelter to the stake not be wrapped directly around the seedling since this could obviously restrict growth and cause damage as seedlings become larger. After shelter installation, the supporting stakes should be several inches below the lip of the shelter to prevent contact with and damage to the emerging tree (fig. 28).

Stakes or posts can be made of a variety of materials, including wood, metal, and fiberglass. The stakes should be durable enough to last the length of time treeshelters are in place, be resistant to warping, offer frictional resistance to any twisting movement around the stake, and be relatively easy to remove (Kerr 1996). We have found that oak stakes provided by manufacturers generally last 5 years, while 1-by-2-inch (2.5-by-5-cm) untreated, pine stakes can rot away below the ground after 1 or 2 years. We have also used 4-foot (1.2-m) pieces of rebar (steel-reinforcing rods) and standard metal fence posts. Both are durable and last far longer than necessary, but they generally require a post-pulling tool to take them out of the ground when the shelters are removed. It has been suggested that seedling roots may grow around the metal flange at the bottom of the fence posts, causing injury to the seedling when the post is removed, but this has not yet been evaluated.

Advantages of Solid-Construction Treeshelters. While solid-construction treeshelters are generally more expensive, they have several advantages over types that require assembly. First, once on site they are relatively easy to place over planting spots. Second, they are inherently more sturdy and, consequently, can more easily be sunk

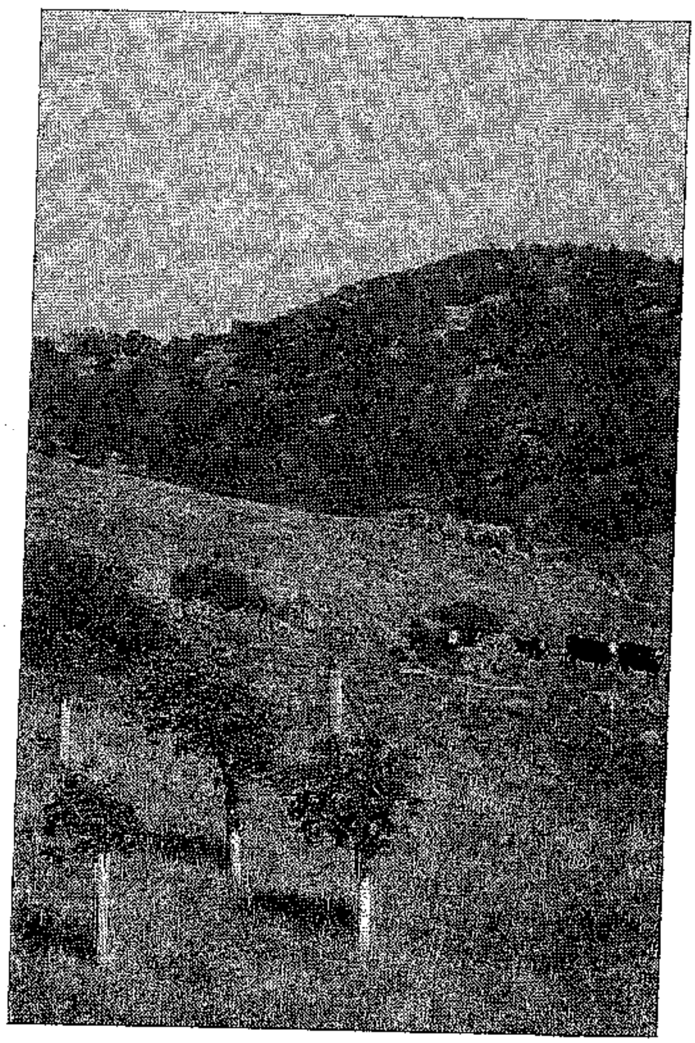


Figure 27. Treeshelters have been used effectively in establishing seedlings in areas grazed by cattle.

Figure 28. The supporting stakes on treeshelters should be several inches below the top of the tube itself.

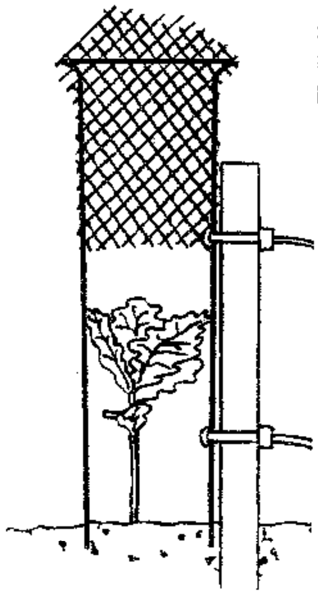


Figure 29. Treeshelters should be installed and maintained in an upright position.

into the ground around the seedlings. This can be important since a gap between the shelter base and the ground can create a "chimney effect," resulting in more desiccating conditions inside the shelter. In the Mediterranean climate of California where moisture stress often limits establishment success, such desiccation can be lethal. Solid shelters are also less likely to be dislodged or damaged by buffeting winds or animals that rub against them. Finally, solid-design treeshelters generally require less maintenance after they are installed, less frequent return visits to make sure they remain attached to the stake, do not have weeds growing inside them, and function properly. For woodland plantings in England, Vickers (1999) estimated that the average cost of maintaining solid-construction treeshelters to original specifications for a planting density of 450 per acre (1,112/ha) would vary between \$50 and \$150 per acre (\$124 and \$372/ha).

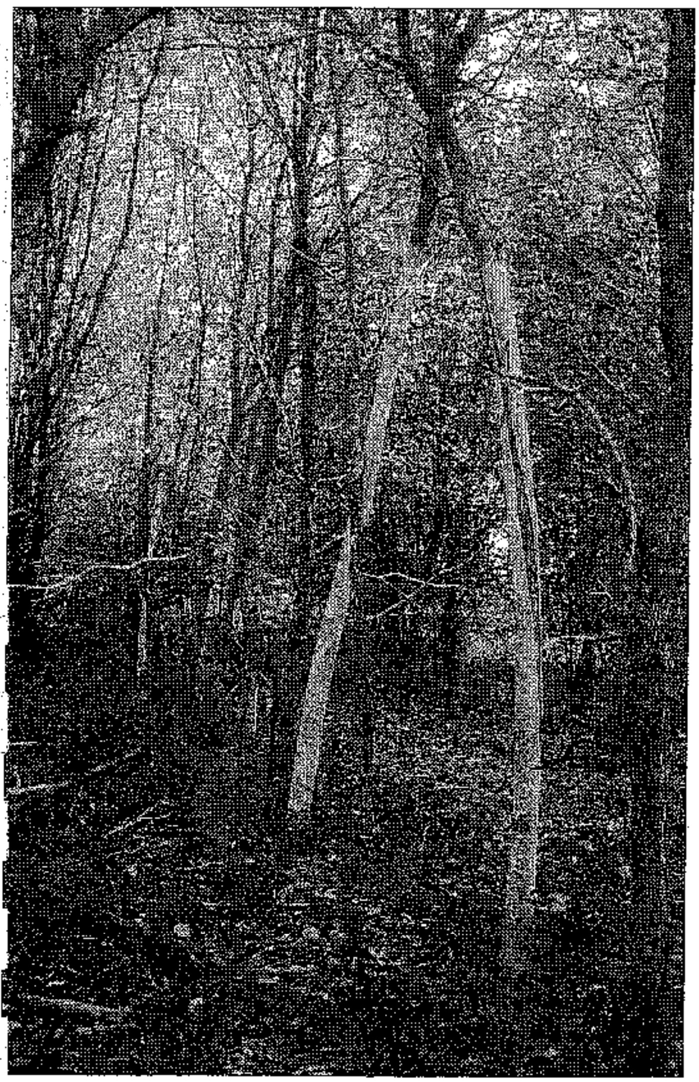


Figure 30. This 13-foot giraffe tube was used to evaluate the effects of very tall treeshelters on oak seedling growth in England.

Colors. In addition to different shapes and sizes, treeshelters also come in several colors, including beige, orange, white, and clear. Beige shelters, which are designed to blend in with surrounding vegetation, are reported to reduce light intensity by approximately 50 percent, while white shelters reduce it by approximately 30 percent (Kjelgren, Montague, and Rupp 1997). In low light situations, such as plantings under canopies, white or clear shelters may, therefore, be preferable. From an aesthetic point of view, white shelters can be unsightly, especially if seedlings are planted in evenly spaced rows, which can give the planting area the appearance of a cemetery. In general, it is recommended that beige shelters be used in open-area plantings, with seedlings planted in irregular patterns, rather than in a systematic grid. Care should be taken to install and maintain shelters in an upright position and to check them and remove weeds that may be growing inside (fig. 29).

Heights. Treeshelters come in a variety of heights, ranging from 8 inches to 6 feet (20.5 cm to 1.8 m). Some trials in England have even used treeshelters that are 13 feet (4 m) tall (Windell 1993) (fig. 30). Not surprisingly, taller shelters are more expensive. Therefore, it is generally advisable to use shelters that are only as tall as necessary to protect against animals that are a threat. For example, if voles are the only concern, shelters that are 1 foot (31 cm) in height should be adequate. For rabbits, shelters that are 2 feet (.6 m) tall can be used. We have found that for deer and cattle at the University of California Sierra Foothill Research and Extension Center, 4-foot

(1.2-m) shelters are tall enough. However, both deer and cattle can clearly reach up and nip seedlings emerging from the tops of 4-foot (1.2-m) shelters, so if browsing pressures are intense (resident deer or confined livestock), it may be necessary to use shelters that are 5 or even 6 feet (1.5 or 1.8 m) tall. It is also important to keep in mind that the effective height of a treeshelter is reduced when used on steep or uneven terrain since browsing animals can stand upslope and more easily reach seedlings. While treeshelters are relatively expensive compared to some other seedling protectors, the cost in the United States has dropped considerably in the last several years. Currently a 4-foot (1.2-m), solid-construction treeshelter, without the stake, costs approximately $3.

In 1995, a treeshelter conference in Pennsylvania surveyed the current state of knowledge on treeshelters used in reforestation and ecological restoration. The proceedings were published by the U. S. Forest Service (Brissette 1996) and are a good reference. Other references include a comprehensive booklet describing the use of treeshelters in Great Britain (Potter 1991) and a general description of the use of treeshelters in the United States and elsewhere (Windell 1992). A large U. S. Forest Service research project has also compared the effectiveness of various treeshelter designs and commercial products (Windell and Haywood 1996).

Trapped Birds. A potential problem associated with treeshelters is that birds can become trapped inside. Western blue birds (*Sialia mexicana*) have been identified as one species prone to this. To reduce the possibility of this happening, some manufacturers provide plastic netting to place over the tops of shelters, creating a physical barrier (albeit fairly flimsy) to entry. Advertisements also state that these nettings prevent the entry of butterflies that can also become trapped. We recommend using these net protectors and have observed them to work reasonably well, as long as they remain in place and are not blown off.

However, where livestock are present, netting is generally not effective. Cattle invariably take the netting in their mouths, chew it up and spit it out. Where cattle are present, we recommend replacing netting with flexible wire threaded through the top of the treeshelter as described by Tecklin (1993) (fig. 31). The wire should be removed as the tree grows up and out of the shelter.

Oak Seedling Growth in Treeshelters

In addition to providing effective protection against a wide range of animals, treeshelters have also increased the growth of blue and valley oak seedlings in trials at the the University of California Sierra Foothill Research

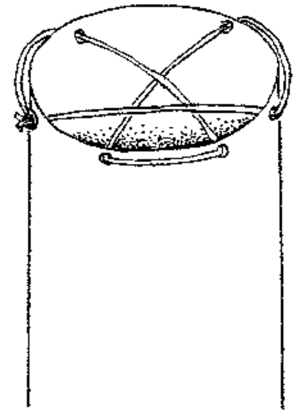


Figure 31. Flexible wire threaded through the top of a treeshelter can be substituted for netting to prevent bird entry when cattle are present.

and Extension Center and elsewhere (McCreary 1997; McCreary and Tecklin 1993a, 1993c; McCreary and Tecklin 1996). On average, height growth in the first 2 years tripled compared with growth of unsheltered seedlings in plots where animal damage was not a consideration (fenced and weeded). Costello, Peters, and Giusti (1996) also reported better growth for blue oak, valley oak, and coast live oak protected with treeshelters, but these differences were greatest in irrigated, rather than unirrigated plots. In two separate trials (Burger, Forister, and Kiehl 1996; Burger, Forister, and Gross 1997), it was reported that valley and coast live oak seedlings in treeshelters were taller compared to unsheltered seedlings during the first year of growth. After 2 years, however, they were not significantly taller.

Diameter Growth. Treeshelters do not seem to lead to an increase in the diameter growth of seedlings. In trials at the SFREC, most blue oak seedlings in treeshelters grew taller but had diameters similar to controls, resulting in seedlings inside shelters that were tall and thin. To evaluate this further, we established a trial to examine different shelter heights (2, 4, and 6 feet [.6, 1.2, and 1.8 m]). We measured the annual height and diameter growth while seedlings were still inside shelters, as well as after they had grown up and out of the tops (McCreary and Tecklin 2001). Height growth was consistently greater while seedlings were shorter than the shelters, regardless of shelter size (fig. 32). As soon as seedlings grew above the tops of the shelters, however, height growth diminished and diameter growth increased (fig. 33). As a consequence, when seedlings were below the tops of the tubes, they were tall and spindly. If the shelters had been removed at this point, the plants would almost certainly have toppled over without staking. After several years of

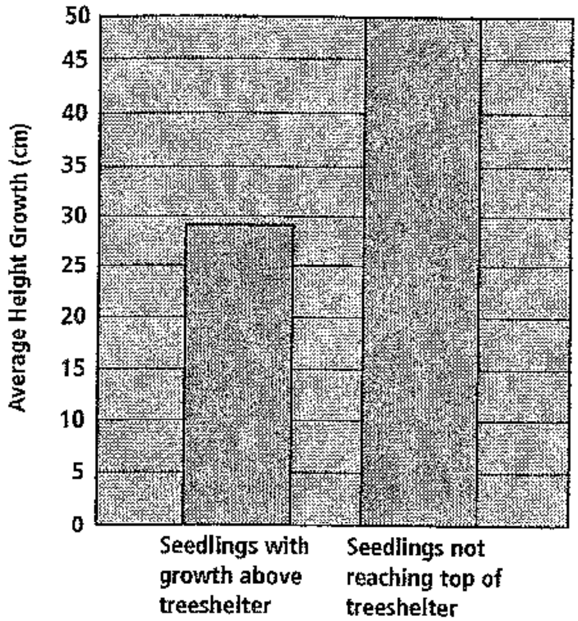


Figure 32. Annual height growth changes once a seedling grows above the top of the treeshelter.

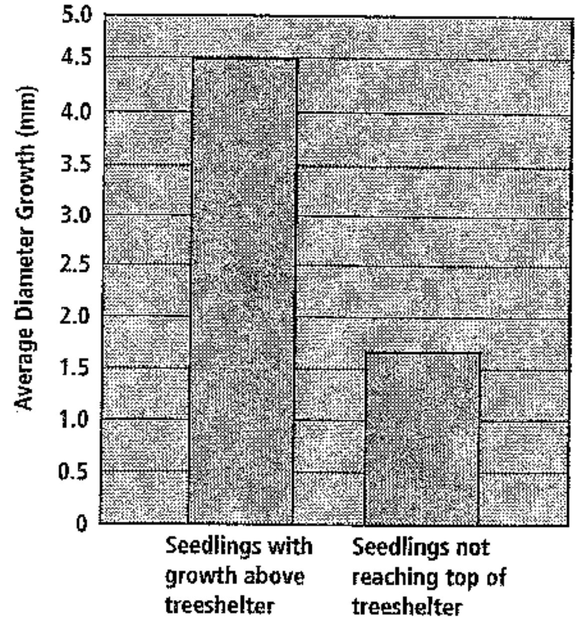


Figure 33. Annual diameter growth changes once the seedling grows above the top of the treeshelter.

growth above shelters, their girth increased greatly (while height growth slowed markedly), and they were larger, more robust plants than their unsheltered counterparts. Costello, Peters, and Giusti (1996) found that when shelters were removed from three species of California oaks after 4 years, most saplings had sufficiently well-developed trunks to maintain an upright position (fig. 34). We recommend that shelters not be removed for at least 3 years after the seedlings have emerged from the tops. Treeshelters can be left in place longer, but should be removed before they restrict diameter growth (see **Treeshelter Durability and Maintenance**, below).

Burger, Forister, and Kiehl (1996), working with 10 species of landscape trees, including valley oak and coast live oak, recommended removing treeshelters as soon as young plants emerge from the tops and then staking them. They found that the benefits of shelters, in terms of accelerated growth, decreased with time. This research, however, focused on ornamental trees where greater costs of establishment—including staking—may be more easily justified. In almost all wildland planting situations, protecting oak seedlings from animals for at least 3 to 5 years is critical for success, and shelter removal before that time could result in unacceptable damage.

Effects on Roots. There is an additional concern that even though the use of treeshelters increases growth, this aboveground growth may be at the expense of the roots, resulting in plants that have a poor root to shoot ratio. Rendle (1985) reported that treeshelters altered the distribution of dry matter in English oak, causing seedlings to have larger shoot to root ratios. Burger, Svihra, and Harris (1992) also found that oaks grown in containers had growth ratios for aboveground and belowground growth that were out of balance. Burger, Forister, and Gross (1997) further reported that after 2 years in a nursery setting, treeshelters reduced root dry mass, root to shoot ratios, total root length, and total root mass for valley oak, as well as the aboveground biomass for valley oak and coast live oak. However, these studies were of short duration, and these ratios may again change as plants grow older. Ponder (1996), for instance, found that sheltered, northern red oak seedlings, harvested 3 years after outplanting in forest openings, had both higher stem and root weights than seedlings not protected with shelters.

Treeshelters have also been effectively used to "retrofit" both natural and planted oak seedlings that are stunted (Gillespie, Rathfon, and Meyers 1996; Tecklin, Connor, and McCreary 1997; Shuler and Miller 1996). This has resulted in greatly accelerated growth. In the Tecklin trial at the SFREC, unprotected blue oak seedlings that had languished in an experiment for 2 years and averaged only 6 inches (15 cm) in height, suddenly grew vigorously when treeshelters were placed over them. After being protected for 2 years, they averaged more than 3 feet (.9 m) in height, while unprotected seedlings continued to grow slowly and averaged less than 1 foot (31 cm) tall.

Figure 34. These seedlings were in treeshelters for 4 years. They continue to stand upright after the treeshelters are removed.

Treeshelters with California Black Oak. We have also used treeshelters with California black oak, but with very different results. In a trial with this species, treeshelters did not promote accelerated height growth, and seedlings in all treatments, including uncovered controls and seedlings covered with seedling protection tubes, remained quite small, even after 3 years. Friske (1997) used treeshelters with California black oak in Yosemite National Park and, after 6 years, found that while seedlings in treeshelters were significantly taller than those in open plastic mesh, they averaged less than 2 feet (.6 m) in height. It is unclear why this oak species seems to initially grow so slowly, both with and without treeshelters.

Treeshelter Durability and Maintenance

Most shelters do not deteriorate readily. They remain intact for a number of years (for durability comparisons, see Windell and Hayward 1996) because they have stabilizing ultraviolet inhibitors added to the plastic. In early trials without stabilizers, treeshelters broke down before seedlings had grown large enough to be self-supporting. While attempts have been made to incorporate a quantity of inhibitors that will result in timely degradation (3 to 5 years), this has not been routinely successful and the treeshelters have not degraded as expected (Kerr 1992). Strobl and Wagner (1996) could detect no photodegradation of treeshelters after 5 years. This raises the question of when treeshelters should be removed. In England, Kerr (1996) recommends removing shelters before they begin restricting the diameter growth of the saplings, or when treeshelters are abrading and severely damaging trees. Until this point, treeshelters help provide support and prevent damage from rabbits, squirrels (which are a terrible pest in England and can girdle trees by stripping bark), and deer (browsing and antler rubbing). For most California species, however, growing to this size could take a decade or more, and there may be aesthetic or environmental reasons to remove shelters earlier. However, it is important to leave shelters in place for at least 3 years after seedlings have emerged from the top.

By the time seedlings are taller than the tops of shelters, it is usually impossible to slip the solid shelters over the seedlings, but it is fairly easy to slice these shelters down the side using a razor or utility knife so they can easily be removed. It is especially important that treeshelters be split or removed before trees become so large that their diameters are as great as that of the shelters. At this point, stem deformation or even sapling death can occur. To reduce this possibility, some treeshelter manufacturers have begun incorporating a strip down the sides with a preformed weakness in the plastic. This is intended to permit the shelters to split apart when plants grow and press against the sides of the shelters. Whether or not this will work reliably is yet to be determined.

Recommended Treeshelter Maintenance Procedures

- Visit shelters at least once each year to make sure they are upright, attached to the stake, buried in the ground, and functioning properly.
- Keep a 4-foot (1.2-m) diameter or larger circle around shelters free of weeds for at least 2 years after planting, and remove weeds that grow inside shelters.
- Replace flexible netting that has blown off shelter tops.
- Replace stakes that have rotted or broken.
- Leave shelters in place for at least 3 years after seedlings have grown out the tops, longer if shelters are still intact and are effectively protecting seedlings.
- Remove shelters if they are restricting growth or abrading seedlings; to remove solid shelters, slice down the sides with a razor or knife, being careful not to damage the seedling inside.

Finally, even though treeshelters have been shown to improve water relations and accelerate seedling growth, it is important to caution that they do not eliminate the need for weed control. Kerr (1996) noted that "the use of effective weed control in combination with treeshelters is very important to ensure rapid establishment of young trees." It is also important to remove weeds growing inside shelters because the favorable environment inside can lead to rapid weed growth.

Fertilization

There have been relatively few fertilization trials with native California oak plantings, and those that have been conducted have had mixed results. Adams, et al. (1987) reported a negative effect of granular, slow-release fertilizer (18-6-12) placed beneath blue and valley oak acorns and transplants at time of planting. Tappeiner and McDonald (1980), however, reported that annual fertilization with ¼ pound (113 g) per seedling of 16-20-0 enhanced survival and height growth of California black oak. McCreary (1996) also found that .74-ounce (21-gm), slow-release, fertilizer tablets (20-10-5), placed below outplanted blue oak acorns and seedlings, significantly increased both diameter and height growth. In the eastern and northern United States, fertilizers have been consistently reported to improve oak seedling performance (Johnson 1980). Differences in the California findings may be partially explained by an interaction with weed growth. In the first trial mentioned (Adams et al. 1987), weeds were not completely controlled and may have benefited more from the fertilizer than the seedlings, resulting in greater competition. In other trials, the plots were kept largely weed-free, and increased competition was not a problem. Obviously, soils can also vary tremendously in their fertility, and seedling response to fertilizers varies accordingly.

Compared with other costs associated with artificial regeneration, fertilization is inexpensive. The .74-ounce (21-gm) tablets used in the study above (McCreary 1996) cost about 5¢ each in 1993 when purchased in bulk, so even small improvements in performance were worth the costs. Since they are so inexpensive, we recommend using fertilizer tablets, placing them 3 to 4 inches (7.5 to 10 cm) below seedling roots at the time of planting.

Irrigation of Rangeland Oaks

When, Where, and How Much to Irrigate

In large-scale, wildland plantings, irrigation is generally not practical, especially if there is not an available water source near the planting area. In some settings, however, especially where cost is not as great a concern, it may be possible to water seedlings for several years after planting. Because water stress can seriously limit seedling survival and growth, irrigation can greatly improve the chances of establishment, especially on dry sites.

Effects of Different Soils. Sites and soils are very different and can have a tremendous effect on moisture-holding capacity and the availability of water for the seedlings. Plantings in deep, sandy, alluvial soils along the Sacramento River may need to be watered almost daily during the first year after planting. In the heavier, shallower soils at the University of California Sierra Foothill Research and Extension Center, however, this is not the case. We conducted a trial with newly planted valley oak seedlings at the SFREC that compared four treatments: no irrigation, 1 gallon (3.8 L) of water weekly, 1 gallon (3.8 L) every 2 weeks, and 1 gallon (3.8 L) every 4 weeks (McCreary 1990b). All 30 seedlings from each treatment in this study survived, indicating that irrigation was not necessary for establishment. After the first year, those that received any of the three irrigation treatments were significantly taller than unirrigated plants, but there were no significant differences among the three irrigated groups. This suggests that 1 gallon (3.8 L) of water every 4 weeks was sufficient during the first year in these soils and this environment.

In a study that evaluated soil moisture availability as a factor affecting valley oak establishment at The Nature Conservancy's Cosumnes River Preserve, irrigated, field-planted seedlings grew vigorously while unirrigated seedlings had greater water stress, less growth, and higher mortality (Meyer 1991). Bernhardt and Swiecki (1991) examined the value of irrigating direct-seeded valley oak and found that irrigation initially had a significant positive effect on seedling growth at two of three sites. However, irrigation was extremely expensive compared with moisture-conserving mulching treatments. Six years after planting, irrigation showed no positive effects on survival or growth, and it was observed that "irrigated seedlings generally sustained greater damage from small herbivores than did unirrigated seedlings. Damaging animals may be attracted to irrigated sites by the moist soil or increased succulence of oak tissues" (Bernhardt and Swiecki 1997).

Fertilization, Irrigation, and Top Pruning

- Place .74-ounce (21-g), slow-release fertilizer tablets (20-10-5) 3 to 4 inches (7.5 to 10 cm) below planted acorns or seedlings.
- Irrigation in many situations is not necessary if there is timely and thorough weed control.
- If irrigation is needed for establishment and the terrain is steep or percolation of water through soil is slow, construct earthen irrigation basins.
- Provide irrigation in the form of infrequent, deep irrigations rather than frequent, shallow irrigations; time irrigations to extend the rainy season.
- Always control competing vegetation, even in situations where supplemental irrigation is provided.
- Top-prune seedlings at the time of planting if they are too tall and are out of balance with root systems; prune small, liner stock back to a 6-inch (15-cm) top.

Irrigation Varies by Species. Light and Buchner (1999) found that optimum irrigation amounts varied for four oak species evaluated on California's North Coast. Providing water enhanced growth of each species, but there were levels of irrigation above which growth declined. Oregon white oak, for instance, performed best on a frequent irrigation schedule that caused blue oak growth to decline. At lower levels of irrigation, however, blue oak growth peaked, while the performance of Oregon white oak declined. They concluded that to thrive, all of the oak species evaluated (which also included California black oak and interior live oak) needed "appreciably more water than is available from rainfall alone."

Effects of Weed Control. It is important to remember that the need for irrigation is closely related to weed control. In almost all situations where there is little or no weed control, irrigated seedlings will still be under moisture stress. In fact, supplemental water can cause so much growth of competing plants that oak seedlings are adversely affected. Eliminating competing vegetation can lessen water stress and greatly reduce or even do away with the need for supplemental water. At the SFREC, which averages 28 inches (71 cm) of rainfall annually, we have concluded that supplemental irrigation is not necessary in our blue, valley, and interior live oak trials as long as we maintain areas around seedlings free of weeds for at least 2 years (preferably longer). Planting seedlings late in the season when soils are already becoming dry creates an exception. In this situation, we like to water-in seedlings to make sure that there is adequate initial moisture in the soil and air pockets are eliminated.

Earthen Basins. In many oak plantings that are irrigated, earthen basins are constructed around individual seedlings to form a reservoir that can hold several gallons of water (Bush and Thompson 1989). This is especially important in heavier soils where percolation can be slow and on slopes where irrigation water would run off too rapidly. With a basin, a large quantity of water can be added and then left to soak in gradually. Generally, these basins are 1 to 2 feet (30 to 61 cm) wide, with sides that are several inches tall (fig. 35). They need to be reasonably level, however, or water will drain out of them when they are filled. Basins have an added advantage of capturing greater quantities of rainfall, so even without irrigation, the soil moisture conditions in the rooting zone should be improved. Basins can be difficult and time consuming to construct, especially in hard, compacted, or rocky soil. This adds to the cost of planting and must be considered along with the benefits expected. In drier regions, and especially where plants will be irrigated occasionally, basin construction is probably a good investment. We generally

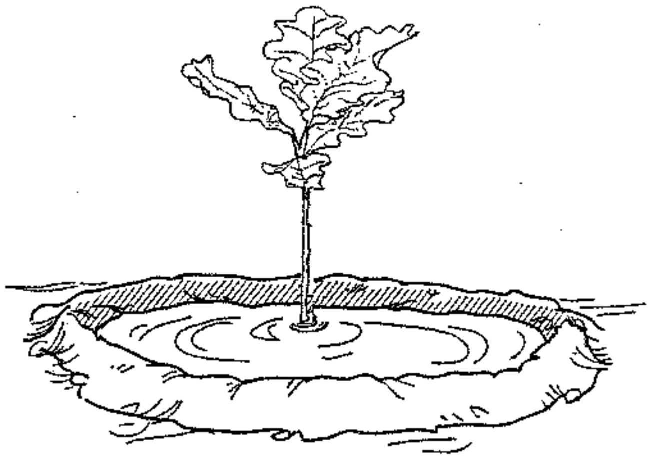


Figure 35. An earthen water basin can prevent rapid runoff of irrigation water.

do not use them at the SFREC since we have found that irrigation is not necessary, as long there is good weed control. At a planting in Walnut Creek, however, basins were essential because plantings were on steep slopes. Without basins, irrigation at this site would have been ineffective.

Potential Risks of Disease with Summer Irrigation

It is well recognized that summer irrigation around native California oaks can prove deadly, since diseases such as oak root fungus *(Armillaria mellea)* and crown rot *(Phytophthora cinnamomi)* proliferate where it is warm and wet, conditions which normally do not occur in the Mediterranean climate of the state (Raabe 1980). Irrigation around mature oak trees, which have evolved in conditions where summer rainfall is rare, should be avoided. Consult any arborist and you will hear horror stories of magnificent oak trees lost to disease after a homeowner put in a lawn beneath them and began watering. But, while there has not been much research on the summer irrigation of oak seedlings, it appears that small seedlings are less sensitive to diseases from warm and moist soils. Also, the benefits of summer irrigation can outweigh the risks for seedlings that are under substantial moisture stress. To reduce potential risks from watering, it is recommended that irrigation be deep and infrequent rather than often and shallow. If only several waterings are planned, it is better to time them to extend the normal rainy season into late spring rather than provide water in the middle of summer.

Superabsorbants

There are a variety of soil amendments on the market that claim to reduce moisture stress on plants. Many of these are superabsorbant hydrogels, polymers that absorb and retain several hundred times their own weight in water. Theoretically, they improve water relations by binding water when it is available and then slowly releasing it. These materials do not create any new water, but they can influence moisture availability over time. While the effectiveness of these materials is debated, it is hard to imagine a situation where they would be particularly useful for wildland oak plantings. First and foremost, it would be prohibitively expensive to mix these materials into the soil where the oaks are to be planted. A variation of these materials are containers similar to milk cartons that contain a polymer gel. These are placed in the ground next to planted seedlings. The material inside the 1-pint (.47-L) or 1-quart (.95-L) container is supposed to slowly release moisture to the target plant over a period of several months. We did a small field trial evaluating blue oaks with and without these containers and could find no benefit.

Shading Oak Seedlings

Blue oak has been characterized as highly intolerant of shade (Sudworth 1908), and it has been reported that blue oak saplings do not survive under dense shade (Swiecki and Bernhardt 1998). However, there is some evidence that providing artificial shade may improve field performance of planted blue oak in certain situations. Muick (1991) compared the response of directly-sown blue oak acorns in full sunlight and 50 percent shade and found that shade improved both emergence and survival. Artificial shade provided by placing commercially available "shadecards" on the south side of seedlings has been reported to improve Douglas fir survival in some situations (Helgerson 1990), and shade may offer some benefit for oaks on dry exposed sites, although the gains are likely to be small. We used black plastic shadecards in one study with blue oaks at the University of California Sierra Foothill Research and Extension Center but found that seedlings quickly grew above them. We could detect no improvement in survival or growth (McCreary 1989) from this treatment and have not used shadecards since.

Top Pruning Oak Seedlings

Studies outside of California have indicated that there are benefits from top pruning oak seedlings, both before and after lifting from bareroot nurseries (South 1996; Johnson 1984) or just after outplanting (Adams 1984).

This is done to create plants of uniform size with more favorable shoot to root ratios. In California there has been no research on top pruning oaks in nurseries. At SFREC, we did a trial to test whether top pruning after field planting would be beneficial (McCreary and Tecklin 1993b). One-year-old blue oak seedlings in containers were top pruned at the time of field planting and compared with both large and small, unpruned controls. After two growing seasons, top pruned seedlings had significantly greater height and caliper increments than the other seedling types, suggesting that seedlings with large tops should be top pruned before or just after field planting to enhance performance.

Appendix A

Nurseries That Sell Oak Seedlings and Saplings

Below is a list of some of the wholesale and retail nurseries in California that produce native oaks in various sizes, ranging from seedlings in liners to specimen trees. The species of oaks grown at each nursery are not identified since this depends on several factors, such as acorn availability and demand, and can vary from year to year. Please contact the nursery for a current list of species and stock sizes available.

All Seasons Nursery
McKnew Enterprises
P. O. Box 2128
Elk Grove, CA 95759
916-689-0902
http://www.growtube.com

Arrowhead Growers
990 Rutherford Cross Road
P. O. Box 398
Rutherford, CA 94573
707-963-5800

Bitterroot Restoration Inc.
55 Sierra College Boulevard
Lincoln, CA 95648
916-434-9695

Blue Oak Nursery
2731 Mountain Oak Lane
Rescue, CA 95672
530-677-2111

Calaveras Nursery
1622 Highway 12
Valley Springs, CA 95252
209-772-1823

California Conservation Corps
Napa Satellite Center
P. O. Box 7199
Napa, CA 94558
707-253-7783

California Department of Forestry and Fire Protection
L. A. Moran Reforestation Center
P. O. Box 1590
Davis, CA 95617
530-753-2441

California Flora Nursery
2990 Somers Street
P. O. Box 3
Fulton, CA 95439
707-528-8813

Circuit Rider Productions, Inc.
Native Plant Nursery
9619 Old Redwood Highway
Windsor, CA 95492
707-838-6641

Cornflower Farms
P. O. Box 896
Elk Grove, CA 95759
916-689-1015

Drought Resistant Nursery
850 Park Avenue
Monterey, CA 93940
831-375-2120

Elkhorn Native Plant Nursery
P. O. Box 270
Moss Landing, CA 95039
831-763-1207

Freshwater Farms
5851 Myrtle Avenue
Eureka, CA 95503
800-200-8969

J. M. Oak Tree Nursery
430 La Lata Place
Buellton, CA 93427
805-688-5563 *(by appointment only)*

King Island Wholesale Nursery
8458 West Eight Mile Road
Stockton, CA 95219
209-957-6212

Las Pilitas Nursery
3232 Las Pilitas Road
Santa Margarita, CA 93453
805-438-5992
http://www.laspilitas.com

Matsuda Nursery
8501 Jackson Road
Sacramento, CA 95826
916-381-1625

Native Oak Nursery
45 Webb Road
Watsonville, CA 95076
831-728-8662

Native Revival Nursery
8022 Soquel Drive
Aptos, CA 95003
831-684-1811

Native Sons Wholesale Nursery
379 West El Campo Road
Arroyo Grande, CA 93420
805-481-5996

North Coast Native Nursery
P. O. Box 744
Petaluma, CA 94953
707-769-1213

Specialty Oaks Inc.
12552 Highway 29
Lower Lake, CA 95457
707-995-2275
http://www.specialtyoaks.com

Tree of Life Wholesale Nursery
P. O. Box 736
San Juan Capistrano, CA 92693
949-728-0685

Village Nurseries
1589 North Main Street
Orange, CA 92867
800-542-0209

Yerba Buena Nursery
19500 Skyline Boulevard
Woodside, CA 94062
650-851-1668

Appendix B

Sources of Materials for Oak Regeneration Projects

TREESHELTERS AND SEEDLING PROTECTION TUBES

All Seasons Nursery
McKnew Enterprises
P. O. Box 2128
Elk Grove, CA 95759
916-689-0902
http://www.growtube.com

Treegard—Albert F. Kubiske
3825 Highridge Road
Madison, WI 53704
608-837-9093

Terra Tech
International Reforestation Suppliers
2635 West 7th Place
Eugene, OR 97402
800-321-1037
503-345-0597

American Forestry Technology, Inc.
100 North 500 West
West Lafayette, IN 47906
765-583-3311

Tree Pro
3180 West 250 North
West Lafayette, IN 47906
800-875-8071
http://www.treepro.com

Tree Sentry Treeshelters
P. O. Box 607
Perrysburg, OH 43552
419-874-6950

Treessentials Company
2371 Waters Drive
Mendota Heights, MN 55120-1163
800-248-8239

ROOT GUARD

Digger's Product Development, Inc.
P. O. Box 1551
Soquel, CA 95073-2531
831-462-6095

CONTAINERS

Stuewe & Sons, Inc.
2290 Southeast Kiger Island Drive
Corvallis, OR 97333
800-553-5331
http://www.stuewe.com

Monarch Manufacturing
13154 County Road 140
Salida, CO 81201
800-284-0390
http://www.monarchmfg.com

Spencer-Lemaire Industries Limited
11406—119th Street
Edmonton, Alberta
Canada T5G 2X6
800-668-8530

SHADECARDS

Terra Tech
International Reforestation Suppliers
2635 West 7th Place
Eugene, OR 97402
800-321-1037
503-345-0597

MULCH MATS

Treessentials Company
2371 Waters Drive
Mendota Heights, MN 55120-1163
800-248-8239

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